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# NAUTICAL TABLES

*DESIGNED FOR THE USE OF BRITISH SEAMEN*

By The Rev. JAMES INMAN, D.D.
LATE PROFESSOR AT THE ROYAL NAVAL COLLEGE, PORTSMOUTH

*WITH A PRACTICAL INTRODUCTORY TREATISE ON*

## NAVIGATION AND NAUTICAL ASTRONOMY

*BY THE SAME AUTHOR*

Revised and Enlarged by his Son

Rev. JAMES WILLIAMS INMAN
LATE FELLOW OF ST JOHN'S COLLEGE, CAMBRIDGE

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1872

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184. h. 46.

# NAVIGATION

AND

# NAUTICAL ASTRONOMY,

FOR THE

# USE OF BRITISH SEAMEN.

# THE EDITOR'S PREFACE.

THE experienced Author of the following pages held that in Navigation, for the greater number of seamen, a habit of correct calculation, and skill in using instruments, were more requisite than scientific acquaintance with mathematical theories and analysis. Public opinion every day more forcibly affirms this judgment to be true. His practical rules have therefore been set before the Logarithmic Tables, by which they are worked.

CHUDLEIGH, 26*th March* 1872.

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# NAVIGATION.

## CHAPTER I.

*Definitions.—Finding Course and Distance between two known Places.—Finding the Place of the Ship, the Course and Distance from a known Place being given.—Parallel Sailing.—Meridian Sailing.—Use of Traverse Table.—Method of keeping a Ship on any given Course by the Compass.—Log-line.—Method of keeping a Log-account.—Day's Work.—Current Sailing.*

(1.) NAVIGATION is the art of conducting a ship by sea from one place to another.

This is done by means of a mariner's compass and log-line; and also by means of astronomical observations. In the first place, we shall explain Navigation by mariner's compass and log-line; afterwards, in combination with this, we shall explain Navigation by astronomical observation, or, as it is usually called, Nautical Astronomy.

(2.) In Navigation by mariner's compass and log-line, the earth is considered as a sphere or globe, which is supposed to turn round one of its diameters once in 24 hours. That diameter, round which it turns, is called the earth's *axis*. The extremities of this axis are called the *poles* of the earth.

The surface therefore of the sea is spherical, and the ship's track thereon must be a curve line.

(3.) The earth is divided by a circle perpendicular to its axis into two equal parts or hemispheres, which are called the *northern* and *southern* hemispheres. The circle thus dividing it is called the *equator* or *equinoctial line*.

The poles are 90° from every point in the circumference of the equator. The pole in the northern hemisphere is called the *north* pole; the other, the *south* pole. The earth's equator extended to the celestial concave is called the celestial equator. A perpendicular to the earth's surface at the place of the spectator, when produced, cuts the celestial concave in a point called the *zenith*, which is the highest point above our heads.

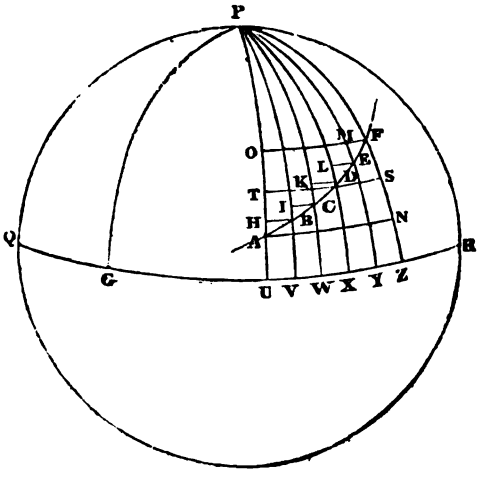
(4.) Curves perpendicular to the equator, the planes of which pass through the poles, are called *meridians*. The meridian passing through any place is called the meridian of that place: thus the meridian passing through Greenwich is called the *meridian of Greenwich*.

The adjoining figure represents the surface of the earth, the point P the pole of the northern hemisphere or *north pole*, QR the equator, PG the meridian of Greenwich, PAU and PFZ the meridians of any places A and F.

(5.) The direction of the meridian towards the north pole is called *north*, and marked N.; the opposite direction is called *south*, and marked S.

Directions at right angles to the meridian are called *east* and *west*; the right hand, in looking to the north, *east*; the left, *west*: they are marked E. and W.

(6.) The degrees, minutes, &c. of the equator contained between the meridian of Greenwich Observatory and the meridian of any other place, is called the *longitude* of that place. Thus GU is the longitude of A, and GZ is the longitude of F.




Longitude is reckoned from the meridian of Greenwich both *east* and *west*, as far as 180°. In the former case it is marked E., as 20° 16′ E.; in the latter it is marked W., as 115° 35′ W. The French reckon longitude from the meridian of Paris Observatory, which is 2° 20′ 15″, or *in time* 9m. 21sec. E. of Greenwich.

(7.) The earth being supposed a sphere, and each meridian a circle, the degrees, minutes, &c. of the meridian of a place, contained between the place and the equator, is called the *latitude* of the place: it is marked N. or S., according as the place is to the north or south of the equator. Thus AU is the latitude of A, and is marked N, because A is to the north of QR.* The latitude of Greenwich Observatory is 51° 28′ 40″ N.; that of Paris Observatory is 48° 50′ 14″ N.

(8.) A small circle on the earth, which is everywhere at the same distance from the equator, that is, every point of which has the same latitude, is called a *parallel of latitude*. Thus AN and OF are parallels of latitude.

The plane of such a circle is evidently parallel to the equator.

(9.) In navigation, a ship is supposed to sail from one place to another on a track cutting all the meridians passing through it at the same angle; and thus a ship, in sailing from A to F, is supposed to describe in the sea a curve AF, which cuts the meridians PA, PB, PC, &c. at the same angle; that is, the angles PAF, PBF, PCF, &c. are supposed to be equal.

This common angle is called the *course*. The length of the line AF, expressed in minutes of a great circle of the earth, is called the *distance*.

* A perpendicular to the surface of the earth, supposing it to be a sphere, would pass through the centre, and its inclination to the equator would be measured by the said arc of the meridian in degrees, minutes, &c. Supposing the earth to be only *nearly* a sphere, and the meridians not circular arcs, such a perpendicular would pass only *near* the centre, and its inclination to the equator could not be measured by any part of the meridian. It would be measured by the arc of a great circle in the celestial concave between the zenith (the extremity of the said perpendicular) and the celestial equator: which arc therefore is in strictness *the latitude*. (See *Art.* 3.)

Minutes of a great circle are usually called *nautical miles*, or simply *miles*.

(10.) Let AF (see fig. Art. 6) be the track of the ship in the sea, and let PU, PV, PW, &c. be meridians dividing AF into several equal parts at B, C, D, &c. Then the angles PAB, PBC, PCD, &c. are equal. Let AN, BH, CI, DK, EL, FO, be parallels of latitude, and TS another parallel of latitude at the middle latitude between A and O. Let PG be considered as the meridian of Greenwich.

Then AF is the distance (*dist.*) between A and F. The arc AU is the latitude of A, and FZ or OU is the latitude of F; consequently AO is the true difference of latitude (*tr. diff. lat.*) of A and F. Again, GU is the longitude of A, and GZ is the longitude of F; consequently UZ is the difference of longitude (*diff. long.*) of A and F.

Supposing the parts AB, BC, CD, &c., into which AF is divided, to be indefinitely diminished and their number to be indefinitely increased, the sum of BH, CI, DK, &c., is called the departure (*dep.*).

Since BH, CI, DK, &c., are less than the corresponding parts of AN, and greater than the corresponding parts of OF, it follows that the departure is less than AN and greater than OF. In short distances it is therefore nearly equal to TS; so that TS may be considered as the departure; TU being the middle latitude between A and F, that is, being half the sum of AU and FZ.

When A and F are on different sides of the equator, that is, when the latitude of one place is north and the other south, the above reasoning respecting TS fails. In such a case, when the distance is not very great, the sum of BH, CI, DK, &c., that is the *dep.*, may be considered, without any error of importance, to be equal to TS drawn between the extreme meridians at a latitude equal to half the difference of the latitudes of A and F.

If the different portions of departure, namely, BH, CI, DK, &c., be supposed to become equal, respectively, to the differences of longitude, UV, VW, WX, &c.; the triangles ABH, BCI, CDK, &c., remaining similar to themselves during the change; then, the sum of the portions of latitude AH, BI, CK, &c., thus increased, is called the meridional difference of latitude (*mer. diff. lat.*). The latitude of any place, supposing it to be thus expanded, is found from a table: the number found being expressed in nautical miles, and called the *meridional parts* of the latitude. The difference of such meridional parts (*m.p.*) for two given latitudes is their meridional difference of latitude (*mer. diff. lat.*).* (See *App.* 1.)

* A ship may be considered as sailing towards or from the pole of the earth, and as being at the same time carried by a current in the sea in a direction perpendicular to the meridian. The two motions combined would produce a single motion in some line AF oblique to the meridian. What the ship, independently of the current, would approach *to* or recede *from* the pole is called *tr. diff. lat.*; what the current *of itself* would carry the ship is called *dep.*; and what the ship is carried in longitude or arc of equator (which is greater than *dep.*) is called *diff. long.*

Were the current (supposed perpendicular to the several meridians) to accelerate its motion, the course or angle PAB would be increased, unless at the same time the rate of sailing towards the pole were proportionally increased, in which case it would remain the same. Let the current be supposed to have accelerated its motion, so as to make it equal continually to the previous motion in longitude, and at the same time the rate of sailing in latitude to have been increased in the same proportion. On this imaginary supposition the *course* would have remained unaltered, the *dep.* would have become the previous *diff. long.*, and the *tr. diff. lat.* would now have been increased to what is called *mer. diff. lat.*

*Ex.* 2. Required the course and distance from C to D.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lat. C | 73° | 15′ | N. | *m. p.* | 6586 | N. | Long. C | 3° | 10′ W. |
| D | 80 | 40 | N. | | 8613 | N. | D | 9 | 30 E. |
| | 7 | 25 | | | 2027 | N. | | 12 | 40 |
| | 60 | | | | | | | 60 | |
| | 445 | N. | | | | | | 760 | E. |

(1) *dist.* : *tr. diff. lat.* :: *rad* : *cos. course.*

(4) *mer. diff. lat.* : *diff. long.* :: *rad.* : *tan. course.*

| (4) | (1) |
|---|---|
| 12.880814 | 12.648360 |
| 3.306854 | 9.971446 |
| 9.573960 | 2.676914 |
| N 20° 33′ E. | 475 naut. miles. |

*Ex.* 3. Required the course and distance from E to F.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lat. E | 0° | 25′ | S. | *m. p.* | 25 | S. | Long. E | 2° | 20′ E. |
| F | 2 | 37 | N. | | 157 | N. | F | 10 | 47 W. |
| Sum | 3 | 2 | | | 182 | N. | | 13 | 7 |
| | 60 | | | | | | | 60 | |
| | 182 | N. | | | | | | 787 | W. |

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(4) *mer. diff. lat.* : *diff. long.* :: *rad.* : *tan. course.*

| (4) | (1) |
|---|---|
| 12.895975 | 12.260071 |
| 2.260071 | 9.352635 |
| 10.635904 | 2.907436 |
| N 76° 59′ W. | 808 naut. miles. |

(14.) *To find the Course and Distance between two places of known latitude and longitude, by Middle Latitude.*

RULE. Proceed to get the *tr. diff. lat.* and *diff. long.* as in RULE Art. 13. Also, when the *lat. from* and *lat. to* have like names (both N. or both S.) take their sum and half their sum, which mark *mid. lat.*; when *lat. from* and *lat. to* have *unlike* names (one N. and the other S.) take their difference and half their difference, which mark *mid. lat.*

Write down proportions (1), (2), (3), and make a dash in (1) and (3) under the terms required, namely, in (1) under *dist.* and in (3) under *tan. course.* Then in (2) add the logarithms of the extreme terms, which will give the sum of the logarithms of the two middle terms in (2) or in (3). Subtract the logarithm of the unmarked extreme term in (3). The result will be the *log. tan. course.* Find the *course* from the Tables (Note ‡ Art. 13), and at the same opening take out the *log. cos. course.*

Then apply Art. 12 to (1) and find logarithm of *dist.*; whence from the Tables find the *dist.* itself.

*Ex.* 1. Required the course and distance from A to B.

| | | | | | |
|---|---|---|---|---|---|
| Lat A | 50° 25′ N. | | 50° 25′ N. | Long. A | 27° 15′ W. |
| B | 47 12 N. | | 47 12 N. | B | 30 20 W. |
| | 3 13 | | 2)97 37 | | 3 5 |
| | 60 | | | | 60 |
| | 193 S. | *mid. lat.* | 48 48 | | 185 W. |

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

(3) *tr. diff. lat.* : *dep.* :: *rad.* : *tan. course.*

| (2) and (3) | (1) |
|---|---|
| 2.267172 | 12.285557 |
| 9.818681 | 9.927151 |
| 12.085853 | 2.358406 |
| 2.285557 | Dist. 228.2 naut. miles. |
| 9.800296 | |
| Course S 32° 16 W. | |

*Ex.* 2. Required the course and distance from C to D.

| | | | | | |
|---|---|---|---|---|---|
| Lat. C | 73° 15′ N. | | 73° 15′ N. | Long. C | 3° 10′ W |
| D | 80 40 N. | | 80 40 N. | D | 9 30 E. |
| | 7 25 | | 153 55 | | 12 40 |
| | 60 | | | | 60 |
| | 445 N. | mid. lat. | 76 57 | | 760 E. |

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

(3) *tr. diff. lat.* : *dep.* :: *rad.* : *tan. course.*

| (2) & (3) | (1) |
|---|---|
| 2.880814 | 12.648360 |
| 9.353726 | 9.969909 |
| 12.234540 | 2 678451 |
| 2.648360 | 476.9 naut. miles. |
| 9.586180 | |
| N 21° 5′ E. | |

*Ex.* 3. Required the course and distance from E to F.

| | | | | | |
|---|---|---|---|---|---|
| Lat. E | 0° 25′ S. | | 0° 25′ S. | Long. E | 2° 20′ E. |
| F | 2 37 N. | | 2 37 N. | F | 10 47 W. |
| | 3 2 | | 2 12 Diff. | | 13 7 |
| | 60 | | | | 60 |
| | 182 N. | mid. lat. | 1 6 | | 787 W. |

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

(3) *tr. diff. lat.* : *dep.* :: *rad.* : *tan. course.*

| (2) & (3) | (1) |
|---|---|
| 2.895975 | 12.260071 |
| 9.999920 | 9.352635 |
| 12.895895 | 2.907436 |
| 2.260071 | 808 naut. miles. |
| 10.635824 | |
| N 76° 59′ W. | |

(15.) *To find the Latitude in and Longitude in, by Meridional Parts, the place sailed from being given with the course and distance.*

Rule. Write down proportions (1) and (4). From (1) find the *tr. diff. lat.* by Art. 12; bring this *tr. diff. lat.* (if more than 60′) into degrees and minutes, and mark the result N. if the course has been to the *northward*, and S. when the course has been to the *southward*. Under the *tr. diff. lat.* so marked, write the *lat. from* marked N. or S. according to its proper name. When the names are *like*, take the sum, which mark with the common name; when the names are *unlike*, take the difference, which mark with the name of the greater. The result will be the *lat. in.*

From a table of meridional parts take the *m. p.* of the *lat. from* and also of the *lat. in.* When the names of lat. from and lat. in are *like*, take the difference of the *m. p.* When their names are *unlike*, take the sum. The result is the *mer. diff. lat.* Then from proportion (4) compute the *diff. long.* by Art. 12. Bring this *diff. long.* (if greater than 60′) into degrees and minutes; mark it W. when the course has been to the *westward*, and E. when the course has been to the *eastward*. Under the result put the *long. from* with its proper name W. or E. When the names are *like*, take the sum, to which put the common name; when the names are *unlike*, take the difference, to which put the name of the greater. The result is the *long. in.*

*Ex.* 1. Sailed from A, S 37° 10′ W. 472.6 miles: required the *lat. in* and *long. in.* The lat. A is 27° 20′ S., and long. A is 25° 12′ W.

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(4) *mer. diff. lat.* : *diff. long.* :: *rad.* : *tan. course.*

| (1) | | | | (4) | | |
|---|---|---|---|---|---|---|
| 2.674494 | | | | 2.641474 | | |
| 9.901394 | | | | 9.879740 | | |
| 2.575888 (rejecting 10) | | | | 2.521214 (rejecting 10) | | |
| *tr. diff. lat.* 376′.6 | | | | *diff. long.* 332′.1 | | |
| | 6° | 17′ S. | *m. p.* | | 5° | 32′ W. |
| *lat. from* | 27 | 20 S. | 1706 | *long. from* | 25 | 12 W. |
| *lat. in* | 33 | 37 S. | 2144 | *long. in* | 30 | 44 W. |
| | | | *mer. diff. lat.* 438 | | | |

*Ex.* 2. Sailed from B, N 60° 45′ E. 672.3 miles: required the *lat. in* and *long. in*. The lat. B is 32° 16′ S., and long. B is 2° 45′ W.

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(4) *mer. diff. lat.* : *diff. long.* :: *rad.* : *tan. course.*

| (1) | | | | (4) | | |
|---|---|---|---|---|---|---|
| 2.827563 | | | | 2.577492 | | |
| 9.688972 | | | | 10.251791 | | |
| 2.516535 | | | | 2.829283 | | |
| 328′.5 | | | | 675′ | | |
| | 5° | 28′ 30 N. | | | 11° | 15′ E. |
| *lat. from* | 32 | 16 0 S. | 2047 | *long. from* | 2 | 45 W. |
| *lat. in* | 26 | 47 30 S. | 1669 | *long. in* | 8 | 30 E. |
| | | | *mer. diff. lat.* 378 | | | |

*Ex.* 3. Sailed from C, S 50° 24′ W. 736.2 miles: required the *lat. in* and *long. in*. The lat. C is 2° 40′ N., and long. C is 3° 50′ E.

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(4) *mer. diff. lat.* : *diff. long.* :: *rad.* : *tan. course.*

| (1) | | | | (4) | | |
|---|---|---|---|---|---|---|
| 2.866996 | | | | 2.671173 | | |
| 9.804428 | | | | 10.082352 | | |
| 2.671424 | | | | 2.753525 | | |
| 469′.3 | | | | 566′.9 | | |
| | 7° | 49′ 18″ S. | | | 9° | 26′ 54″ W. |
| *lat. from* | 2 | 40 0 N. | 160 | *long. from* | 3 | 50 0 E. |
| *lat. in* | 5 | 9 18 S. | 309 | *long. in* | 5 | 36 54 W. |
| | | | 469 | | | |

(16.) *To find the Latitude in and Longitude in, the place sailed from being given with the course and distance, by Middle Latitude.*

RULE. Write down proportions (1), (2), (3); in (1) put a dash under the *tr. diff. lat* and in (2) under *diff. long.* From (1), find by Art. 12 the *tr. diff. lat.* and thence as in the last Rule the *lat. in.* When the *lat. from* and *lat. to* have *like* names, take *half* their sum for *mid. lat.*; when *lat. from* and *lat. to* have *unlike* names, take *half* their difference for *mid. lat.*

In proportion (3) add the logarithms of the extreme terms, and from the sum subtract the *log. cos. mid. lat.*: the result will be the logarithm of *diff. long.*, whence find the *diff. long.* from the Tables, and from this proceed as in the last Rule to find the *long. in.*

*Ex.* 1. Sailed from A, S 37° 10′ W. 472.6 miles; required the *lat. in* and *long. in.* The lat. of A, is 27° 20′ S.; and long. of A, is 25° 12′ W.

(1) *dist.* : $\frac{\textit{tr. diff. lat.}}{}$ :: *rad.* : *cos. course.*

(2) $\frac{\textit{diff. long.}}{}$ : *dep.* :: *rad.* : *cos. mid. lat.*

(3) *tr. diff. lat.* : $\frac{\textit{dep.}}{}$ :: $\frac{\textit{rad.}}{}$ : *tan. course.*

| (1) | | (3) and (2) | |
|---|---|---|---|
| | 2.674494 | | 2.575888 |
| | 9.901394 | | 9.879741 |
| | 2.575888 | | 12.455629 |
| | 376′.6 | | 9.935450 |
| | 6° 16′ 36″ S. | | 2.520179 |
| *lat. from* | 27 20 0 S. | | 331′.3 |
| *lat. in* | 33 36 36 S. | | 5° 31′ 18″ W. |
| | | *long. from* | 25 12 0 W. |
| Sum | 60 56 36 | | |
| Half | 30 28 18 *mid. lat.* | *long. in* | 30 43 18 W. |

*Ex.* 2. Sailed from B, N 60° 45′ E. 672.3 miles; required the *lat. in* and *long. in.* The lat. of B is 32° 16′ S.; the long. of B is 2° 45′ W.

(1) *dist.* : $\frac{\textit{tr. diff. lat.}}{}$ :: *rad.* : *cos. course.*

(2) $\frac{\textit{diff. long.}}{}$ : *dep.* :: *rad.* : *cos. mid. lat.*

(3) *tr. diff. lat.* : $\frac{\textit{dep.}}{}$ :: $\frac{\textit{rad.}}{}$ : *tan. course.*

| (1) | | (3) and (2) | |
|---|---|---|---|
| | 2.827563 | | 2.516535 |
| | 9.688972 | | 10.251791 |
| | 2.516535 | | 12.768326 |
| | 328′.5 | | 9.939572 |
| | 5° 28′ 30″ N. | | 2 828754 |
| *lat. from* | 32 16 0 S. | | 674′.2 |
| *lat in* | 26 47 30 S. | | 11° 14′ 12″ E. |
| Sum | 59 3 30 | *long. from* | 2 45 0 W. |
| Half | 29 31 45 *mid. lat.* | | |
| | | *long. in* | 8 29 12 E. |

*Ex.* 3. Sailed from C, S 50° 24′ W. 736.2 miles; required the lat in and long. in. The lat. of C is 2° 40′ N.; the long. of C is 3° 50′ E.

(1) *dist.* : *tr. diff. lat.* :: *rad.* : *cos. course.*

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

(3) *tr. diff. lat.* : *dep.* :: *rad.* : *tan. course.*

| (1) | | (3) and (2) | |
|---|---|---|---|
| | 2.866996 | | 2.671424 |
| | 9.804428 | | 10.082352 |
| | 2.671424 | | 12.753776 |
| | 469′.3 | | 9.999897 |
| | 7° 49′ 18″ S. | | 2.753879 |
| *lat. from* | 2 40 0 N. | | 567′.4 |
| *lat. in* | 5 9 18 S. | | 9° 27′ 24″ W. |
| | | *long. from* | 3 50 0 E. |
| Diff. | 2 29 18 | | |
| Half | 1 14 39 *mid. lat.* | *long. in* | 5 37 24 W. |

## *Parallel Sailing.*

(17.) When the latitude from and the latitude to are the same, the track of the ship must be on a parallel of latitude. Thus suppose it were required to find the *course* and *dist.* from A to N (fig. Art. 6), which points have the same latitude; the course in this case is on the parallel of latitude AN, which cuts all the intermediate meridians at the same angle, namely, a right angle.

Again, when the given course from a known place is due *west* or *east*, in that case also the track of the ship must be a parallel of latitude, since the angle is 90°, in which a parallel of latitude passing through the place sailed from makes with a meridian, and consequently the direction of the parallel is *west* or *east*.

The necessary process in these cases has therefore been called *parallel sailing*. The *tr. diff. lat.* is nothing, the *dist.* is the same as the *dep.*, and the *mid. lat.* is the same as the *lat. from*. Hence the only proportion necessary in parallel sailing is

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

### (18.) *To find the Course and Distance in Parallel Sailing.*

Rule. Put the *long. to* under the *long. from* with their proper names W or E. When they have *like* names, take their difference for *diff. long.*: when they have *unlike* names, take the sum for the *diff. long.*, bringing the result in either case (if necessary) into minutes, and marking it W. or E. as directed in notes * and † to Art. 13. Then write down proportion (2), and compute, by the general rule in Art. 12, the *dep.*, which will be the required *dist.* The *course* will be W. or E. according as *diff. long.* is W. or E

*Ex.* 1. Required the course and distance from A to B.

Lat. A 50° 48′ N. Long. A 29° 12′ W.
B 50 48 N. B 30 13 W.

mid. lat. 50 48 1 1
60

Th course is W. diff. long. 61 W.

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

1.785330
9.800737

1.586067 38′.6 dep. or dist.

*Ex.* 2. Required the course and distance from C to D.

Lat. C 80° Long. C 3° 50′ E.
D 80 D 6 10 W.

mid. lat. 80 10 0
60

The course is W. diff. long. 600 W.

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

2.778151
9.239670

2.017821 104′.2 dep. or dist.

(19.) *To find the Latitude and Longitude in, in Parallel Sailing.*

RULE. The *lat. in* is the same as the *lat. from.* Considering the *lat. from* or *lat. in* as the *mid. lat.*, and the given *dist.* as the *dep.*, compute from proportion (2) the *diff. long.* Bring this *diff. long.*, if necessary, into degrees and minutes, and mark the result W. or E., according as the given *course* is W. or E. Write underneath the *long. from.* If the names be *like*, the sum with the name of either will be the *long. in*; if the names be *unlike*, the difference, with the name of the greater, will be the *long. in.*

*Ex.* 1. Sailed from A 500 miles due west; required the latitude in and longitude in.

Lat. A 46° 10′ S. Long. A 125° 10′ E.

(2) *diff. long.* · *dep.* :: *rad.* : *cos. mid. lat.*

722′

12.698970 diff. long. 12° 2′ W.
9.840459 long. from 125 10 E.

2.858511 long. in 113 8 E.
722 miles. lat. in 46 10 S.

*Ex.* 2. Sailed from B 506.2 miles due east; required the latitude in and longitude in.

Lat. B 5° N. Long. B 2° 45′ W.

(2) *diff. long.* : *dep.* :: *rad.* : *cos. mid. lat.*

508′.1

12.704322
9.998344
2.705978
508.1 miles.

diff. long. 8° 28′ 6″ E.
long. from 2 45 0 W.
long. in 5 43 6 E.
lat. in 5 0 N.

*Meridian Sailing.*

(20.) Sometimes the course of a ship is on a meridian due N. or S In this case the latitude only is altered, the longitude remains the same The method of proceeding will be apparent from the following examples.

*Ex.* 1. Required the course and distance from a known place A to another known place B.

Lat. A 40° 15′ N. Long. A 45° 10′ W.
B 52 16 N. B 45 10 W.

12 1 0 0
60

tr. diff. lat. 721 N.

The course is evidently due N., and the distance is equal to the *tr. diff lat.*, or 721 miles.

*Ex.* 2. Required the course and distance from a known place C to another known place D

Lat. C 2° 10′ N. Long. C 10° 0′ W.
D 4 45 S. D 10 0 W.

6 55 0 0
60

tr. diff. lat. 415 S.

The course is evidently due S., and the *dist.* is equal to the *tr. diff. lat.* to 415 miles.

*Ex.* 3. A ship sails from a known place A 560 miles due S.; required the *lat. in* and *long. in.*

Lat. A 42° 16′ N. Long. A 12° 13′ W.

The tr. diff. lat. is 560.

or 9° 20′ S.
lat. from 42 16 N.

lat. in 32 56 N.

The long. in is evidently the same as the long. from, or 12° 13′ W.

*Ex.* 4. A ship sails from a known place B 328.8 miles due N.; required the lat. in and long. in.

Lat. B 3° 25′ S. Long. B 169° 40′ W.

tr. diff. lat. 328.8

or 5° 28′ 48″ N.
lat. from 3 25 0 S.

lat. in 2 3 48 N.

The long. in is evidently the same as the long. from, or 169° 40′ W.

### *A Traverse Table.*

(21.) A table containing the *tr. diff. lat.* and *dep.* corresponding to certain *distances* in nautical miles for every course expressed in points* or in degrees, is called a *Traverse Table.* The *dist.* is put at the top of the table; the *courses* under 4 points or 45° are put near the left-hand margin; those above 4 points or 45° are put near the right-hand margin. The corresponding *diff. lat.* and *dep.* are put in the proper columns; as marked at the *top* for courses under 4 points or 45°; as marked at the *bottom* for courses above 4 points or 45°. (See *Naut. Tables.*)

### *Use of Traverse Table.*

(22.) First, if the *dist.* and *course* be given, (supposed within the limits of the table,) the *tr. diff. lat.* and *dep.* may be easily found. When the *dist.* is beyond the limits of the table, it must be divided by 1, 2, 3, &c., using the smallest number that will bring the quotient within its limits: the *tr. diff. lat.* and *dep.* being taken out corresponding to the quotient as a *dist.*, they must be multiplied by the number before used as a divisor: the products will be the required *tr. diff. lat.* and *dep.*

It must not be forgotten that the titles at the *top* of the columns are to be used, when the course is less than 4 points or 45°; and those at the *bottom*, when the course is greater than 4 points or 45°.

Since, from proportions (3) and (4) it appears that the *mer. diff. lat.* and *diff. long.* have the same proportion to each other as the *tr. diff. lat.* and *dep.*, namely, the proportion of *rad.* to *tan. course*, it follows that by looking for the *mer. diff. lat.* and *diff. long.* in the columns marked *tr. diff. lat.* and *dep.*, we shall have the same *course.*

A traverse table may be of use in working any case of a right-angled plane triangle, considering the hypothenuse as a *dist.*, one of the acute angles as a *course*, the adjacent side to this angle and the side opposite thereto respectively as *tr. diff. lat.* and *dep.* This will be made apparent by considering the proportions that hold good among the parts of the right-angled triangle, which agree with proportions (1) and (3).

This agreement is expressed by saying, that if the hypothenuse be made the *dist.* and one of the acute angles the *course*, the adjacent side will be the *tr. diff. lat.* and the opposite side the *dep.*; and conversely, if one of the sides be made the *tr. diff. lat.* and the other the *dep.*, the hypothenuse will be the *dist.* and the angle adjacent to the side taken for *tr. diff. lat.* will be the *course.*

* A *point* is 11° 15′, or $\frac{1}{8}$th of 90°.

### (23.) *To find the Course and Distance by Traverse Table and Meridional Parts.*

RULE. Proceed as by Rule, Art. 13, to get the *tr. diff. lat.*, *mer. diff. lat.*, and *diff. long.* Guess* a *dist.* corresponding to *mer. diff. lat.* and *diff. long.* considered as *tr. diff. lat.* and *dep.* Look for this *dist.* so guessed, and if the *mer. diff. lat.* and *diff. long.* be found at the same place in the columns of *tr. diff. lat.* and *dep.*, using the titles of columns either at the top or bottom of page, the course required will be seen at once at the side, but if the said numbers cannot be found there, try other *distances* near, till they *are* found, and thus the *course* will be determined.

Look in the Table for the *tr. diff. lat.* at the *course* just determined; the corresponding *dist.* at the top will be the *dist.* required.

When it appears that to find the course as above from the *mer. diff. lat.* and *diff. long.*, the *dist.* to be looked for is beyond the limits of the Table, work with *half* the *mer. diff. lat.* and *half diff. long.*, or if necessary with *one-third*, *one-fourth*, &c., which will give the same *course* as the whole.

When the *tr. diff. lat.* is greater than can be found at the course, look for *half*, *one-third*, &c. of the *tr. diff. lat.* and multiply the *dist.* immediately got from these by the divisor. The result will be the whole *dist.* required.

*Ex.* 1. Required the course and distance from A to B.

| | | | |
|---|---|---|---|
| Lat. A 40° 15′ N. | *m. p.* 2642 | Long. A 42° 28′ W. |
| B 41 25 N. | 2735 | B 46 18 W. |
| 1 10 | 93 N. | 3 50 |
| 60 | | 60 |
| 70 N. | | 230 W. |

The hypothenuse corresponding to 93 and 230 as the two sides of a right-angled triangle may be guessed to be 250. The distance corresponding to these as a *diff. lat.* and *dep.* is actually found to be 248, and the required *course* is N 68° W. The distance corresponding to this *course* and the *tr. diff. lat.* 70 is 187, which is the required *dist.*

*Ex.* 2. Required the course and distance from C to D.

| | | |
|---|---|---|
| Lat. C 50° 42′ S. | *m. p.* 3540 | Long. C 28° 30′ E. |
| D 42 17 S. | 2805 | D 33 10 E. |
| 8 25 | 3) 735 N. | 4 40 |
| 60 | 245 | 60 |
| 3) 505 N. | | 3) 280 E. |
| 168.3 | | 93.3 |

* This guess may be facilitated by sketching a right-angled plane triangle, considering one side as *mer. diff. lat.* and the other as *diff. long.*: the hypothenuse (the number of miles in which may be nearly estimated by comparing it with a side) will be the *dist.* to be looked for in the first place.

The distance corresponding to 735 and 280 as *tr. diff. lat.* and *dep* is evidently beyond the limits of the table. Dividing them by 3 the quotients are 245 and 93.3. The *dist.* corresponding to these as *tr. diff. lat.* and *dep.* may be guessed to be 300: it is found to be 262, and the corresponding *course* is N 21° E. The *distance* corresponding to 21° as a *course* and 168.3 (one-third of the real *tr. diff. lat.*) as a *tr. diff. lat.* is found to be 180, which being multiplied by 3, the required distance is 540 miles.

*Ex.* 3. Required the course and distance from E to F.

| | | | | | |
|---|---|---|---|---|---|
| Lat. E | 65° 42′ N. | *m. p.* | 5280 | Long. E | 2° 10′ E. |
| F | 70 30 N. | | 6055 | F | 7 12 W. |
| | 4 48 | | 775 N. | | 9 22 |
| | 60 | | | | 60 |
| | 288 N. | | | | 562 W. |

Dividing the *mer. diff. lat.* and *diff. long.* by 4, and proceeding as in the last example, the *course* and *dist.* are found to be N 36° W. 356 miles.

(24.) *To find the Course and Distance by Traverse Table and Method of Middle Latitude.*

By inspecting proportions (1) and (2) it appears that if the *diff. long.* be considered as a *dist.* in the traverse table, and the *dep.* as a *tr. diff. lat.*, the *mid. lat.* will be the corresponding *course.* Hence the following rule for finding the *course* and *distance.*

Rule. Find the *tr. diff. lat.*, *diff. long.*, and *mid. lat.*, as directed in Rules, Arts. 13, 14. Enter the Traverse Table with *diff. long.* in minutes at the top as a *dist.*; from the column underneath at the *mid. lat.* as a course take the *tr. diff. lat.*, which write down and mark *dep.* Then with the real *tr. diff. lat.* and this *dep.* find the required *course* and *dist.* as follows:

Guess* a *dist.* corresponding to the *tr. diff. lat.* and *dep.*, and in the columns under this *dist.* or in some other columns near, look for *tr. diff. lat.* and *dep.* at the same *course:* when found, the said *course* and corresponding *dist.* in the table will be those required.

When the *diff. long.* is beyond the limits of the *distances* at the top of the Traverse Table, it must be divided by 2, 3, or some other number, and the quotient (supposed within the limits) must be used as a *dist.* In this case the *tr. diff. lat.* taken out must be multiplied by the divisor of the *diff. long.*, in order to get the whole *dep.*

When the real *tr. diff. lat.* got from the latitudes given, and this *dep.* would plainly give a *dist.* beyond the limits of the Table, divide each of them by 2, 3, or some other number, and use the quotients in finding a *course* and *dist.* This course will be the *course* required, and this *dist.* multiplied by the divisor just used will give the *dist.* required.

* The guess may be facilitated by sketching a right-angled plane triangle, considering one side as the *tr. diff. lat.*, and the other side as *dep.* The miles in the hypothenuse (which may be estimated nearly by comparing it with the sides) will be *dist.* to be first used or guessed.

*Ex.* 1. Required the course and distance from A to B.

| | | | | | |
|---|---|---|---|---|---|
| Lat. A | 40° 15′ N. | | 40° 15′ N. | Long. A | 42° 28′ W. |
| B | 41 25 N. | | 41 25 N. | B | 46 18 W. |
| | 1 10 | Sum | 81 40 | | 3 50 |
| | 60 | | | | 60 |
| | | Half | 40 50 *mid. lat.* | | |

*tr. diff. lat.* 70 N. *diff. long.* 230 W.

Looking for the *diff. long.* 230 as a *dist.* and 41° (the nearest degree to *mid. lat.*) as a *course*, the *tr. diff. lat.* is 173.6, which by rule is to be considered as *dep.* The question is therefore reduced to this: to find a *dist.* and *course* corresponding to 70 as a *diff. lat.* and 173.6 as a *dep.* The distance guessed may be 200; the real *dist.* is found to be 187 miles, and the corresponding *course* N. 68° W.

*Ex.* 2. Required the course and distance from C to D.

| | | | | | |
|---|---|---|---|---|---|
| Lat. C | 50° 42′ N. | | 50° 42′ | Long. C | 28° 30′ E. |
| D | 42 17 N. | | 42 17 | D | 33 10 E. |
| | 8 25 | Sum | 92 59 | | 4 40 |
| | 60 | | | | 60 |
| | | Half | 46 29 *mid. lat.* | | |
| | 505 S. | | | | 280 E. |

Looking for 280 as *dist.* and 46° as *course*, the *tr. diff. lat.* (to be considered as *dep.*) is 194.5. The *tr. diff. lat.* is therefore 505 and the *dep.* is 194.5, the former of which being evidently beyond the limits of the Table the *halves* are taken, namely, 252.5 and 97.2; the *dist.* guessed may be 280 miles: it is found to be 270 and the corresponding *course* 21°. The required *course* and *dist.* are therefore S. 21° E. and twice 270, or 540 miles.

(25.) *To find the Latitude in and Longitude in, the course and distance from a known place being given, by Traverse Table and Meridional Parts.*

Rule. With given *course* and *dist.* enter the Traverse Table and take out corresponding *tr. diff. lat.*, from which and *lat. from* find *lat. in*, and then *mer. diff. lat.*, as in Rule, Art. 15. At the given *course* look (in the column of the *tr. diff. lat.*) for the *mer. diff. lat.*; the corresponding *dep.* will be the *diff. long.*, from which and the *long. from*, find the *long. in*, as by Rule, Art. 15.

If the given *dist.* be beyond the limits of the Table, one-half, one-third, &c., must be used, and the resulting *tr. diff. lat.* must be multiplied by the divisor, in order to get the whole *tr. diff. lat.* required.

When the *mer. diff. lat.* is beyond the limits of the *tr. diff. lat.* in the Table, look for one-half, one-third, &c., of it, and multiply the resulting *dep.* or *diff. long.* by the divisor used, in order to get the whole *diff. long.*

*Ex.* 1. Sailed from A S. 41° E. 275 miles: required the latitude in and longitude in; the Lat. A 50° 48′ N.; Long. A 1° 10′ W.

In the Traverse Table at the distance 275 and *course* 41, the corresponding *tr. diff. lat.* is 207′.5 or 3° 27′.5 S., which being subtracted from 50° 48′ N., the *lat. in* is 47° 20′.5 N., taking out the *mer. parts* for 50° 48′, and 47° 20′.5, the *mer. diff. lat.* is found to be 317, to *half* which as a *tr. diff. lat.* and at the course 41°, the *dep.* is 137.8, twice which is 275.6, that is, the *diff. long.* is 4° 36′ E. Hence the longitude in is 3° 26′ E.

*Ex.* 2. Sailed from B 672 miles N. 70° W.: required the lat. in and long. in.

Lat. B, 50° 45′ S. Long. B, 179° 12′ W.

Entering Traverse Table with *dist.* 168 (one-fourth of the *given dist.*) and *course* 70°, the *tr. diff. lat.* is 57.5, four times which is 230 or 3° 50′ N., the whole *tr. diff. lat.* This being subtracted from 50° 45′ S., the *lat. in.* is 46° 55′ S. The *mer. diff. lat.* for *lat. from* and *lat. in* is 350, and the *dep.* corresponding to one-fifth of this or 70, as a *tr. diff. lat.*, at the course 70°, is 192.6. The *diff. long.* is therefore *five times* this or 963′, in degrees 16° 3′ W. The *long. in* is therefore 195° 15′ W., or subtracting this from 360°, it is 164° 45′ E.

(26.) *To find the Latitude in and Longitude in, the course and distance from a known place being given, by Traverse Table and Middle Latitude.*

Rule. With given *course* and *dist.* enter the Traverse Table and take out *tr. diff. lat.*, from which and *lat. from* find *lat. in* as in Rule, Art. 15; and at the opening of the Table for finding *tr. diff. lat.* take out also the corresponding *dep.* Get the *mid. lat.* as directed in Rule, Art. 16, and at this *mid. lat.* as a *course* look in the column of *tr. diff. lat.* for the *dep.*: the corresponding *dist.* at the top will be the *diff. long.*, from which and the *long. from*, get the *long. in* as in Rule, Art. 15.

If the given *dist.* be beyond the limits of the Table, one-half, one-third, &c., must be used, and the resulting *tr. diff. lat.* and *dep.* must be multiplied by the divisor, in order to get the whole *tr. diff. lat.* and *dep.* When the *dep.* to be looked for as a *tr. diff. lat.* at the course, is beyond the limits of the Table, one-half, one-third, &c., must be used, and the resulting *diff. long.* multiplied by the divisor, in order to get the whole *diff. long.*

*Ex.* 1. Sailed from A, S. 41° E. 275 miles: required the lat. in and long. in.

Lat. A 50° 48′ N. Long. 1° 10′ W.

Entering the Traverse Table with *dist.* 275 miles and *course* 41°, the *tr. diff. lat.* is 207′.5 or 3° 27′.5 S.; applying this to *lat. from*, the *lat. in* is 47° 20′.5 N. The corresponding *dep.* is taken out at the same opening, which is 180.4. The *mid. lat.*, or half sum of *lat. from* and *lat. in*, is 49° to the nearest degree. The *dist.* corresponding to 49° as a course and 180.4 as a *tr. diff. lat.* is found to be 275, in degrees 4° 35′ E., which is the *diff. long.* Applying this to the *long. from* 1° 10′ W., we have the *long. in* 3° 25′ E.

*Ex.* 2. Sailed from B 672 miles N. 70° W.: required the lat. in and long. in.

Lat. B 50° 45′ S. Long. B 179° 12′ W.

Entering the Traverse Table with 168 (one-fourth of the given *dist.*) and *course* 70°, the *tr. diff. lat.* is 57.5, and the *dep.* is 157′.9. Applying four times 57′.5 or 3° 50′ N. to 50° 45′ S., the lat. in is 46° 55′ S. The *mid. lat.* to the nearest degree is 49°. The *dist.* corresponding to 49° as a *course* and 157.9 as a *tr. diff. lat.* is found to be 241. Four times this is 964′ or 16° 4′ W. the *diff. long.*, which being applied to the *long. from*, 179° 12′ W., the *long. in* is 195° 16′ W.; or, subtracting this from 360°, it is 164° 44′ E.

### (27.) *To find the Course and Distance in Parallel Sailing by Traverse Table.*

In parallel sailing, that is, in sailing on a parallel of latitude (17), the *dist.* is the same as the *dep.*, and the *lat. in* or *lat. from* is the same as the *mid. lat.* In getting the *dist.* we have therefore only to turn *diff. long.* into *dep.* or *dist.* by identifying the two proportions (1) and (2); the *course* is due east or due west.

Rule. Look for the *diff. long.* in minutes (found as in Art. 15) at the top as a *dist.*, in the column corresponding to which, find the *tr. diff. lat.* at the common *lat.* as a *course*; this *tr. diff. lat.* will be the *dist.* required.

When the *diff. long.* is beyond the limits of the table, take one-half, one-third, &c., of it, and multiply the *dist.* thus get by the divisor used, in order to get the whole *dist.* required. The course will be W. or E. according as the *diff. long.* is W. or E.

*Ex.* 1. Required the course and distance from A to B.

| Lat. A 50° 48′ N. | Long. A 1° 0′ W. |
|---|---|
| B 50 48 N. | B 1 0 E. |
| No difference or change of latitude. | 2 0 |
| | 60 |
| | 120 E. |

Entering the Traverse Table with 120 as a *dist.* and 51° as a course, the corresponding *tr. diff. lat.* is 75.5, which is the required *dist.* The required course and distance are therefore East 75.5 miles.

*Ex.* 2. Required the course and distance from C to D.

| Lat. C 30° 20′ N. | Long. C 18° 26′ W. |
|---|---|
| D 30 20 N. | D 29 40 W. |
| No difference or change of latitude. | 11 14 |
| | 60 |
| | 3)674 W. (224 W. |

The *diff. lcng.* 674 is beyond the limits of the table as a *dist.* Taking one-third, that is 224, the corresponding number in the *tr. diff. lat.* column, at the course 30°, is 194, and three times this is 582. Hence the required *course* and *dist.* are West 582 miles.

(28.) *To find the Latitude in, and Longitude in, in Parallel Sailing, the Course and Distance from a known place being given, by Traverse Table.*

As the *course* is due west or due east, the *lat. in* must be the same as *lat. from:* also the *dist.* given may be considered as *dep.*, which is to be turned into *diff. long.*, in order to get the *long. in.*

RULE. Find the given *dist.* in the *diff. lat.* column at the *lat. from* as a *course:* the *dist.* at the top will be the *diff. long.*, which (turned if necessary into degrees and minutes) mark E. when the course has been E., and W. when the course has been W.: underneath put the *long. from* with its proper name. When the names are *alike*, the sum with the common name will be the *long. in;* when the names are *unlike*, the difference with the name of the greater will be the *long. in.*

*Ex.* Sailed from A due west 110 miles: required the *lat. in* and *long. in.* The lat. of A is 60° 15′ S; the longitude of A is 25° 10′ W.

Looking in the Traverse Table at the *course* 60° for 110 in the *tr. diff. lat.* column, the corresponding *dist.* at the top is 220′ or 3° 40′ W. Applying this to the *long. from*, the *long. in* is 28° 50′ W.; the *lat. in* is 60° 15′ S.

*Ex.* 2. Sailed from B west 600 miles: required the latitude in and longitude in.

Lat. B 45° N. Long. B 3° E.

At the *course* 45° and *tr. diff. lat.* 200 (one-third of the given *dist.* 600), the tabular *dist.* is 283, which is one-*third* of the required *diff. long.* Hence 849′ or 14° 9′ W. is the *diff. long.*, and the *long. in* is 11° 9′ W. The *lat. in* is 45° N.

*Ex.* 3. Sailed from the Land's End, 1000 miles due West: required lat. in and long. in.

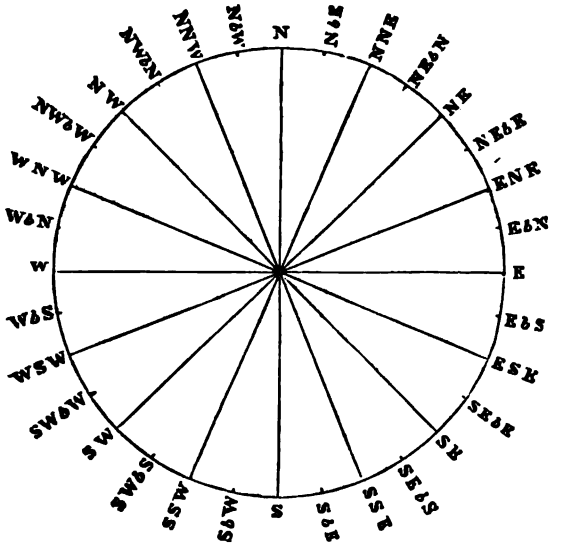
Answer. Lat. in 50° 4′ N. Long. in 31° 38′ W.

*Method of Keeping a Ship on any given Course.*

(29.) A ship is kept on any given course in the open sea, by means of an instrument called the Mariner's Compass, which is constructed as follows.

The circumference of a circular card is divided into 32 equal parts, and lines are drawn from its centre to the points of division. Two points, which are opposite to each other, are marked N. and S., and the points 90°

from the N. and S. are marked E. and W. The intermediate points are marked as in the following figure.




A small bar of steel, touched by magnets, is fixed on the under side of the card, the extremities coinciding with the points marked N. and S. The card and bar together are then placed in a box, so as to turn horizontally on a fine central pin. By this motion each point on the card is brought nearly into its proper position with respect to the true north and south points of the horizon; the effect of magnetism being to turn the bar of steel or needle, and consequently the N. and S. line of the card, so as to rest nearly in the meridian. The compass, secured from the wind and sea by a glass cover, is placed in the binnacle, near the seaman who has the helm; and who is said to steer on any particular point of the compass, as N.N.W., when he brings a fore and aft line of the ship into the same direction with N.N.W. line on the card, and keeps it so.

(30.) The bar of steel or needle generally deviates something from the true north; in some parts of the earth turning to the east, in others to the west thereof. This deviation is called the *variation* of the compass; E. or W., according as the needle points to the east or west of the true north. Having therefore calculated the course from one place to another, as explained in the preceding articles, it becomes necessary, before that course can be steered upon by means of the Mariner's Compass, to make a proper allowance for the variation; that is, to find what point on the card corresponds with the course determined by calculation.

(31.) To explain the method of doing this, we must first suppose a ship to lie on the calculated or true course, and the needle to be directed due north and south without any variation. In this case, as is manifest, no allowance would be required. When the ship and the compass are thus situated, let the north point of the needle turn a little to the west, that is, if the view be directed to the north, to the left. By this motion every other

point on the card will be carried to the left of its former place, that is, the course, though in reality the same, will appear by the compass to be to the right of what it was before, or to the right of the *true* course. If we suppose the needle to deviate to the eastward of the true north, in that case the contrary effect will be produced; the apparent course by the compass will be to the left of the *true* course.

By placing the card of a compass on a table, and turning it in the manner described above, the truth of these observations will become evident.

Hence we see what is meant, when, in finding the course by the compass, westerly variation is said to be allowed to the *right*, and easterly to the *left*; and also, when in reducing the true course from that by compass, westerly variation is allowed to the *left*, and easterly to the *right*.

(32.) But before the student in navigation proceeds farther on this subject, it will be necessary that he should obtain a perfect acquaintance with the names and position, with respect to each other, of the different points of the compass. In doing this he may observe that the middle point between

N. and E. is N. E.
N. and W. is N. W.
S. and E. is S. E.
S. and W. is S. W.

The names of these are got by simply putting together the letters of the principal points, between which they lie, and from which they are distant four points.

(33.) It may next be observed, that the middle point between

N. and N. E. is N. N. E.
E. and N. E. is E. N. E.
E. and S. E. is E. S. E.
S. and S. E. is S. S. E.
&c. &c.

Thus it appears, that the second set of middle points is got also by putting together the letters of the points already known, namely, N. and N. E.; E. and N. E.; &c., their distance from which is two points.

(34.) The remaining points, which may be considered as the third set of middle points, receive their names from the side on which they lie from N.; N. E.; E.; S. E.; &c.; being called N. by E.; N. by W.; N. E. by N.; N. E. by E.; &c.

By proceeding in this way, and repeating the points in the order which has been mentioned, the compass will soon be thoroughly known.

(35.) It must be noticed that the arc contained between two contiguous points is frequently called a *point*. This arc or *point*, since eight of them make 90°, must be 11° 15′; two must be equivalent to 22° 30′; three to 33° 45′; four to 45°, &c. Each of these arcs is moreover divided into four equal parts or quarters, named from their situation with respect to the contiguous point: thus the first quarter point, which is on the east of N. E., is called N. E. $\frac{1}{4}$ E.; the second, N. E. $\frac{1}{2}$ E.

The division of the compass being now supposed known, we shall proceed to give rules for shaping any given course by this instrument: and also for finding the true course steered, supposing the compass course to be known.

(36.) *To Shape the Compass Course, the True Course being given* (*App.* 61).

Put down the number of points (P) and quarter points (Q), which the *true course* is from the N. or S., marking them R. or L., according as they are to the right or left of N. or S. Underneath put the *variation* in points and quarter points, marking it R. or L. according as it is W. or E. If the names or letters be alike, the sum with that name will be the number of points and quarter points the *compass course* is from the N. or S.: if the names be unlike, the difference with the name of the greater will be the number of points and quarter points the *compass course* is from the N. or S., according as the true course has been reckoned from the N. or S.

| True Course. | Variation. | Compass Course. |
|---|---|---|
| N. N. E. | 2¼ W. | N. E. ¼ E. |
| E. N. E. | 1½ E. | N. E. ½ E. |
| S. E. ½ E. | 3¼ W. | S. b. E. ¼ E. |
| S. ¾ W. | 1¼ E. | S. b. E. |

| P. | Q. | | P. | Q. | | P. | Q. | | P. | Q. | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0 | R. of N. | 6 | 0 | R. of N. | 4 | 2 | L. of S | 0 | 3 | R. of S. |
| 2 | 1 | R. | 1 | 2 | L. | 3 | 1 | R. | 1 | 3 | L. |
| 4 | 1 | R. | 4 | 2 | R. | 1 | 1 | L. | 1 | 0 | L. |
| N. E. ¼ E. | | | N. E. ½ E. | | | S. b. E. ¼ E. | | | S. b. E. | | |

*Leeway.*

(37.) The point of the compass, which is directed from the steerage to the head of a ship, is called the *compass course*. There are two reasons why this may not be the true course. First, there may be a variation to allow; and secondly, the ship's track in the sea may not be in the direction of this fore and aft line: in other words, there may be an error in supposing the point of sailing shewn by the compass to be the true course, and there may be another error in supposing the line of sailing shewn by the ship to be so.

(38.) The action of the wind on the sails, rigging, and sides of a ship, when it lies near the point from which the wind blows, not only tends to impel the vessel through the water in the direction of a fore and aft line, but also presses it sideways; and thus, upon the whole, the track made in the sea is to the leeward of the apparent line on which it is directed, and makes an angle with it. This angle is called the *leeway*.

(39.) If the wind be on the right-hand side of the ship, the spectator being supposed to look forward, its track must evidently, when there is leeway, be to the left of a fore and aft line: if the wind be on the left-hand side, this track must be to the right. In the former case the ship is said to be on the *starboard tack*; in the latter, on the *larboard tack*. Hence it appears, that on the starboard tack leeway is allowed to the left, and on the larboard tack it is allowed to the right.

(40.) The amount of leeway depends on the proportion which the velocity of the ship *sideways* bears to the velocity *forward*. Under all sail this proportion is so small, that, even when the ship is close-hauled, no leeway whatever is allowed. When a less quantity of sail is carried, it is then usual to make allowances according to the sail actually set.

Although no rule can be given which will apply to all ships, yet the following one may come near the truth for ships of war.

*Rule for Leeway when by the Wind.*

1. Under all sail allow *no* leeway.

2. Under courses, single-reefed top-sails, and top-gallant-sails, when the water is smooth allow *no* leeway.
Where there is much swell, allow *one-quarter* of a point.

3. Under courses, double-reefed top-sails, and top-gallant-sails, allow *half* a point.
When the top-gallant-sails are furled, allow *three-quarters* of a point.

4. Under courses, treble-reefed top-sails, and top-gallant-sails, allow *one* point.
When the top-gallant-sails are furled, allow *one* point and a *quarter*.

5. Under courses, and close-reefed top-sails, allow *two* points.

6. Under courses, close-reefed fore and main top-sails, allow *two* points and a *half*.

7. Under reefed courses, and close-reefed fore and main top-sails, allow *three* points.

8. Under reefed courses, and close-reefed main top-sail, allow *three* points and a half.

9. Under reefed fore-sail, and close-reefed main top-sail, allow *four* points.

10. Under storm main top-sail, allow *five* points.

11. Under storm stay-sails, allow *six* points.

12. Under bare poles, allow *seven* points.

(41.) The above allowances suppose a ship to be constructed in the common way, and to be in perfect sailing order. When a ship is light, has higher upper works, less draught of water, less sharpness of body, or less length than usual, it will in any given case make more leeway than has been stated. But such variations must be left to the judgment of the seaman.

(42.) The leeway actually made by a ship at sea may be estimated by drawing a small arc of a circle at the stern, and marking on it the points of the compass. The estimated angle between a fore and aft line produced, and the track left by the ship in the sea, will be the leeway required. This angle may also be observed by a Mariner's Compass placed at the stern.

If this were done from time to time, and recorded, seamen would perhaps be enabled to make the proper allowance with greater certainty, than by following any general rule whatever.

The leeway being supposed known, the true course may be deduced from the compass course by the following rule.

### (43.) *To Correct the Compass Courses* (*see App.* 61).

RULE. Put down the points and quarter points which the *compass course* is to the right or left of the N. or S., marking them R. or L. Underneath put the *variation*, marking it R. or L., according as it is E. or W. If the names be alike, take the sum with that name: if unlike, take the difference with the name of the greater. Under this put the *leeway*, marking it R. or L., according as the course is right or left of the wind. Again, take the sum with the name of either, if the names be alike; and the difference, with the name of the greater, if the names be unlike. The result will be the number of points the *true course* is from the N. or S., according as the compass course has been reckoned from the N. or S.

The compass course and true course, if more convenient, may be reckoned from the W. or E.

| Compass Course. | Variation. | Leeway. | True Course. |
|---|---|---|---|
| N. N. E. | 2¼ W. | 1¼ R. | N. b. E. |
| N. W. | 2½ W. | 2½ L | W. b. S. |
| S. E. ½ E. | 3¾ E. | 3¼ R. | S. S. W. ½ W. |
| W. b. S. ¼ S. | 1¼ E. | 1¾ L. | W. b. S. ¾ S. |
| 2 0 R. of N. | 4 0 L. of N. | 4 2 L. of S. | 6 3 R. of S. |
| 2 1 L. | 2 2 L. | 3 3 R. | 1 1 R. |
| 0 1 L. | 6 2 L. | 0 3 L. | 8 0 R. |
| 1 1 R. | 2 2 L. | 3 1 R. | 1 3 L. |
| 1 0 R. | 9 0 L. | 2 2 R. | 6 1 R. |
| N. b. E. | W. b. S. | S. S. W. ½ W. | W. b. S. ¾ S. |

Sometimes it may be desirable to express the course, variation, and leeway, in degrees. The method of proceeding in reducing the true course to the compass course, and conversely the compass course to the true, will be apparent from the following examples, and from the foregoing observations and directions.

*True Course, &c. given in Degrees to find the Compass Course* (*App.* 61).

| True Course. | Variation. | Compass Course. |
|---|---|---|
| N. 50° E. | 21° W. | N. 71° E. |
| N. 20 W. | 23 W. | N. 3 E. |
| S. 82 E. | 12 E. | E. 4 N. |
| 50° R. of N. | 20° L. of N. | 82° L. of S. |
| 21 R. | 23 R. | 12 L. |
| 71 R. or N. 71° E. | 3 R. or N. 3° E. | 94 L. or E. 4° N. |

(44.) *To Correct the Compass Course in Degrees* (*see App.* 61).

| Compass Course. | Variation. | Leeway. | True Course. |
|---|---|---|---|
| S. 39° W. | 23° W. | 10° L. | S. 6° W. |
| N. 10° E. | 20° E. | 35° L. | N. 5° W. |
| N. 80° W. | 25° W | 12° R. | W. 3° S. |

| | | |
|---|---|---|
| 39° R. of S. | 10° R. of N. | 80° L. of N. |
| 23 L. | 20 R. | 25 L. |
| 16 R. | 30 R. | 105 L. |
| 10 L. | 35 L. | 12 R. |
| 6 R. | 5 L. | 93 L. |
| S. 6° W. | N. 5° W. | W. 3° S. |

*Method of Measuring the Distance Sailed.*

(45.) To determine the velocity, or degree of swiftness, with which a vessel sails, a piece of wood called the log is cast into the sea, and is then considered as a fixed point. The distance run from this point by the vessel is measured by means of a string fixed to the log, and unwound from a reel, as the vessel moves through the water.

The log is a piece of board cut out in the form of a sector of a circle. It has the curved part loaded with lead, so as to sink the whole just below the surface of the water, and at the same time to keep it in an upright position. One string is securely fixed to the central point of the log, and a second is attached, by means of a peg, to the middle of the curve. These two strings, at a short distance, are united in one; and have the effect, when stretched, of keeping the broad side of the log towards the ship, and thereby causing it to oppose the most powerful resistance to motion in that direction.

(46.) Thus prepared the log is cast into the sea, and about ten fathoms of the line, called *stray line*, is suffered to run off the reel, for the purpose of stretching it. Afterwards the length of line run off in a certain number of seconds is measured, whence the rate of sailing at that time is deduced. The person who heaves the log knows when the proper quantity of stray line is gone by a particular mark on the line, and the length afterwards run out by means of knots, which are at distances from each other, bearing the same proportion to a nautical mile that the time run by a sand-glass does to an hour. If one of these knots pass in the interval, the ship is sailing at the rate of one mile an hour; if two knots pass, it is sailing at the rate of two miles an hour; and so on.

(47.) In the operation described above of measuring a ship's way, a sand-glass running 28 seconds is generally used; in which case the knot ought to be 47 feet 3 inches, which bear the same proportion to 6075.5, the feet contained in a *mean* nautical mile, that 28 seconds do to 3600, the seconds contained in an hour. In some cases a sand-glass of 14 seconds is used, in which case the common knots run off must be doubled or a log line with half knots used. The length of the knot is frequently taken, as

little as 44 or 45 feet: by which means the sailing of the ship is over-rated. This is done with a view that the reckoning of the ship may be on the safe side in making land.

(48.) The knot is commonly supposed to be 8 fathoms; but it would be better to consider this space of 47 feet 3 inches as made up of *tenths*: for the space of 8 fathoms or 48 feet is evidently too much for the knot, when a 28 seconds sand-glass is used. Besides measuring by fathoms is attended with inconvenience in calculation, and leads to errors. The knot of 47 feet 3 inches might be divided into *double* tenths by smaller knots of 9 feet 5¼ inches; and thus the distance run off would always be known to the nearest tenth.

The number of seconds run by the sand-glass, and also the length of the knots on the log-line, should from time to time be ascertained, and if necessary altered. Or, what would answer better than shifting the marks on the log-line so frequently as would thus be required, the error of several knots above or below their proper length, being determined by measurement immediately after heaving the log, at least once every day, a correction might be applied in working the day's work, from a table constructed for that purpose. Four knots should measure 189 feet; 8 should measure 378.

(49.) Suppose now a ship to sail at noon from a known place, bound to another known place. The first thing to be done is to calculate the true course as in Art. 13 or 14, 23 or 24. Having made the proper allowance for the variation (Art. 36), the compass course is thence deduced, and, if the wind permit, the ship is steered on it.

At the end of an hour, that is, at $1^h$ P.M., the log is hove, and the number of nautical miles and tenths of miles is determined which the ship has run in the preceding hour. At 2 P.M., the same operation is repeated.

Let the ship keep the same course till 4 P.M. Then up to this time we know the compass course, and by correcting for variation and leeway (Art. 13), the true course; and by adding up the hourly distances, we know also the whole *dist.* From a traverse table we can find the *tr. diff. lat.* and *dep.*, the former of which must be marked N. or S. the latter, E. or W.

After 4 P.M., let the ship be steered on a new course till 8 P.M., and let the distance run in each hour, from 4 to 5, from 5 to 6, &c., be measured as before. Then, correcting the compass course for variation and leeway, and adding up the miles in each hour, we again know the *course* and *dist.*; and thence, with the assistance of the traverse table, the *tr. diff. lat.* and *dep.*; which are also marked with their proper names.

(50.) Thus we may be supposed to go on till the next noon, determining, by means of the compass and the log, the different courses steered, the distance on each course; with the *tr. diff. lat.* and *dep.* on each.

Let all the *tr. diff. lat.* marked N. be added together, and all those marked S. The difference of the sums, with the name of the greater, will be the *tr. diff. lat.* upon the whole. In a similar manner the *dep.* on the whole is got, and marked E. or W. according to its name. Then the *tr. diff. lat.* and *dep.* in the preceding 24 hours being known, the distance of the ship from the place left, and the course from thence to the ship, may be determined either by logarithms or by a traverse table, from proportions (3) and (1) in Art. 11. By the course and distance thus determined

are meant the course upon which the ship must have sailed without any variation, in order to arrive at the same place, and the distance the ship must have run on that supposition.

(51.) By applying the *tr. diff. lat.* to the *lat. from*, we get the *lat. in;* we may then proceed either by the method of meridional parts, or by the method of middle latitude, to find the *diff. long.* made, from which and the *long. from* we get the *long. in.* The proportion (4) in Art. 11 is used in the former method, and proportion (2) is used in the latter.

The same thing may be done by inspection in a traverse table, by working proportion (4) under the names of (3), or (2) under the names of (1). (*See* Arts. 25 and 26.)

(52.) The place of the ship at the noon following the time of sailing being known, the *course* and *dist.* from thence to any other known place, or, as they are usually called, its *bearing* and *distance*, may be easily computed as in Art. 13, 14, 23, 24, &c.

(53.) The hourly distances, compass courses as they are changed from time to time, the winds, quantity of sail set, &c., are first written with chalk on a board, called a log-board, and are afterwards transcribed into a book, called the ship's log-book. At each noon the *course*, *dist.*, *lat. in*, *long. in*, and the *bearing* and *dist.*, determined as explained above, are inserted in proper spaces in this book, at the end of the previous account.

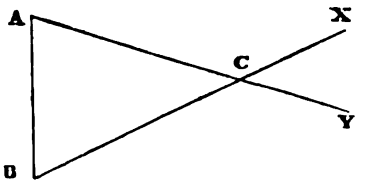
This mode of computing is called a *dead reckoning;* the work necessary each 24 hours is called a *day's work;* and the place of the ship deduced therefrom is called its place by the *log. account*, or simply *by account.*

(54.) In the above sketch of the method of proceeding in keeping the dead reckoning, it has been supposed that a ship sails from a known place or point. Now this is seldom the case: on quitting the land, the point, which is known as to latitude and longitude, is usually at some distance from the ship, though within sight. This distance is commonly estimated by the eye, and its compass-bearing taken: then the ship is supposed to have sailed, on a compass course opposite to this bearing, the estimated distance from the known point; which would bring it to the place actually sailed from. This is called taking a *departure.*

Thus when a vessel leaves its anchorage, let a known point A bear N. N. E. and the estimated distance be 15 miles. Then the vessel is supposed to have sailed by compass S. S. W. 15 miles from A; and this corrected for variation is considered as the first course in the day's work. The result will evidently be the same as if the ship had really sailed, from A, 15 miles on a S. S. W. course.

Afterwards the courses steered from the situation of the ship on sailing are taken from the log-board, and corrected for variation and leeway, as has been already pointed out.

(55.) In some instances the distance of a ship from a known point, in taking its departure from the land, is found by observing the compass-bearing of that point; by then running a measured distance upon a given course, so as to change the bearing considerably; and lastly by taking the bearing of the same point again. These observations furnish sufficient data for computing the ship's distance from the known point at the time, when either bearing was taken.




Let C be the known point, A the first position of the ship when its bearing is taken, B the second. Produce AC and BC to Y and X. Then in the triangle ACB, we know the angle A between the first bearing and the ship's course; we also know the angle ACB, which is equal to XCY, the angle between the two bearings observed: lastly, we know AB the side opposite to ACB. Consequently, since the sides of a plane triangle are proportional to the sines of the opposite angles, we can easily compute BC, the side opposite to the angle A, from the following proportion.

$$\textit{sin}\ \text{C} : \textit{sin}\ \text{A} :: \text{AB} : \text{BC}$$

Or *sin* ang. between bearings : *sin* ang. between first bearing and course :: dist. run : $x$

where $x$ represents the required distance, and may easily be found by attending to the rule in Art. 12.

*Ex.* Sailing past a lighthouse, at 1 A.M., it bore by compass N 15° W.; at 4 A.M. it bore N 50° W.; the ship in the interval run N 60° E. 6 miles an hour: required the distance of the ship from the lighthouse at 4 A.M.

Angle between bearings = 35°; angle between first bearing and course = 75°; distance run = 18 miles: hence

*sin* 35° : *sin* 75° :: 18 : $x$

| | |
|---|---|
| 1.255273 | log 18. |
| 9.984944 | log *sin* 75. |
| 11.240217 | |
| 9.758591 | log *sin* 35. |
| 1.481626 | log 30.3 miles required dist. |

In a similar manner, if necessary, the ship's distance from a known point at the time of taking the first bearing may be determined.

(56.) Sometimes a ship, in sailing through a tide or current, is carried away by it in the direction in which it runs. And as the log itself, when cast into the sea for the purpose of ascertaining the rate of sailing, must also be swept by the stream in the same direction and with the same velocity, it is manifest that the place of a ship determined by a log account must, in such circumstances, differ from its true place by the whole effect of this stream. For the ship may be considered as a point moving on the top of a table, while the table itself is moved: we have first the motion of the point on the table to account for, and then the motion of the table itself. The proper correction will therefore be found by supposing the ship, in addition to the courses on the log-board, to have sailed through the number of miles passed over by the tide or current.

The course of the tide or current is usually taken by the compass, and must be corrected for variation only.

The actual operation of a day's work will be briefly explained after the following transcripts from a journal, wherein the ship is supposed to take a departure from Cape Finisterre, and to sail for the island of Madeira.

At Noon on Nov. 9, 1835, Cape Finisterre, N. N. E. 15 miles.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 8 | | S. W. ½ W. | N. N. W. | | P. M. Moderate breezes and fine weather, all sails set. |
| 2 | 7 | 8 | | | | |
| 3 | 7 | 6 | | | | At 3, wind shifted to S. S. W. ¾ W., down Studding-sails, Rl. and Middle Stay-sails, and braced up on the starboard tack. |
| 4 | 7 | 8 | S. E. ¾ S. | S. S. W. ¾ W. | | |
| 5 | 8 | | | | | |
| 6 | 8 | 2 | | | | At 4, Do. Wr. |
| 7 | 8 | 6 | | | | At 7, fresh breezes and fine Wr., in Royals, down Flying-Jib and Top-gallant Stay-sail, and in second reefs of the Top-sails (Leeway ½). |
| 8 | 8 | 6 | | | | |
| 9 | 8 | 8 | W. ¾ N. | Do. | | |
| 10 | 8 | 4 | | | | |
| 11 | 8 | 8 | | | | At 8, fresh breezes, tacked ship. |
| 12 | 8 | 6 | | | | Midnight, Do. weather, tacked ship. |

| H. | K. | T. | Courses. | Winds. | No. of Signals | Remarks, &c. H. M. S. ——, Nov. 10, 1835. |
|---|---|---|---|---|---|---|
| 1 | 8 | 7 | S. E. by S. | S. W. by S. | | A.M. Fresh breezes and cloudy. |
| 2 | 8 | 5 | | | | |
| 3 | 9 | 2 | | | | At 4, strong breezes, in Top-gallant-sails and 3d reef of the Top-sails, down outer and set inner Jib, reefed the Spanker, down Royal and Top-gallant-yards, and struck Top-gallant-masts (Leeway 1½). |
| 4 | 9 | 5 | | | | |
| 5 | 4 | 3 | | | | |
| | 4 | 3 | W. by N. ½ N. | S. W. ½ S. | | |
| 6 | 8 | 5 | | | | At 4.30 tacked ship. |
| 7 | 8 | 3 | | | | |
| 8 | 8 | 5 | | | | At 10, strong breezes, down inner Jib, and up Fore-top-mast Stay-sail. |
| 9 | 8 | 5 | | | | |
| 10 | 8 | 3 | | | | A Swell the last 6 hours setting the ship S. E. 1 mile an hour. Noon, Do. weather. |
| 11 | 7 | 5 | | | | |
| 12 | 7 | 7 | | | | |

| Course. | Distance. | Latitude in | Longitude in | Bearing and Distance of Funchal |
|---|---|---|---|---|
| S. 24° 28′ W. | 78 | 41° 45′ N. | 10° 1′ W. | S. 30° 58′ W. 639 miles. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 7 | 4 | S. E. | S. S. W. | | P. M. Strong breezes with a heavy head sea. |
| 2 | 7 | 2 | | | | |
| 3 | 7 | 2 | | | | At 4, Do. weather, tacked ship. |
| 4 | 7 | 3 | | | | |
| 5 | 7 | 5 | W. by S. ½ S. | S. ½ W. | | At 5, got the Top-gallant-mast on deck, and Flying Jib-boom in. |
| 6 | 7 | 6 | | | | |
| 7 | 7 | 4 | | | | At 6, in 4th reefs of the Top-sails and reefed the Courses, down Spanker and set the Try-sail (Leeway 2). |
| 8 | 7 | 6 | | | | |
| 9 | 7 | 8 | E. S. E. | S. | | |
| 10 | 7 | 8 | | | | At 8 wore ship. |
| 11 | 7 | 6 | | | | Midnight, strong breezes, wore ship. |
| 12 | 8 | | | | | |

| H. | K. | T. | Courses. | Winds. | No. of Signals | Remarks, &c. H. M. S. ——, Nov. 11, 1835. |
|---|---|---|---|---|---|---|
| 1 | 7 | | N. W. by W. | S. W. by W. | | A. M. Strong breezes. |
| 2 | 6 | | | | | |
| 3 | 5 | | | | | At 4 wore ship. |
| 4 | 5 | | | | | |
| 5 | 5 | 6 | S. ¾ E. | S.W.b.W.½W. | | At 6, in Mizen Top-sail, and set the Mizen Stay-sail (Leeway 3). |
| 6 | 5 | | | | | |
| 7 | 5 | 4 | | | | |
| 8 | 5 | | | | | At 8, Do. Wr. wore ship, in Fore Top-sails (Leeway 3½). |
| 9 | 5 | | W. N. W. | S. W. | | |
| 10 | 5 | | | | | |
| 11 | 4 | | | | | Noon, strong breezes. |
| 12 | 4 | | | | | |

| Course. | Distance. | Latitude in | Longitude in | Bearing and Distance of Funchal. |
|---|---|---|---|---|
| N. 60° 53′ E. | 18 | 41° 54′ N. | 9° 40′ W. | S. 31° 47′ W. 655. |

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 4 | | W. N. W. | S. W. | | P. M. Strong breezes and cloudy. |
| 2 | 3 | 6 | | | | At 2, fresh gales, up Main-sail, and furled it, set Main Stay-sail (Leeway 4). |
| 3 | 3 | 2 | | | | |
| 4 | 2 | 6 | | | | |
| 5 | 1 | | | S. S. W. ½ W. | | |
| 6 | 1 | | up W. by N. | | | At 4, strong gales, up Fore-sail, down Fore Top-mast, and set Fore Stay-sail (Leeway 5). |
| 7 | 1 | | off N.W.b.W. | | | |
| 8 | 1 | | | | | |
| 9 | 1 | 5 | | S. W. ½ W. | | |
| 10 | 1 | 5 | up W. N. W. | | | |
| 11 | 1 | 5 | off N. W. | | | |
| 12 | 1 | 5 | | | | Midnight, strong gales and cloudy. |

| H. | K. | T. | Courses. | Winds. | No. of Signals | Remarks, &c. H. M. S. ——, Nov. 12, 1835. |
|---|---|---|---|---|---|---|
| 1 | 1 | 4 | up W.bN.½N. | S. W. by S. | | A. M. Do. Wr. |
| 2 | 1 | | off N.W.½W. | | | At 2, more moderate, wind shifted to N. N. W., trimmed sails. |
| 3 | 1 | 2 | S. W. ½ W. | N. N. W. | | |
| 4 | 1 | 4 | | | | At 4, fresh breezes and fine, out reefs and made sail. |
| 5 | 6 | | | | | |
| 6 | 6 | 4 | | | | |
| 7 | 7 | | | | | At 8, Do. Wr. |
| 8 | 8 | 2 | | | | |
| 9 | 8 | 4 | | | | |
| 10 | 9 | | | | | |
| 11 | 9 | | | | | |
| 12 | 8 | 6 | | | | Midnight, fresh breezes and fine. |

(57). In the above journal there is one column for the hours, and two adjoining ones for the knots and tenths of knots, marked K and T. The third column contains the courses, which are put opposite the hour next after the one, when they are begun or changed. In the fourth column is inserted the point from which the wind blows. A fifth column is made in ships of war, for the No. of any signal made. In the last column or space, the public occurrences of the ship are written.

The day is divided, according to the civil mode, into two intervals of twelve hours, the first marked A. M., the latter P.M. It is supposed to begin at midnight, and end at midnight; but the reckoning is worked from noon to noon, and the ship's place settled each day at that time.

(58.) In working the above journal, the variation of the compass will be assumed *one* point and *three-quarters* westerly, or $1\frac{3}{4}$ W. It is usual to insert this, as determined by astronomical observation, in the space for remarks, where the results also of other observations for finding the latitude and longitude are put; but at present we wish to confine ourselves to the log account alone.

(59.) The compass-bearing of Cape Finisterre at starting is N. N. E; the opposite point to which is S. S. W. Allowing the variation to the left of this, we have the true bearing of the ship from Cape Finisterre S. $\frac{1}{4}$ W., and dist. 15 miles.

(60.) The ship first sails S. W. $\frac{1}{2}$ W. $9\frac{1}{2}$ points from the wind, under all sail. Consequently no leeway is to be allowed. But correcting for the variation, we have the true course S. S. W. $\frac{1}{4}$ W. The distance on this course is 23.4 miles; which is got by adding up the *dist.* columns as far as 3 P. M., when the course is changed.

The second course is S. E. $\frac{1}{4}$ S, six points from the wind, the ship being now close-hauled. It is still however kept under all sail, and therefore no leeway is allowed. The variation 1 P$^t$. 3 Q. is allowed to the left, (see mode of correcting courses in Art. 43). Hence the true course is S. E. by E. The distance on this course is 32.6, adding up the distance columns from 4 to 7 P. M., when sail is taken in, and the ship in consequence makes leeway.

(61.) By referring to the general rule for leeway and the column of remarks in the journal, it appears that *half* a point should be allowed for leeway after 7 P. M.; to the left, because the ship is on the starboard tack (Arts. 38 and 39). Allowing therefore first the variation 1 P. 3 Q. to the left and the leeway 2 Q. to the left, the true course becomes S. E. by E. $\frac{1}{2}$ E. The distance is 8.6 miles.

(62.) The two next courses W. $\frac{3}{4}$ N. and S. E. by S. are corrected for variation and leeway as explained in Art. 43. The latter will require a different correction after 4 A. M., because more sail is taken in, and the leeway becomes greater. From this hour therefore to $4\frac{1}{2}$ A. M. we have a distinct true course, namely, E. S. E. (see following form), the distance upon which is the 4.3 miles placed above the cross line drawn at 5 A. M.

(63.) The next course W. by N. $\frac{1}{2}$ N. commences at $4\frac{1}{2}$ P.M., and the distance run includes the 4.3 miles under the cross line. This course is continued to the noon of Nov. 10.

(64.) On referring to the remark column, we find that the ship, in addition to the courses which are put down in the proper column, has been set by a swell 6 miles S. E. This is considered as a distinct compass course (56), and corrected for variation.

(65.) The following is the form in which the different corrected courses and distances are inserted. There is one column for the *true courses*, another for the number of points, which each is from the N. or S.; a third for the *distances* run; and lastly four columns marked N, S, E, W, for the *tr. diff. lat.* and *dep.* made on each course.

| | Points from N. or S. | True Course. | Dist. | N. D. Lat. | S. D. Lat. | E. Dep. | W. Dep. |
|---|---|---|---|---|---|---|---|
| Dep. course .. | S. ¼ W. | S. ¼ W. | 15 | — | 15.0 | — | 0.7 |
| | S. 2¾ W. | S. S. W. ¾ W. | 23.4 | — | 20.1 | — | 12.0 |
| | S. 5 E. | S. E. by E. | 32.6 | — | 18.1 | 27.0 | — |
| Sail taken in . | S. 5½ E. | S. E. by E. ½ E. | 8.6 | — | 4.0 | 7.6 | — |
| | S. 7½ W. | W. ½ S. | 34.6 | — | 3.3 | — | 34.3 |
| | S. 5¼ E. | S. E. by E. ¼ E. | 35.9 | — | 18.5 | 30.9 | — |
| | S. 6 E. | E. S. E. | 4.3 | — | 1.6 | 4.0 | — |
| | N. 7 W. | W. by N. | 61.6 | 12.0 | — | — | 60.3 |
| Swell course.. | S. 5¼ E. | S. E. by E. ¼ E. | 6 | — | 2.6 | 5.4 | — |
| | | | | 12.0 | 83.2 | 74.9 | 107.3 |
| | | | | | 12.0 | | 74.9 |
| | | | | | 71.2 | | 32.4 |

(66.) When the courses are corrected, and the distances added up, the number of points which each course is from the N. or S. is put in a separate column, in order that the calculator may open the traverse table with less danger of mistake. With a similar view the columns, in which the *tr. diff. lat.* and *dep.* on each *course* are to be inserted, when taken from the traverse table, are left open, and the others filled up with a dash. Thus, in the first course of the above form, the S. and W. columns are left open, and the N. and E. are marked with a dash.

(67.) In looking for each distance in the traverse table, in order to find the *tr. diff. lat.* and *dep.*, it may be taken to the nearest unit; or, what would be more correct, the integral and decimal parts of the *dist.* may be looked for, where the limits of the traverse table admit of it, as a whole number; care being taken to carry the decimal mark one back in the corresponding *tr. diff. lat.* and *dep.* Thus in the second course of the following form, the *dist.* 23.4 may be looked for as 234, and the corresponding *tr. diff. lat.* 201 and *dep.* 120 written 20.1 and 12.0.

(68.) Having added up the different columns of *tr. diff. lat.* and *dep.* we find that the N. *diff. lat.* is 12, and the S. *diff. lat.* is 83.2. Whence the difference with the name of the greater, or 71.2 S., is the whole *tr. diff. lat.* In like manner 32.4 W. is the whole *dep.*

After getting the numbers we proceed to compute the *course* and *dist.* made good upon the whole, with the *lat. in* and *long. in*, either by logarithms or by a traverse table.

(69.) *By Logarithms and Meridional Parts.*

See Art. 11, proportions (1), (3), (4).

| (3) | | (1) |
|---|---|---|
| 11.510545 | | 11.852480 |
| 1.852480 | | 9.959138 |
| 9.658065 | | 1.893342 |
| Course S. 24° 28′ W. | | Dist. 78.2 miles. |

| | | | | (4) |
|---|---|---|---|---|
| Tr. diff. lat. | 1° 11′ | S. | M.P. | 9.658065 |
| Lat. from | 42 56 | N. | .....2858 | 1.982271 |
| Lat. in | 41 45 | N. | .....2762 | 1.640336....43′.7 |
| | | | Mer. diff. lat. 96 | |

Hence *diff. long.* is 0° 44′ W., and *long. in* is 10° 1′ W., the long. of Cape Finisterre being 9° 17′ W.

Hence it appears that the *course* from Cape Finisterre during the last 24 hours is, upon the whole, S. 24° 28′ W.; the *dist.* is 78.2 miles; the *lat. in* is 41° 45′ N.; and the *long. in* is 10° 1′ W. These are inserted in the proper spaces at noon on the 10th Nov. (see journal); also the *bearing* and *dist.* of Funchal in Madeira, which is computed as in Art. 13.

(70.) *By Traverse Table and Meridional Parts.*

Judging from the *tr. diff. lat.* 71.2 and *dep.* 32.4, the corresponding *dist.* may be guessed to be about 80 (see Note, Art. 24). It is found by inspection that under a *dist.* 78 and at a *course* 24° *tr. diff. lat.* is 71.3, and *dep.* is 31.7. To the nearest degree therefore the course is S. 24° W and the *dist.* is 78 miles.

(71.) *By Logarithms and Middle Latitude.*

The *course* and *dist.* from Cape Finisterre, and *lat. in*, are found as above; half the sum of the *lat. in* and *lat. from* is taken, which is 42° 20′ the *mid. lat.*; and then proportion (2), Art. 11, is used as follows.

| | | | |
|---|---|---|---|
| 11.510545 | diff. long. | 0° 43′.8 | W. |
| 9.868785 | long. from | 9 17 | W. |
| 1.641760....43′.8 | long. in | 10 1 | W. |

(72.) *By a Traverse Table and Middle Latitude.*

The *course* and *dist.* are determined as before; then the *diff. long.* is found by looking for the *dep.* 32.4, (or the nearest number we can find thereto) in the *tr. diff. lat.* column at the course 42°, see proportion (3) and (4). The corresponding number 44 in the *dist.* column will be the *diff. long.* whence the *long. in* is got as before.

The above are the different methods of finding the *course, dist. lat. in,* and *long. in.* In addition to this the *bearing* and *dist.* of the place to which the ship is bound, or some other place it is expected to make, are computed as in Art. 13, &c., and entered in the proper space in the log-book at each noon.

*Form for the second Day's Work.*

| | Points from N. or S. | True Course. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|---|---|
| | S. 7 E. | E. by S. | 29.1 | — | 5.7 | 28.5 | — |
| | S. 6 W. | W. S. W. | 15.1 | — | 5.8 | — | 13.9 |
| | S. 6¾ W. | W. S. W. ¾ W. | 15.0 | — | 3.6 | — | 14.6 |
| Sail taken in | N. 6½ E. | E. N. E. ½ E. | 31.2 | 10.5 | — | 29.4 | — |
| | N. 4¾ W. | N. W. ¾ W. | 23.0 | 13.7 | — | — | 18.6 |
| | S. 4½ E. | S. E. ½ E. | 11.6 | — | 7.4 | 9.0 | — |
| Sail taken in | S. 5½ E. | S. E. by E. ½ E. | 10.6 | — | 5.0 | 9.3 | — |
| | N. 4¼ W. | N. W. ¼ W. | 18.0 | 12.1 | — | — | 13.3 |
| | | | | 36.3 | 27.5 | 76.2 | 60.4 |
| | | | | 27.5 | | 60.4 | |
| | | | | 8.8 | | 15.8 | |

(73.) There is nothing in this day's work which will not be understood by attending to the different steps of the first. The variation is supposed to be the same as before, namely 1¾ W.; the leeway is known by referring to the column of remarks, or by comparing the sail on the ship with the general rule in Art. 40.

*Form for the third Day's Work.*

| Points from N. and S. | True Course. | Dist. | N. | S. | E. | W. |
|---|---|---|---|---|---|---|
| N. 4¼ W. | N. W. ¼ W. | 7.6 | 5.1 | — | — | 5.6 |
| N. 3¾ W. | N. W. ¼ N. | 5.8 | 4.3 | — | — | 3.9 |
| N. 2¾ W. | N. N. W. ¾ W. | 4.0 | 3.4 | — | — | 2.1 |
| N. 1¾ W. | N. by W. ¾ W. | 6.0 | 5.6 | — | — | 2.0 |
| N. 2¼ W. | N. N. W. ¼ W. | 2.4 | 2.2 | — | — | 1.0 |
| S. 2¾ W. | S. S. W. ¾ W. | 65.2 | — | 55.8 | — | 33.4 |

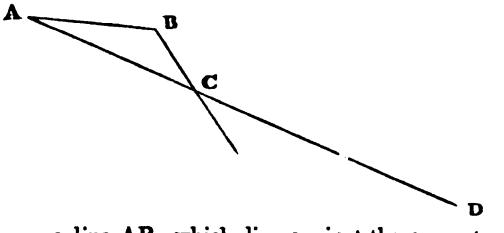
(74.) In the journal of the last 24ʰ we see that the ship from 4 P.M. to 2 A.M. lay-to on the larboard tack, coming up as near the wind the first four hours, as W. by N., and falling off as far from it as N. W. by W. In this case the middle point W. N. W. is taken, and corrected for variation and leeway; the resulting true course (see above form) is N. N. W. ¾ W. A similar method is pursued in finding the compass courses, and thence the true courses for the next four hours.

The other steps of this day's work are similar to those in the first.

(75.) Having given the foregoing outline of the mode of keeping a sea journal by the log account, we may conclude this subject by observing that, whenever at sea the latitude of the ship at noon is found from astronomical observation, it is usual to discard the latitude by account and to insert the astronomical latitude in its place, and to use this in computing, as above, the *course*, *dist.*, and *long. in.* When no observations are got for determining the longitude of the ship, such a substitution tends to correct in some degree the log account.

### *Current Sailing.*

(76.) Suppose it were required to pull a boat from A to D in a straight line, a current setting in the intermediate space in the direction BC. Then to keep the boat in the line AD, it is manifest that the boat must be steered along some line AB, which lies against the current; so that if at one pull the boat is propelled (or independently of the current would be propelled) through AB, the current may in the same time carry it through BC, in which case, at the termination of the motion produced by the pull, the boat will be actually in the line AD at C. The lines AB and BC are, as is evident, proportional to the rates of motion of the boat in still water and of the current. Thus, if the boat could be pulled at the rate of 6 miles an hour in still water, and the current run at the rate of 3 miles an hour, AB : BC :: 6 : 3. But since the sides of a plane triangle are proportional to the sines of the opposite angles, AB : BC :: *sin* C : *sin* A; where C is the angle between the bearing of D and the direction in which the current runs, and A is the angle between the bearing of D and the bearing on which the boat must be steered. Hence therefore, calling the latter angle $x$, we have the following proportion:—




Rate of pulling in still water : rate of current :: *sin* angle between bearing and current : *sin* $x$.

The application of this proportion will be best seen by an example.

*Ex.* The bearing of a ship is S. S. W. and a current runs west 4 miles an hour: how must a boat be steered to fetch the ship, supposing I can pull in still water 6 miles an hour?

Here the angle between the bearing and the current is 6 points or 67° 30′; the angle between S. S. W. and the required course is $x$. Then (see Art. 12.)

$$6 : 4 :: \sin 67° 30' : \sin x$$

| | |
|---|---|
| | 9.965616 |
| | 0.602060 |
| | 10.567676 |
| | 0.778151 |

$x = 38° 1'$ or $3\frac{1}{2}$ *points*.....*sin* $x$ = 9.789525

Hence allowing $3\frac{1}{2}$ *points* from S. S. W. *against* the current, that is, to the left, we get S. by E. $\frac{1}{2}$ E. the course to be steered.

(77.) The rule therefore is this:

RULE. To the *log. sin* of the angle between the given bearing and the set of the current, add the *logarithm* of the rate per hour of the current, and subtract the *logarithm* of the rate per hour of the boat supposing there were *no* current. The remainder will be the *log. sin* of an angle, which find from the tables and express in points. Allow this to the right or left of the given bearing, always against the current. The result will be the course to be steered.

The same rule applies to a ship impelled by the wind on the sails, as well as to boats impelled by the stroke of oars; only, in ships the rate of sailing will depend on the course to be steered on, and therefore must depend on the angle which it is proposed to compute. However, every seaman is able by practice to estimate this angle nearly; and then, by considering the strength and direction of the wind, he is able also to estimate nearly the rate of sailing. With this he may, by the rule, compute the angle more exactly, and thence the course to be steered.

(78.) The rate of approach to the point aimed at, that is, the value of AC, may also be easily computed. For, subtracting the sum of the angles CAB and ACB from 180°, the remainder will be ABC. Then, *sin* A : *sin* B :: BC : AC; in which proportion, the three first terms being known, the fourth may be easily computed by the rule in Art. 12.

(79.) If in computing the course to be steered in a current the *log. sin* of the angle A should come out equal to *log. rad* or 10, in that case the vessel must be steered perpendicularly to AC. If the *log. sin* of the angle A should come out greater than *log. rad* or 10, in that case it is impossible, under the circumstances proposed, to keep the boat in the line AD.

(80.) Since, in shaping a course for a vessel in a current, the object is to keep it in the line AD, the bearing of D, as the boat advances towards the point, must remain constantly the same. Which proves the correctness of the rule in practice, namely, that the boat must be so steered, that *the bearing of the object steered for may not alter.*

(81.) The same practical rule applies, when it is required to come up with a vessel itself in motion, in the least time possible. The vessel in chase must be so steered, that the vessel chased may always be kept on the same bearing; supposing this possible. For the *relative places* of the two vessels will be the same, as if the chasing vessel had the motion of the vessel chased on the opposite bearing, and the latter were actually at rest.

*Ex.* A ship B bears from another A, S. by W., the wind being North. The ship B is standing on a W. N. W. course at the rate of 8 miles an hour. On what course must A be steered so as to come up with B in the shortest time, the rate of sailing on the *estimated* course being 11 miles an hour?

The practical rule in this case would be to keep the ship A on the same bearing, namely S. by W.: but the course to be steered may be found by supposing B to be stationary and A to be carried by a current on the opposite point to W. N. W., that is, E. N. E., at the rate of 8 miles an

hour. The angle between the bearing of B and the set of the supposed current will then be 11 points or 123° 45′. Hence, denoting by $x$ the angle between the required course S. by W., we have, by the rule in Art. 76,

| | |
|---|---|
| 9.919846 | Whence $x = 37° 12\frac{1}{2}'$ or $3\frac{1}{4}$ points; which |
| 0.903090 | must be allowed against the supposed current, |
| 10.822936 | that is, to the right. The required course is |
| 1.041393 | therefore S. W. $\frac{1}{4}$ W. |
| 9.781543 | |

On the foregoing principles is easily deduced the following rule for chasing.

(82.) *Chasing to Leeward.* Close the chase, keeping her on the same bearing as at first; always changing course with her.

(83.) *Chasing to Windward.* When it is possible, close the chase, keeping her on the same bearing as at first. When this is not possible, keeping on the same course with her, fore-reach, till she is a point or two abaft the beam; then tack; and repeat this till you fetch the chase. In the latter case the least time would be lost by fore-reaching till the chase could be closed and kept on a constant bearing on the other tack; but in doing this the distance from her might become too great, and by manœuvring or accident she might escape from a superior ship.

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Great Circle Sailing.—Ingenious navigators have attempted to discover the shortest ocean routes by sailing on a great circle of the globe, and scientific men have taxed their skill to show what modifications of this problem are practicable. The greater knowledge we now possess of the currents, and disturbances of the atmosphere, has demonstrated that in the enterprise of crossing from land to land by the shortest route, other elements are more worthy of consideration, and that a proposal to bind the mariner by any geographical lines may be perilous as well as futile. No rules, therefore, respecting Great Circle Sailing find place in this book.

# CHAPTER II.

## NAUTICAL ASTRONOMY.

### *Introductory Observations and Definitions.*

(84.) BEFORE we give rules for finding the situation of a ship at sea by observations on the heavenly bodies, it is necessary to say something on the places and motions of these bodies, and to explain, as far as is consistent with the object of this treatise, the first principles of Astronomy.

The sun is a central body of great magnitude, giving light and heat to several smaller globular bodies called planets, which move round it in elliptical orbits from west to east, at different distances, and complete their revolutions in different periods of time; the more distant one of these is from the sun, the longer it is in going round. A distinct idea of the motion of each in this respect may be got by carrying in the hand a small ball round a candle in an oval-shaped curve.

The names of the said globular bodies, with the order of their distance from the sun, are as follows:—

Mercury, Venus, the Earth, Mars, Jupiter, Saturn, Uranus or the Georgian.

Between Mars and Jupiter are four other very small ones; namely, Vesta, Juno, Ceres, Pallas. These, on account of their being so small as to be invisible to the naked eye, are called *telescopic planets*.

Each of these bodies, as it describes an orbit round the sun, has a whirling motion round one of its own diameters, also from west to east; in like manner as a small ball may be turned about a needle or wire run through its centre. And these two motions, namely, the one round the sun, and the whirling motion just mentioned, occasion different seasons and alternate changes of day and night. Of these a clear idea may be got by the following simple experiment. Run a needle through the centre or middle of a small ball, as an apple or an orange; incline one end of the needle towards the flame of a candle. By this it will be seen, that the light of the candle shines more directly, and with greater lustre, on the half of the ball inclined towards it, than on the half reclined from it. This excess of light and heat may be called *summer* on that part; and the defect on the other, *winter*. Carry the ball round the candle to the opposite side, keeping the needle parallel to its former position. The side before turned *from* the candle will now be inclined *towards* it; where it was summer before, there will now be winter; and where it was winter, it will now be summer. At the middle points between the two positions just mentioned, as the ball is carried round the candle with the needle always parallel to its first position, neither extremity of the needle will be turned towards the light; the two halves or hemispheres of the ball will be equally illumined.

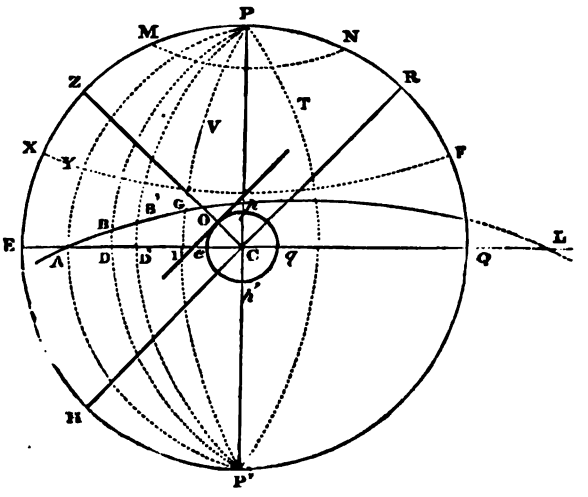
By turning the ball round the needle, in different positions, as it is carried round the candle, we may see that points on the surface will be a certain time in the light, and the remainder of their revolution in the shade. Thus is produced the change of day and night. Those parts where it is summer will thus appear to have longer days than nights, and where neither extremity of the needle is turned towards the light, all spots on the surface will have equal days and nights.

What is thus simply shewn in the above manner is actually experienced on the globular planets which revolve round the sun. Thus on the earth, when the hemisphere which we inhabit is turned towards the sun, we have the greatest heat, and the days are longer than the nights. This season is called our *summer*. Half way between two successive summers, our hemisphere is reclined from the sun; we have then the least heat, and the days shorter than the nights. This season is called our *winter*. At intermediate times, we have a mean or average heat, and the days and nights are equal.

Not being sensible of the earth's rapid motion round the sun, in any other way than by observing the sun to shift its apparent place in the celestial concave about us, we imagine the earth to rest, and the sun to move; and in fact the same effect would be produced either way. Instead of carrying the small ball round the candle, as described above, carry the candle round the ball, taking care to move it in an orbit inclined to the needle run through the middle of the ball. By doing this and turning the ball round the needle, the same appearances as before will be observed.

Not being sensible of the whirling motion of the earth, except by observing the heavenly bodies, the sun, moon, and stars, to pass in the opposite direction every day, we are apt to imagine the earth to rest in this respect also, and the bodies just mentioned, every day to rise, pass over the earth, and set.

Let the needle run through the ball be supposed to be produced both ways, as $pp'$ in the figure is produced into $PP'$; then, let a concave surface,



like the top of an umbrella extended into a concave globular surface, inclose the ball in the middle. By turning the ball round independently of the exterior concave, the same effect will apparently take place as if the exterior concave turned round the needle produced the contrary way, the interior ball having no whirling motion at all. This may be satisfactorily shewn by actually using, as just described, any small ball and an umbrella. But it will be seen also from the annexed figure. The spectator is supposed to be placed at O, on the small sphere *pep'q*, which revolves from left to right round *pp'*. In consequence of this whirling motion, the celestial concave, PEP'Q, will appear to revolve round a line PP' (which is *pp'* produced) the contrary way, that is, from *east* to *west*. For let *pep'q* be a section of the earth passing through *p* and *p'*, and through O the place of the spectator, and let *pep'q* be supposed to be extended into the circle PEP'Q on the celestial concave. Then as *pep'q* revolves from left to right (or from west to east), PEP'Q must revolve with it, and would really pass through the heavenly bodies X, Y, V, T, &c., successively; but as the spectator passes on with the same angular velocity round PP' that PEP'Q does, he is not sensible of this motion in PEP'Q, but is led to imagine that the motion is in X, Y, V, T, &c., the contrary way; and as P and P' are stationary, each of these bodies must keep constantly the same distance from these points: in other words, they must appear to describe circles, some greater and some smaller, but all in the same time (24 hours), round these points or poles; which is exactly what they would do, if placed on the celestial concave revolving round PP' from *east* to *west*.

Bodies seen near P or P' will describe small circles, and appear to move slowly: those seen near E or Q will describe large ones, and appear to move more rapidly.

(85.) In the above articles, the heavenly bodies have been supposed to be situated on the surface of the celestial concave; but they only appear so: for in fact they are situated at different distances from the spectator, and thus interspersed in infinite space. We imagine them to be equally distant from us, because we have no means of estimating by the eye their relative distance; in like manner as we suppose lights in the night to be at equal distances, though one may be 100 yards from us, and another a mile or two. The greatest part of the shining bodies we thus see on the celestial concave preserve constantly the same situation with respect to each other, and are thence called *fixed stars*. Several others appear to change their places among the fixed stars: these are the sun, the moon, the planets (or bodies moving round the sun like the earth), and comets*. Their apparent motion depends on their own real motion, and also on that of the earth from which they are viewed. The sun seems to describe a great circle in the course of a year among the fixed stars; this is owing entirely to the real motion of the earth round the sun in that time, at a distance of about 94 millions of miles: the moon is seen to describe an orbit among the fixed stars, round the earth, in a month; and it really moves round the earth in an elliptic orbit in that time, at the distance of 240 thousand

* Comets are bodies which seem to consist of vapour with a denser nucleus in the middle thereof, and describe round the sun very excentric orbits, that is, very narrow elliptic orbits. At one extremity of such orbits, they approach very near to the sun, and at the other pass off to a very great distance.

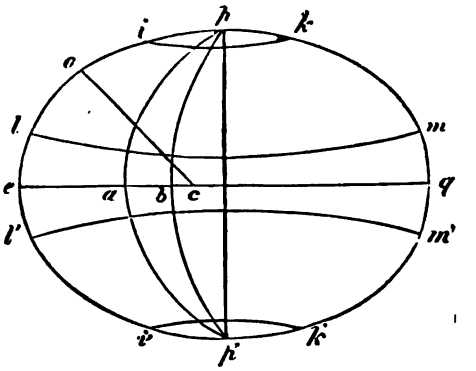
miles. The planets have irregular motions, sometimes progressive, sometimes retrograde, among the fixed stars; and they are sometimes stationary. This is owing to their real motion round the sun, and to that of the earth with them round the same central body. Thus an apparent motion in them is caused by the earth's motion, and another by their own real motion: these are sometimes in the same direction, and sometimes in opposite directions, which accounts for the irregularity just mentioned.

After the above general observations, it will be proper to give the principal definitions used in Astronomy.

## *Definitions.*

(86.) The *axis* of the earth is that diameter round which it revolves every twenty-four hours, from west through south (Art. 5) to east. Thus $pp'$ may be considered as the axis of the earth $pep'q$.

The extremities of this axis on the surface of the earth are called the poles of the earth: thus $p$ and $p'$ are the poles of $pep'q$.




(87.) That great circle on the surface of the earth, which is equidistant from each pole, and cuts the earth into two equal parts, is called the *terrestrial equator*. This is represented by $eo$.

The axis of the earth is manifestly perpendicular to the terrestrial equator.

The earth has been supposed to be a sphere in the preceding general observations; but by its whirling motion, the parts near the equator, which have the greatest velocity, acquire thereby a greater distance from the centre than the parts near the poles, which have a less velocity in turning round the axis. In consequence of which, the earth assumes the shape of the annexed figure; $eq$ being the equator, and $p$ and $p'$ the poles. The curvature towards $p$ and $p'$ is less than towards $e$ and $q$ (see *App.* 3).

(88.) Sections of the earth passing through the axis $pp'$, as $pap'$, $pbp'$, &c., are called *Meridians*. They are denominated frequently from places through which they pass: thus, if Greenwich be situated on the meridian $pap'$, this is called the meridian of Greenwich. The arc of the equator or the angle at the pole between the meridian of Greenwich and the

meridian of any other place is called the *longitude* of that place. Thus *ab* or the angle *apb* is the longitude of any place on the meridian *pbp'*.

Longitude is reckoned both ways from *a*, that is, both to the east and west. Thus one place is said to be in the longitude of 20° E., and another in that of 20° W.

(89.) If a perpendicular be drawn to the surface of the earth where the spectator stands, and produced to cut the plane of the equator, the angle it makes with the equator is called the *latitude*. Thus, let *o* be any place and *oc* the perpendicular cutting the equator at *c*; then the angle *oce* is the latitude of *o*.

Since the surface at *o* is in a slight degree more curved than the surface towards *p*, the point *c* will not be exactly in the centre of the earth; neither will the arc *oe* be exactly circular so as to measure the angle *oce*. It is usual, however, in general language, to consider *oe* as a circular arc; and the *latitude* of any place is said to be the arc of the meridian of that place, intercepted between the place and the equator (see *App.* 4).

Supposing *co* and *ce* be produced to cut the celestial concave, as in Z and E (fig. Art. 84), the circular arc ZE would measure the angle at *c*, and would therefore be strictly the latitude of *o*, considering the earth as it really is, a *spheroid*. If a straight line were drawn from the centre of the figure (Art. 86) to *o*, and produced so as to cut the celestial concave in some point as Z', then Z'E would be called the latitude of *o* on the *sphere*; since, supposing the figure to be a sphere, the line joining *o* and the centre would be perpendicular to the surface at *o*: this is called the *reduced latitude*, being less than the true latitude by a small quantity called the *reduction* (see *App.* 3, 4).

(90.) Sections of the earth parallel to the equator are called *parallels of latitude*. Such sections are supposed to be circular. Thus *ik*, *lm*, are parallels of latitude north of the equator; and *i'k'*, *l'm'*, are parallels of latitude south of the equator.

Two parallels of latitude, one on each side of the equator at the distance of about 23° 27', are called *tropical circles*: these may be represented by *lm*, *l'm'*. Two others at the same distance from the poles, as *ik* and *i'k'*, are called *polar circles*.

(91.) These four parallels divide the surface of the earth into five zones, namely, the torrid zone, the two temperate zones, and the two frigid zones. The torrid zone lies between the tropical circles *lm* and *l'm'*; the temperate zones lie between the tropical and polar circles, as between *lm* and *ik*, and between *l'm'* and *i'k'*; the frigid zones lie towards the poles within the polar circles.

(92.) The celestial concave or surface, in which the fixed stars and all the heavenly bodies are seen, is supposed to be at such a distance from the spectator, that two straight lines drawn to the same point therein from any places of two spectators make no sensible angle there. Such lines, therefore, may be considered as parallels. The nearest fixed stars are, in reality, at such a distance from the earth, that lines drawn to any one of them from opposite points of the earth's orbit have no sensible inclination. This has been determined by accurate observations. Also straight lines actually parallel to each other, drawn from any places of two spectators, may be considered as meeting in a point on the same spherical concave.

(93.) The *axis of the heavens* is the axis of the earth, produced both ways to the celestial concave. That extremity of it which is towards the north pole of the earth is called the north pole of the heavens: the other is called the south pole. Thus in the figure Art. 84, PP′ is the axis of the heavens, P and P′ the north and south poles.

The earth, in describing its orbit round the sun, keeps its axis always in the same position or parallel to itself. Consequently this axis must always cut the celestial concave in the same points (92).

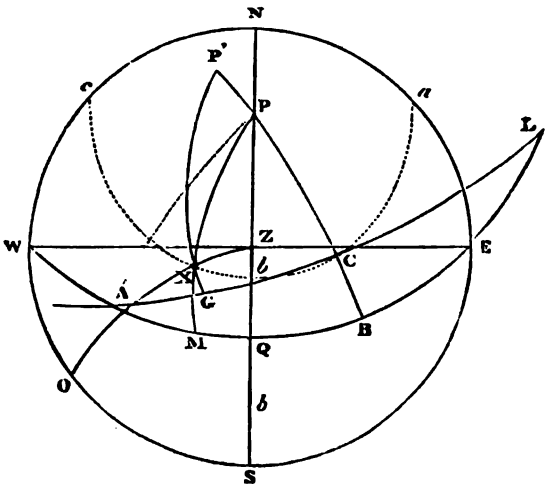
This is independent of a slight deviation from parallelism in the axis of the earth, which will be noticed hereafter.

(94.) The terrestrial equator extended to the celestial concave is called the *celestial equator*. In the figure Art. 84, *eq* represents the terrestrial equator, and EQ the celestial equator.

The earth in describing its orbit round the sun keeps the terrestrial equator always parallel to itself; consequently the circle which is formed on the celestial concave, by the extension of the earth's equator, must be always the same, and may therefore be considered as a permanent circle on the celestial concave.

This also is independent of slight deviations to be noticed hereafter.

(95.) In consequence of the earth's actual motion round the sun in the same plane, the sun appears to describe a circle on the celestial concave; and as the circle is in the same plane with the earth, it must be a great circle. This circle is called the *ecliptic:* it is represented in the figure by ACL.




The ecliptic is inclined to the equator at an angle, as determined by observation, of about 23° 27′; and these two circles cut each other at two opposite points: one near the constellation, or cluster of stars, Aries, and

thence called the *first point of Aries;* the other near the constellation Libra, and thence called the *first point of Libra.*

Let ABL be half the celestial equator, and ACL the corresponding half of the ecliptic, A the first point of Aries, and L the first point of Libra. Let AB and AC be respectively half ABL and ACL, or quadrants. Then a great circle BC must be perpendicular to ABL and ACL, and must pass through the poles of both. Let P be the pole of the celestial equator, and P′ that of the ecliptic. Then since PB is a quadrant, and also P′C is a quadrant, it is manifest, by taking the common part PC from each, that the remainders PP′ and BC must be equal.

Also BC measures the angle A (about 23° 27′); consequently PP′ measures it also, or is the same number of degrees, minutes, &c., as angle A.

Let X be the place on the celestial concave, where any heavenly body is seen; PXM, P′XG great circles cutting the celestial equator and the ecliptic in M and G. Then XM is called the *declination* of the body, and AM or angle APM its *right ascension* (marked R.A.); XG is called the *latitude* of the body, and AG its *longitude.*

(96.) Hence great circles passing through the pole of the heavens are called *circles of declination;* and great circles passing through the pole of the ecliptic are called *circles of latitude.*

Small circles parallel to the celestial equator are called *parallels of declination.* Small circles parallel to the ecliptic are called *parallels of latitude.*

(97.) The *declination* and *right ascension* of a heavenly body may be defined thus:—

The *declination* of a heavenly body is the arc of the circle of declination passing through its place in the celestial concave, intercepted between this place and the celestial equator. The *right ascension* (R. A.) of a heavenly body is the arc of the celestial equator measured from the first point of Aries to the circle of declination passing through the place of the body in the celestial concave: or it is the angle at the pole between the equinoctial colure (see Art. 100) and the circle of declination passing through the body's place—measuring round the equator or the pole in the direction of from west through south to east.

(98.) The *latitude* and *longitude* of a heavenly body may be defined as follows:—

The *latitude* of a heavenly body is the arc of a circle of latitude passing through its place in the celestial concave, intercepted between this place and the ecliptic. The *longitude* of a heavenly body is the arc of the ecliptic intercepted between the first point of Aries and the circle of latitude passing through the place of the body—measuring on the ecliptic from west through south to east, or in direction of the earth's motion round the sun.

(99.) The zone which extends 8° on each side of the ecliptic, is called the *zodiac.* In this zone nearly all the planets appear to make their revolutions among the fixed stars. The zodiac is supposed to be divided into twelve equal parts, each extending 30° on the ecliptic. These parts

are called *signs*, and are denominated from constellations or clusters of stars, which lie near them. They begin at the first point of Aries, and are as follows :—

*North of the Celestial Equator.*

| *No*..... | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| *Name*.... | Aries. | Taurus. | Gemini. | Cancer. | Leo. | Virgo. |
| *Character.* | ♈ | ♉ | ♊ | ♋ | ♌ | ♍ |

*South of the Celestial Equator.*

| *No*..... | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|
| *Name*.... | Libra. | Scorpio. | Sagittarius. | Capricornus. | Aquarius. | Pisces. |
| *Character.* | ♎ | ♏ | ♐ | ♑ | ♒ | ♓ |

Each quadrant of the ecliptic must contain three signs, so that the point which is the farthest north from the celestial equator is the commencement or first point of *Cancer;* and the point farthest to the south of the celestial equator, for a similar reason, must be the first point of *Capricorn*. These points are called *solstices* or stationary points of the sun, because here the sun appears neither to advance to the north nor south.

(100.) The circle of declination which passes through the first points of Aries and Libra, that is, through the intersections of the ecliptic with the celestial equator, is called the *equinoctial colure*. The circle of declination which passes through the first points of Cancer and Capricorn, and consequently through the pole of the equator and that of the ecliptic, is called the *solstitial colure*.

(101.) The two parallels of declination which pass through the first point of Cancer and that of Capricorn are called *tropical circles;* the two parallels of declination, at the same distance from the poles of the heavens which the tropical circles are from the celestial equator, are called the *polar circles*. They pass through the poles of the ecliptic, which are at this distance from the poles of the heavens.

(102.) A circle touching the earth where the spectator stands, and extending to the celestial concave, is called the *visible horizon*. This is represented in fig. Art 84, by the line touching the earth at O, and supposed to be produced both ways to the celestial concave.

A circle parallel to the visible horizon, which passes through the centre of the earth, and extends to the celestial concave, is called the *rational horizon*. Thus in the fig. HCR, Art. 84, represents the rational horizon.

These two circles, as is manifest from the observations in Art. 92, form one and the same circumference on the celestial concave. Wherefore either of them is to be understood by the word *horizon*, in speaking of the situation of points on the celestial concave.

(103.) If a perpendicular to the visible horizon be erected at the spot where the spectator stands on the earth, and be produced both ways upwards and downwards, so as to cut the celestial concave in two points, the point above the spectator, that is, over his head, is called the *zenith*; that downwards in the invisible celestial concave is called the *nadir*.

In fig. Art. 84, O is the place of the spectator on the earth's surface, OZ is supposed perpendicular to the visible horizon at O, or to the rational horizon HR, and cuts the concave sphere upwards at Z; then Z is the zenith of O. If ZO were produced downwards through the earth to cut the celestial concave, we should have the nadir.

When the spectator stands at the pole of the earth, the zenith and nadir will evidently coincide with the poles of the heavens; when the spectator is at the terrestrial equator, the zenith and nadir must be in the celestial equator; when he is at any intermediate point between the terrestrial pole and equator, the zenith and nadir will be situated between the celestial poles and the celestial equator, as in fig. Art. 84.

(104.) It is usual to describe a circle to represent the visible or rational horizon (fig. Art. 95), as NWSE, and to take the centre Z to represent the place of the spectator and also the zenith of that place. The zenith is in fact in the celestial concave immediately over the spectator, but for the facility of construction it is put down on the circle itself, at the point which is truly the place of the spectator. Let the pole of the heavens be also represented on the same circle by P: draw PZ, and produce it to cut the horizon at N. and S. Then the line NPZS will represent the line RPZH in fig. Art. 84.

Since NPZS passes both through Z, the pole of the horizon, and through P, the pole of the celestial equator, both these latter circles must be perpendicular to NPZS, and consequently their points of intersection must be 90° from NPZS. Let therefore W and E be each 90° from S; then the representation of the celestial equator must pass through W and E. Let this representation be EQW cutting NPZS in Q. Then ZQ will be the same as ZE in fig. Art. 84, PZ the same as PZ in fig. Art. 84, and PN the same as PR in fig. Art. 84: that is, ZQ will be the *latitude* of the place where the spectator stands on the surface of the earth; PZ being the complement of ZQ, will be the *colatitude*. Also PN will be the altitude of the pole above the horizon. And since NZ is 90°, PZ is the complement of PN: but PZ is also the complement of ZQ; wherefore PN is equal to ZQ, that is, PN is the latitude of the place of the spectator.

The circle represented by NPZS, which passes through Z the zenith and P the pole of the heavens, is called the *celestial meridian*. It cuts the horizon at two opposite points. That point which lies towards the north pole (which we may suppose P to be) is the *north*, and marked N.; the other which is towards the south pole is the *south*, and marked S.

If the spectator on the surface of the earth look to the south, he sees the heavenly bodies rising above the horizon on the left, and setting on the right. That point of the horizon which is 90° from the north and south towards the left or rising of the heavenly bodies, is the *east*, and marked E.: that point on the horizon which is 90° from the north and south towards the right or setting of the heavenly bodies, is the *west*, and marked W. Hence it is manifest that W. and E. (fig. Art. 95) are the West and East points.

It is evident that the west point is opposite to the east, so that a great

circle passing through the zenith and one of these points passes also through the other. Such a circle as WZE is called the *prime vertical.*

Let X be the place of a heavenly body in the celestial concave, and let a great circle passing through the zenith Z and the place of the body at X cut the horizon at O: then XO is called the *altitude* of the body; NO or SO is called the *azimuth* of the body.

Hence great circles passing through the zenith are called *circles of altitude* or *vertical circles*; and the altitude and azimuth of a heavenly body may be defined as in the following articles.

(105.) The *altitude* of a heavenly body is the arc of a circle of altitude intercepted between the place of the body in the celestial concave and the horizon. The *azimuth* is the arc of the horizon intercepted between the north or south point, and the circle of altitude passing through the place of the body: or it is the corresponding angle at the zenith between the celestial meridian and the circle of altitude passing through the place of the body.

The *amplitude* of a heavenly body is the distance from the east at which it rises, or the distance from the west at which it sets; these distances or arcs being measured on the horizon: or it is the corresponding angle at the zenith between the prime vertical and the circle of altitude passing through the place of the body.

(106.) It will be of great use to the student, before he proceed farther, to represent on such a figure as in Art. 95 as many of the arcs as possible which have been defined above, under different circumstances with respect to the latitude of the place he is supposed to stand at, as well as to the situation in the celestial concave of the heavenly body. It will be of still greater use to him to compare the figure when completed with the celestial globe, adjusted to the latitude of the place by raising the pole to an altitude equal to the latitude; putting a small piece of wetted paper at a spot on the globe corresponding nearly to the place assumed for X in the figure, in right ascension and declination.

### *Apparent Time, Mean Time, and Sidereal Time.*

(107.) As the earth turns round its axis from west to east, we may suppose the celestial meridian of any place on its surface to revolve with it. Thus let *pep'* (Art. 84) be the meridian of any place on the surface of the earth, and PEP′ the corresponding celestial meridian. As *pep'* revolves round the terrestrial axis *pp'*, let PEP′ revolve in the same direction, that is, from E towards Q, round PP′ the axis of the heavens. Then PEP′ in thus revolving will pass through heavenly bodies, as A, B, G, &c., in order, from west to east; and after describing or tracing out the whole celestial concave round PP′, the celestial meridian will return to the same position as at first, namely, PEP′.

Instead of supposing the celestial meridian thus to revolve round the axis of the heavens eastward, to pass the circle of declination of any heavenly body, as the sun, and make greater and greater angles with it at the pole, we may suppose the celestial meridian of the place to be fixed, and the circle of declination of the heavenly body to revolve with the body westward, increasing the polar angle as before. This supposition will perhaps be more convenient in giving easy definitions of *apparent time*, *mean time*, and *sidereal time*.

(108.) *Apparent Time* is the polar angle (in time*) described westward from the celestial meridian of the place by the circle of declination passing through the centre of the *true* sun.

(109.) *Mean Time* is the polar angle (in time*) described westward from the celestial meridian of the place by the circle of declination passing through the *mean* sun.

(110.) The *true* sun is that which is seen by the eye. Its motion from west to east in right ascension is variable, so that the intervals of different complete revolutions of the circle of declination passing through it, *from* the celestial meridian to the celestial meridian again, are unequal. The unequal intervals are called *apparent solar days*. They begin and end when the true sun's centre is on the meridian. The *mean* sun is an imaginary sun, moving uniformly from west to east in right ascension with the mean or average motion of the *true* sun, and beginning its course along the celestial equator at a particular period.

The motion of the *mean* sun in right ascension or in polar angle being uniform, it follows that the different intervals of complete revolutions of the circle of declination passing through it from celestial meridian to celestial meridian again must be equal. These equal intervals are called *mean solar days*. They begin and end when the mean sun's centre is on the meridian.

(111.) The *equation of time* is the difference between apparent time and mean time. It amounts at most to about 16 minutes, and is nothing four times in the year.

(112.) *Sidereal Time* is the polar angle (in time*) described westward *from* the celestial meridian of the place by the circle of declination passing through the *first point of Aries* or the equinoctial colure, Art. 100.

A *sidereal day* is the interval in which the equinoctial colure makes a complete revolution westward from the celestial meridian to the celestial meridian again. It begins and ends when the first point of Aries is on the meridian.

(113.) In fig. Art. 84, if B be the true sun, D′ the mean sun, A the first point of Aries, and PT the celestial meridian of the place, the angle BPT (in time) will be *apparent time*, D′PT (in time) will be *mean time*, and APT (in time) will be *sidereal time*. Here the left-hand side of the figure is supposed to be the west, and the right-hand side the east.

By inspecting the figure, it is evident that sidereal time is the same as the right ascension of the meridian: for the angle APT is in fig. Art. 84 the right ascension of the meridian PT (see Art. 97).

It thus appears also that *sid. time* = *app. time* + *true sun's* R.A. (in time); and that *sid. time* = *mean time* + *mean sun's* R.A. (in time). For angle APT = BPT + APB, and also APT = D′PT + APD′.

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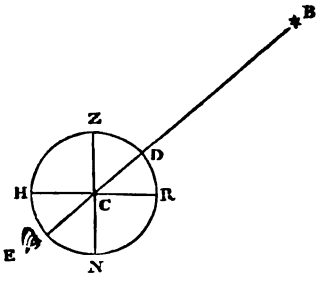
* An angle or arc is expressed in time by allowing $24^h$ for 360°; that is, $1^h$ for 15°; $1^m$ for 15′; $1^s$ for 15″, and so on in proportion. When an angle or arc is thus expressed, it is said to be *in time*; when expressed in ° ′ ″ it is said to be *in arc*. One may be turned into the other very readily by means of the Table of *Log. Haversines* (see *Naut. Tables*).

If the sum be greater than $24^h$, then $24^h$ must be rejected: this will appear manifest by constructing a figure to suit such a case. (See *Aop.* 12.)

(114.) *Apparent time* is shewn by a *sun-dial*; which, when the true sun's centre is on the celestial meridian of the place, throws the shadow of the stile on $0^h$ or $12^h$. *Mean time* is shewn by a clock or watch properly adjusted to go $24^h$ uniformly in a mean solar day, and to begin from 0 when the centre of the mean sun is on the celestial meridian. *Sidereal time* is shewn by a clock or watch adjusted to go uniformly $24^h$ in a sidereal day, and to begin from 0 when the first point of Aries is on the meridian.

(115.) The *Hour Angle* of a heavenly body is the angle at the pole (measured west or east) between the celestial meridian and the circle of declination passing through the place of the body: thus in fig. Art. 95 ZPX is the hour angle of X, and ZPC is the hour angle of C.

(116.) The transit of a heavenly body over the celestial meridian, or of the celestial meridian through the body, has been mentioned in the foregoing observations: it may not be amiss to say a few words here on the method of ascertaining this transit. Let a thin circular board ZHNR be supposed to be placed in the plane of the celestial meridian at the place of the spectator, and a vertical and horizontal line ZN and HR to be drawn upon it. Let the spectator's eye be placed at E on the edge of the board, and his view be directed along the surface of the board in the line ECD. This circular board placed in the plane of the meridian would revolve with the earth; and to the eye at E a heavenly body B would be seen passing the edge of the board as at D, when it passed the celestial meridian. And thus by shifting the eye round the semicircle HNR, the transit of every heavenly body above the horizon might be observed. And not only the time of the meridian transit might be taken, but also the altitude above the horizon: for, supposing the edge of the board to be graduated, DR would be the meridian altitude at which B would pass; also ZD would be the meridian zenith distance.




The circular board, instead of being placed in the plane of the celestial meridian, may be supposed to be placed in the plane of any circle of altitude whatever, in which case DR would be the altitude of B.

Let now ED be supposed to be a telescope lying on the flat side of a brass circular instrument. Let a fine wire be fixed within this telescope parallel to the said flat side, and be distinctly visible to an eye at E. Suppose that the circle can be turned in its own plane round a *horizontal axis* passing through C perpendicularly to the paper, and let the telescope be capable either of being fastened to the circle so as to turn with it, or of being unfastened and turned round the same horizontal axis independently of the circle.

The wire in the telescope, and the axis or middle line of the telescope (supposed to pass through the wire), are adjusted so as to be exactly parallel to the plane of the circle, and at the same time so as to be constantly in the plane of the celestial meridian, as the telescope is turned round.

The rim of the circle is graduated, so that the position of the axis of the telescope is known by observing the place of an index attached to the eye end and lying close to the said rim. The wire represents any portion of the celestial meridian to which it is directed; so that, when a heavenly body as a star is seen on the wire, it is known to be on the celestial meridian: the index on the rim of the circle shewing at the same time its meridian altitude or its meridian zenith distance.

A telescope by itself without the circle, adjusted as above, is called a *transit telescope*. Such a one is used *only* for taking the meridian transits of heavenly bodies. When a graduated circle is added, the instrument is more especially used for measuring meridian altitudes or meridian zenith distances. These two instruments, together with a clock going according to sidereal time (112), form the main instruments in an observatory on shore.

In some cases the whole combined instrument, or circle and telescope, is constructed and adjusted so as to turn also round a vertical axis, and thus the wire may be brought not only into the plane of the meridian, but also into the plane of any circle of altitude whatever. By means of such an instrument both the azimuth (105) and altitude (104) of a heavenly body may be observed at the same instant.

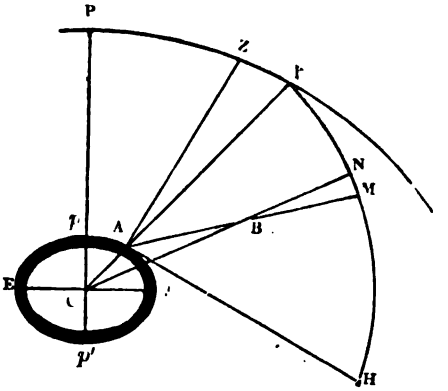
## *Parallax and Refraction.*

(117.) The place of a heavenly body as seen, or rather supposed to be seen, from the centre of the earth, is called its *true* place; thus the altitude of the moon, its right ascension, declination, &c., seen from thence, are called the true altitude, the true right ascension, and true declination of the moon. Again, the place of a heavenly body as seen from any point on the earth's surface is called its *apparent place*. Thus the altitude of the moon, its right ascension, declination, &c., seen from the earth's surface, are called its apparent altitude, apparent right ascension, apparent declination, &c.

The true and apparent places of a heavenly body differ on account of *parallax* and *refraction*.

### *Diurnal Parallax.**

(118.) *Diurnal Parallax* is the arc on the celestial concave between the place of any heavenly body as seen from the surface of the earth and its place as seen from the centre, supposing no refraction to exist. Let $pEpQ$ be the earth, C its centre, A the place of the spectator on the surface, and B any heavenly body. Then, on the supposition that rays of light coming from B pass to A and C in straight lines, the spectator at C would see B in the celestial concave at N; the spectator at A would see it at another place M. The arc of a great circle between M and N, or the angle




* The arc between the places of a heavenly body, as seen from opposite points of the earth's orbit round the sun, is called *annual parallax*.

MBN or ABC, which MN measures, is called the *diurnal parallax* of B Let CA the radius of the earth, when produced, cut the celestial concave in X which is called the *reduced zenith*, and let the polar radius of the earth, when produced, cut it in P, which is the pole of the heaveus. Then, since the great circle passing through M and N must pass through AB and BC, it must also pass through CAX, and therefore through X. That is, diurnal parallax MN lies in a great circle XNM, and the apparent place (as far as diurnal parallax is concerned) is farther from X than the true place is, by MN.

Let CB, the distance of B from the centre of the earth, be denoted by $d$; CA a radius of the earth by $r$; the diurnal parallax MN or angle ABC by $p$; the arc XN or angle XCN, that is, the *true reduced zenith distance* by $z'$; and the arc XM or angle XAM, that is, the *apparent reduced zenith distance*, by $z$. Then $p = z - z'$: and $\frac{r}{d} = \frac{\sin \text{ABC}}{\sin \text{CAB}} = \frac{\sin \text{ABC}}{\sin \text{XAM}} = \frac{\sin p}{\sin z} = \frac{\sin (z - z')}{\sin z}$. Now, the value of $p$, when the body appears in the horizon, or $z = 90°$, is called the *horizontal parallax*, which may be denoted by H. Hence, since in this case $\sin z = 1$, we have

$$\sin \text{H} = \frac{r}{d} = \text{(generally)} \quad \frac{\sin p}{\sin z} = \frac{\sin (z - z')}{\sin z} \quad . \quad . \quad . \quad . \quad (1)$$

$$\text{consequently } \sin (z - z') = \sin \text{H} \sin z \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If for $\sin p$, $\sin$ H, $\sin (z - z')$, which are small, $p'' \sin 1''$, $\text{H}'' \sin 1''$, $(z - z')'' \sin 1''$, be severally substituted; $p$, H, and $(z - z')$ being expressed in seconds of arc; and then the resulting equations be divided by $\sin 1''$; we have

$$\text{H}'' = \frac{r}{d} \cdot \frac{1}{\sin 1''}; \quad \text{H}'' = \frac{p''}{\sin z}; \quad p'' = \text{H}'' \sin z;$$

$$\text{H}'' = \frac{(z - z')''}{\sin z}; \quad (z - z')'' = \text{H}'' \sin z \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

The above equations at (1), (2), (3) will be very nearly true, supposing X to be the *true zenith*, that is, the zenith on the earth considered as a spheroid: in other words, supposing XAC to be perpendicular to the surface of such spheroid at A.

(119.) Let AZ be perpendicular to the surface of the earth at A, and let it cut the celestial concave in Z, which is the *true zenith*. Then Z must be near X, since the earth is *nearly* a sphere. Moreover, since the earth is considered as a regular spheroidal body, having the flatter part of its surface towards the pole, AZ must be in the plane of the meridian CPX, and Z must be nearer to P than X. In most nautical questions X may be considered as the true zenith Z; in some computations, however, this cannot be done, as in determining the longitude by occultations, &c.

(120.) The arc PZ is the colatitude on the spheroid, and PX is the colatitude on the sphere whose radius is CA. It is usual to call the latitude on the spheroid, that is, the angle *oce* (fig. Art. 86), or the complement of PZ (Art. 95), the *true latitude*; and to call the latitude on the sphere whose radius is CA, that is, the complement of PX, the *reduced*

*latitude*. When it is necessary in particular computations to use the *reduced latitude*, it is got from the true latitude by subtracting the arc ZX, called the *reduction*, therefrom ; which reduction is known supposing the figure of the earth to be known. (See *App.* 4.)

(121.) The *horizontal parallax* of a heavenly body, that is, its diurnal parallax, when its app. zen. dist. independently of refraction is 90°, is determined by particular astronomical observations at different points of the earth's surface. For any other app. zen. dist. it is computed from the equation $p'' = H'' \sin z$ (Art. 118, (3)), where $p''$ = diurnal parallax, $H''$ = hor. par., and $z$ = app. zen. dist. The results are inserted in tables, from which they may be taken by inspection for any given app. zen. dist. or any given app. alt. They are generally, for the purposes of navigation, combined with the effects of refraction in altering the altitude of a body, so that the combined effect of both may be taken out of the tables at once (see Naut. Tables (*m*) and (*w*) ).

(122.) From first formula at (3), namely, $H'' = \frac{r}{d} \cdot \frac{1}{\sin 1''}$, it appears (supposing the distance of a heavenly body to remain unchanged) that the horizontal parallax H must be the greatest where the radius of the earth or $r$ is the greatest, which is at the earth's equator;* and that it must diminish continually as the observer changes his place from the equator towards the pole, because the radius of the earth or $r$ does so ; at the pole $r$ is the least, consequently the horizontal parallax of a heavenly body at a given distance is also the least there. The polar horizontal parallax for the moon is about 12′ less than the equatorial horizontal parallax. What the hor. parallax at any place is less than the equatorial hor. parallax is called the *reduction*. (See *App.* 5.)

It appears also from the same formula, when $r$ is considered as given, or for a fixed point on the earth's surface, that, the less the distance of a heavenly body or of $d$, the greater must be the value of H the horizontal parallax; and the greater $d$ is, the less is the horizontal parallax. Thus the horizontal parallax of the moon is greater than that of any other heavenly body, because the moon is the nearest body to the earth. For a fixed star, which is at an immeasurable distance from the earth, the horizontal parallax is insensible.

The horizontal parallax of the moon alters its value, since the moon's distance is variable. At the nearest approach of the moon it is about 61′ 29″. When the moon is farthest from the earth it is about 53′ 50″. The sun's horizontal parallax also changes in a slight degree, for a similar reason.

From the third of the formulæ at (3), namely $p'' = H'' \sin z$, it appears that, if we suppose H to be the same or unchanged, the diurnal parallax or parallax in altitude will be the greatest when the apparent zenith distance or $z = 90°$, because then $\sin z$ is the greatest; and it will diminish as the apparent zenith distance diminishes, or the apparent altitude increases, because $\sin z$ thus becomes less and less. When the zenith distance is 0, or the body appears in the zenith, $\sin z = 0$, and the parallax in altitude is nothing.

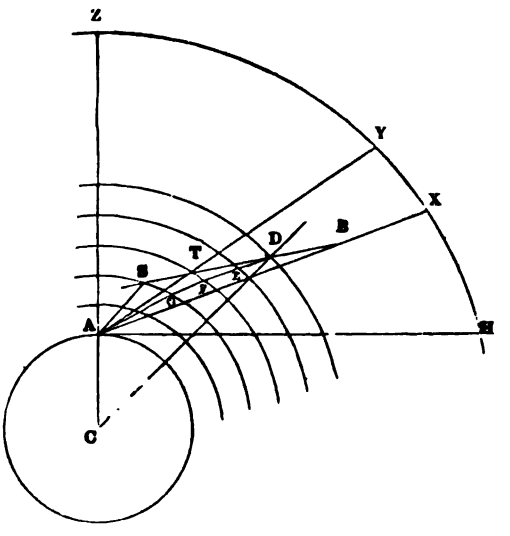
* The *equatorial* hor. par. is put down in the Naut. Almanac, and, in strictness, should always be diminished by reduction in Naut. Table (*g*).

## *Refraction.* (See *App.* 6.)

(123.) In the above observations on diurnal parallax, rays of light by which vision is produced have been supposed to come from a heavenly body to the eye of a spectator in straight lines, and the difference in the place of a body, as seen from the surface and centre of the earth, has been supposed to arise only from difference of situation in the observer. And under this partial view of the subject, the terms *apparent* place and *true* place have been used. But in fact rays of light do not always proceed in straight lines: for when they pass into the atmosphere of the earth obliquely, in their transit to the spectator on the earth's surface, their direction is in a slight degree changed, and the more so the farther they penetrate the atmosphere; so that, in entering the spectator's eye after these deviations, each makes an impression in a different direction from a straight line drawn to the true place of the heavenly body. The consequence is, that the apparent place of the body is changed, when thus seen from the surface of the earth. But rays of light passing from the heavenly body to the centre of the earth enter the earth's atmosphere perpendicularly, in which case they pass through it without varying their direction at all. No change, therefore, is made by the earth's atmosphere in the place of the heavenly body as seen from the earth's centre.

The change produced on the apparent place of the body by the earth's atmosphere is called ***refraction***.

(124.) Let the atmosphere of the earth be represented by the space between two concentric circles A and D; and let this space be supposed to be divided into any number of concentric laminæ by the intermediate concentric circles E, F, &c. Let the air in the first lamina between D and E be considered as of uniform density; let that between E and F be also of uniform density, but, from the pressure of the superior lamina, of greater density than the former. And thus let the interposed laminæ go on increasing in density to the surface of the earth at A.




Suppose now a ray of light from the heavenly body B to enter the atmosphere at D, making at that point an acute angle with its surface towards the horizon AH, and an obtuse angle with it towards the zenith Z. Then it is well known, from the principles of optics, that this ray, after entering the surface at D, will move on in a direction as DE, making a

larger acute angle than before with the surface of the fluid, and a smaller obtuse angle on the other side. A similar effect will be produced at E, where the ray enters the second lamina of increased density; at F, where it enters the third; and so on, till it arrives at A, the place of the spectator.

It is evident, therefore, that the ray will enter the eye of the spectator at A, in a direction more approaching to a vertical line than a ray from the body would have done, if no atmosphere had existed: that is, the body will appear farther from the horizon, or at a greater altitude, than it would have done on this supposition.

If there were no atmosphere, B would be seen from A in the line AB at X; when light passes through the atmosphere it is seen at Y. The effect therefore of this bending or refraction of light, on the place of the body, is XY.

By the laws of refraction the ray BD is refracted at D in a plane passing through BD and a straight line perpendicular to the surface of the atmosphere at D, that is, in a plane passing through C, the centre of the earth.* In like manner DE must be refracted at E in a plane passing through DE and C; and so on. The ray, therefore, must enter the eye at A in a plane passing through C; and hence it is evident that the course of the ray BDEF must be in a vertical plane or circle of altitude AZH, passing through B and A. Consequently X and Y are in a vertical circle, and the body B is raised in altitude by the arc XY.

The thickness of each lamina of air from D to A has been supposed to be finite; but the same observations will be true however much this thickness is diminished: it will therefore be true, when the density of the air continually increases from D to A, that is, in the natural state of the atmosphere. In this case the line DEFGA will be a curve line, and the heavenly body will be seen by the spectator at A in the direction of a tangent to the curve at that point. (See *App.* 6.)

(125.) It is known from experiment that a ray of light does not alter its course when it enters, or rather is incident upon, any refracting medium perpendicularly. Hence, when a heavenly body is seen in the zenith at Z, so that a ray of light in coming from it in the line ZA cuts the atmospheric laminæ at right angles, in that case there is no refraction. It is also known, from experiment, that the greater the difference between the angles an incident ray makes with the surface of any medium, that is, the more acute the angle is on one side of the ray, and the more obtuse on the other, the greater will be the deviation. Now the greatest difference between these angles will take place for a visible body when it is seen in the horizon. From the zenith to the horizon, therefore, refraction will increase from nothing to its greatest value, which is about 34′.

(126.) The quantity of refraction varies with the state of the air: from experiment it is found, under other similar circumstances, to be proportional to the density of the air by which a ray is refracted. And the density is measured by its pressure and temperature. The degree of its pressure is shewn by the barometer; the degree of its temperature by the thermometer. After a table therefore has been constructed, shewing the refraction of a heavenly body at different altitudes from the horizon to the

* The earth is here considered as a sphere.

zenith for a supposed mean or average state of the air, it becomes necessary to construct other tables by which the necessary corrections (see Naut. Tab. ($z$ 4)) may be made for any particular state of the air differing from this. (See *App.* 6).

The mean state of air is assumed to be such that Fahrenheit's barometer stands at 30 inches, and the thermometer at 50 degrees.

(127.) The following astronomical phenomena are produced by the refraction and reflection of light.

Owing to the refraction of light, the sun is seen wholly at rising and setting when its lower limb is in reality 34′ below the horizon. For a ray of light, coming from a point supposed so placed, is bent, in passing through the earth's atmosphere, into a curve line, which just touches the surface of the earth where the spectator stands. Such a ray therefore enters the eye as if it came in the plane of the visible horizon, and the point of the sun from which the ray proceeds is seen apparently in the same place. The body of the sun must then be seen just above the horizon.

In a similar manner is explained the twilight, which we experience a short time before the sun is visible in the morning and after it sets in the evening. A ray of light coming from the sun 18° below the horizon of the spectator, after passing once through the atmosphere, just touches the earth, and then goes on in a line still concave to the earth till it reaches again the upper regions of the atmosphere. It is there partly reflected, and again passes down through the atmosphere to a farther point on the earth's surface, where the spectator is supposed to be placed, and where it produces a slight degree of light. The number of rays that in this manner reach this point increases, as the sun rises nearer to the horizon, and thus the light gradually increases.

It is owing to the different effects of refraction on light coming from the upper and from the lower limb of the sun, that at rising and setting it assumes an oval form, its horizontal diameter appearing greater than the vertical one. The lower side or limb is raised by refraction more than the upper, because it is nearer to the horizon; and consequently the vertical diameter is contracted, while the horizontal diameter remains nearly the same.

At the same time also, it appears to be much larger than at any other time. For the solar rays which then come to the spectator, nearly in the plane of the horizon, lose much more light than when the sun is at a considerable altitude, because they pass through a much greater space of the lower and denser strata of the atmosphere.

In consequence of this greater diminution of light when the sun is near the horizon, it appears much less brilliant in that situation than when it is higher. This gives us an idea of its greater distance. But when, of bodies subtending in reality the same angle at the eye, one appears farther from us than another, we imagine that the former is superior in magnitude. Thus, if, of two ships filling the same space on the horizon, one seems to be at a much greater distance than the other, we imagine this to be the larger.

(128). From the foregoing articles respecting parallax and refraction, it appears that on account of refraction the apparent place of a heavenly body as seen from the surface of the earth is higher, that is, nearer the zenith, than as seen from the centre of the earth. Hence, in reducing the apparent altitude to the true altitude, the effect of refraction, which may

be taken from a table, must be subtracted. Thus the altitude corrected for refraction is found. On account of parallax, the place of the body is lower as seen from the surface of the earth than from the centre; that is, the apparent altitude is less than the true. The necessary correction therefore for parallax is to be added. The table from which the correction is taken should strictly be entered with the apparent altitude corrected for refraction.

(129). The correction for refraction is taken from the same table for all heavenly bodies; the correction for parallax is taken from a separate table for each, since it depends on the distance of the body, or on the horizontal parallax, which is a measure of the distance.

(130.) In nautical questions it is usual to combine the refraction with the parallax by taking their difference, which difference is called the *correction in altitude*. This correction in altitude is taken from one table for the sun, and is subtractive, because refraction is greater than parallax; and from another table for the moon, and is for this body additive, because the parallax in altitude of the moon is greater than refraction. Each table is entered with the apparent altitude as observed, which is sufficiently exact for nautical purposes. (See *Naut. Tables* (*m*) and (*w*)).

For fixed stars the only correction applied is for refraction; since they may be considered as having no parallax.

(131.) In the following examples the corrections for refraction and parallax are first applied separately, and then together in one. They are applied only to the nearest second. (See *Naut. Tables* (*m*) and (*w*)).

| | | | |
|---|---|---|---|
| A. Alt. Sun's Cr. | 12° 42′ 17″ | 38° 45′ 29″ | 82° 20′ 16″ |
| Refraction | 4 13 | 1 13 | 8 |
| | 12 38 4 | 38 44 16 | 82 20 8 |
| Parallax | 8 | 7 | 1 |
| T. A. | 12 38 12 | 38 44 23 | 82 20 9 |

Or thus:

| | | | |
|---|---|---|---|
| A. A. Sun's Cr. | 12° 42′ 17″ | 38° 45′ 29″ | 82° 20′ 16″ |
| Corr. in Alt. | 4 5 | 1 6 | 7 |
| T. A. | 12 38 12 | 38 44 23 | 82 20 9 |
| For Moon, Hor. Par. | 60′ 17″ | 58′ 42″ | 54′ 18″ |
| A. A. Moon's Cr. | 16° 37′ 20″ | 42° 18′ 20″ | 80° 18′ 49″ |
| Refraction | 3 13 | 1 4 | 10 |
| | 16 34 7 | 42 17 16 | 80 18 39 |
| Par. | 57 47 | 43 26 | 9 9 |
| T. A. | 16 31 54 | 43 0 42 | 80 27 48 |

(137.) From the meridian altitudes of the sun, observed at both points, the inclination of the equator to the ecliptic may be found without using the latitude of the place. For if $i$ denote the inclination, $z$ the meridian zenith distance at the first point of Cancer, $z'$ that at the first point of Capricorn, $d$ the greatest declination, north or south, of the sun, and $l$ the latitude supposed north and greater than the declination; then at the first point of Cancer $d = l - z$, and at the first point of Capricorn $d = z' - l$; adding these two equations $2d = z' - z$ or $d = \frac{1}{2}(z' - z)$; that is, the inclination is equal to half the difference of the true zenith distances of the sun.

The same may be easily shewn to be true for any other latitude.

In the foregoing method of finding the inclination of the celestial equator to the ecliptic, the sun has been supposed to be at the first point of Cancer or Capricorn precisely when on the meridian of the place of observation, which can only be the case for one meridian of the earth. For others the declination observed near the solstice is reduced to the solstitial declination. And this is done for several declinations observed about that time; so that, by taking a mean of the results, the inclination in question is determined very accurately.

*Ex.* On June 21, 1825, the true meridian altitude of the sun at Greenwich was 61° 59′ 3″: required the inclination of the equator to the ecliptic; supposing the sun to have been at the first point of Cancer at the observation.

Here the true zenith distance of the sun is 28° 0′ 57″, the zenith being north of the sun; the latitude is 51° 28′ 40″ N.: hence by making a figure it will be apparent that the sun's greatest declination is 23° 27′ 43″, which is the inclination required.

### *To find the Right Ascension of the Sun.*

(138.) The declination of the sun being deduced as in Art. 134 from the meridian altitude of the sun, and the inclination of the equator to the ecliptic being known as above, we have given the angle A (see fig. Art. 84), and the side BD, to compute AD, the sun's right ascension; the sun being supposed to be between the first point of Aries and that of Libra.

In order to determine by this method the sun's right ascension with the greatest accuracy, its meridian altitude should be taken as near an equinox as possible, since then a small error in the observation will least affect the result.

### *To find the Right Ascension of a Fixed Star.*

(139.) A clock is supposed to be adjusted so as to go regularly, and also to go 24 hours in one diurnal revolution of a fixed star. This is done by taking successive transits of the same fixed star and altering the length of the pendulum till the adjustment is made. Or, what amounts to the same, and is more easy in practice, the daily gain or loss of a clock on 24 hours in this interval is noted, and an allowance is afterwards made for it.

Although the star undergoes a small apparent change of place, yet it is so small in the time of adjustment, that the clock may be considered as going exactly 24 hours in one complete revolution of the earth.

Let the time by such a clock be supposed to be taken when the sun passes the meridian, and also afterwards when the star, whose right ascen-

sion is required, passes the meridian. Then the difference of times, properly corrected, will be the difference of the sun and star's right ascensions. Hence, if the right ascension of the sun be found as in Art. 138, the right ascension of the star may be easily deduced. And thus the right ascensions of several bright fixed stars may be determined.

Again, by comparing the times when these bright fixed stars pass the meridian, with the times any other heavenly bodies pass, the right ascensions of the latter may be also found. And thus we may proceed till the right ascensions of all the fixed stars are known, and of the other heavenly bodies at their transits.

(140.) Observations made in the manner pointed out in the above articles, and their results, confirm the supposition that has been made of the sun's describing, or appearing to describe, on the celestial concave a great circle: since it is found thus that the sun passes through all the places which would be deduced from computation on such an hypothesis.

The methods by which the right ascensions and declinations of the principal fixed stars, or of any other heavenly body, may be determined for any epoch, have been mentioned. These methods at different epochs have given different results, from which, at a very early period, it was concluded that the points in the celestial concave, where the celestial equator cuts the ecliptic, are shifted from east to west, that is, in a direction opposite to that in which the sun appears to move among the fixed stars, and in which right ascension is measured. It has likewise been discovered, by similar observations for finding the right ascension and declination of the principal fixed stars, that this recession of the first points of Aries and Libra is not uniform; also that the inclination of the celestial equator to the ecliptic undergoes slight periodical changes; and moreover that the fixed stars themselves have an apparent small annual motion, by which their places as determined by observation are found to be affected.

### *Precession of Equinoxes, &c.* (See *App.* 7.)

(141.) If the earth were an exact sphere of uniform density, the axis round which it revolves as it is carried round the sun, together with the equator to which that axis is perpendicular, would always preserve the same position; since the attraction of the particles, of which it consists, to the sun, would exactly balance on a line joining the centres of the two bodies. This balanced attraction therefore can neither produce rotatory motion in the earth, nor influence one in any way which the earth may have. On such a supposition the celestial equator and pole of the heavens would remain fixed. But in fact the earth is not an exact sphere. By its whirling motion the particles near the equator are forced out from the centre, while those near the pole sink down; so that the form becomes that of a spheroid, having the greatest diameter at the equator, and the shortest one at the poles. We may consider the earth as consisting of an internal sphere surrounded by and attached to an outward spheroidical shell, which increases in thickness from the poles to the equator. In which case, although the inscribed sphere will, of itself, balance in every position on the radius vector or line drawn to the sun, yet the circumscribed shell will not do so, except in particular positions with respect to that line.

(142.) When the sun has south declination, its attraction on the shell tends to incline the north pole of the earth towards it. This tendency produces the effect of shifting the axis round which the earth performs its diurnal revolutions, and thus the equator is made to undergo a corresponding alteration of position with respect to its intersection with the plane of the earth's orbit round the sun, that is, of the ecliptic; and also with respect to its inclination to the ecliptic. These intersections, and consequently the equinoctial points, are shifted annually about 50″ from east to west, or in a direction the opposite to that of the earth's motion round the sun: the inclination alternately decreases and increases about $1\frac{1}{2}''$.

(143.) When the sun has north declination, then the south pole of the earth has a tendency to incline towards the sun, and consequently the north pole to recline the contrary way, that is, the same way it does when the sun has south declination. Similar effects therefore on the place of the equinoxes and the obliquity must follow, as the ones just mentioned above.

(144.) Similar effects are also produced by the attraction of the moon, the lunar orbit round the earth being inclined to the equator: so that the moon for about a fortnight is north of the equator and the next fortnight south thereof. The discovery of these effects and their cause is due to Bradley.

(145.) The average regression of the equinoxes thus produced by the attraction of both the sun and moon is 50″.35; of which about $14\frac{1}{2}''$ is to be attributed to the former body, and about $35\frac{1}{2}''$ to the latter. What the real regression varies at any time from the average, in consequence of variations in the disturbing effects of these bodies, is called *nutation* or *lunisolar nutation.*

(146.) The planets, by drawing the earth out of the ecliptic, that is, by thus producing a variation in the position of the ecliptic, modify in a certain degree the effect of the disturbing forces of the sun and moon as above. The average annual regression of the equinoxes is thus diminished at present 0″.12; so that the correct average regression, called the *precession of the equinoxes*, is 50″.35 — 0″.12, or 50″.23. (See *App.* 7.)

*Aberration of the Fixed Stars.* (See *App.* 8.)

(147.) Beside the effects of lunisolar precession and nutation, and of planetary attraction, there is another small deviation of the fixed stars from their places as determined for any particular epoch, which is called aberration. Bradley's discovery of this preceded his discovery of nutation in point of time, but the same series of observations which led to one led also to the other. The star γ Draconis, situated nearly on the solstitial colure, passed the meridian at the vernal equinox farther from the pole by about 20″, and at the autumnal equinox nearer to the pole by 20″, than at either tropic. This could not be owing to nutation in the earth's axis: for if so, a star similarly situated below the pole on the solstitial colure would have been affected equally a different way; that is, when the polar distance of γ Draconis was increased 20″, the polar distance of the other would have been diminished 20″. This, however, was not the case.

(148.) On making observations on several other stars, Bradley found that the greatest alteration of polar distance, which for $\gamma$ Draconis took place about the equinoxes, took place for other stars at different times of the year. He observed also, on whatever day any star deviated the most from its mean place in polar distance, that at the end of half a year from that day it deviated as much in the contrary direction, and that at the end of a whole year it returned to the same place as at first. From which it appeared that the period of this motion for every star was annual, and that it was connected some way or other with the place of the earth in its orbit.

(149.) After endeavouring, for some time without success, to account for this change in the observed place of a fixed star by different suppositions, he was at length led to conceive that all the phenomena observed might be an effect of the earth's rapid motion round the sun combined with the motion of light; from the consideration that the apparent place of a fixed star cannot be the same when the eye is at rest as when it is moving in any other direction than that of a line passing through the eye and the star; and that, when the eye moves first in one direction and then in another, the apparent place of the star must alter. Considering light as a fluid flowing from a fixed star, an eye at rest would receive it in the direction of the stream, and the body would be seen in its true situation. Supposing light to be a quiescent fluid, and the eye to move through it, an impression would be made in a direction opposite to that of its motion, and the star would always be seen in the line in which the earth was moving. The fact is, both light and the eye are in motion; an impression is therefore made on the eye by a ray of light in an intermediate direction, and the star is seen between its true place and the line of the earth's motion; much nearer however to the former than the latter, because the velocity of light greatly exceeds that of the earth. (See *App.* 8.)

(150.) The aberration is in a great circle, the plane of which evidently passes through the true place of the star and the line of the earth's motion. And since the latter, that is, the line of the earth's motion, during a whole revolution of the earth round the sun, traces out the ecliptic, it appears that the great circle in which aberration takes place, supposing the star to be out of the ecliptic, revolves round the sphere of the fixed stars, and consequently the apparent place of the star describes a small orbit* round its true place, which is supposed invariable.

If the star be in the ecliptic, the above-mentioned revolving circle coincides with the ecliptic; aberration therefore is then wholly in longitude.

(151.) The amount of aberration evidently depends on the velocity of light, the velocity of the earth, and the direction in which the earth is carried through the stream of light flowing from the star. The two former may be considered as constant; but the last, namely, the angle at which the earth passes through the rays of light, is continually varying, not only for different stars, but also for the same. Aberration, therefore, with respect

* The apparent changes of place in the fixed star during an entire revolution of the earth round the sun would be the same if the spectator, instead of moving round that body, were supposed to move from one single point, with the earth's velocity, in every direction with respect to a line drawn to the sun; keeping always, however, in the plane of the earth's orbit.

both to direction and quantity, considering all the stars which are observed in the heavens, must be infinitely varied; it must also undergo continual changes at different times of the year for the same star.

(152.) When the earth's motion is in a direction opposite to that of the stream of light coming from the body, or in the same direction with it, that is, when the earth moves directly towards or from the body, there is no aberration. As this angle increases, aberration increases; and when it becomes a right angle, aberration is the greatest. Thus, since the earth may be considered as always moving perpendicular to a line drawn to the sun, it follows that the sun's aberration, which is wholly in longitude, is always the greatest. It would be the greatest also for a star situated in the pole of the ecliptic, from which, if rays were propagated, they might be considered as everywhere perpendicular to the earth's orbit.

(153.) Since aberration for the same star takes place at different times of the year in the direction of every great circle passing through the star's true place, it must take place twice in the year in a circle of declination, and twice in the year in a circle perpendicular to this, which may be considered as a parallel of declination. Twice in the year, therefore, aberration takes place wholly in declination, and twice wholly in right ascension.

A similar remark may be made concerning aberration in latitude or longitude.

(154.) Bradley determined from this theory a general expression for aberration in terms of its greatest value supposed unknown, and of terms that were known. This expression he compared with the result of observation, when its whole value could be measured by an instrument, that is, when it was wholly in declination or on the meridian. Hence he found its greatest value to be about $20''$. This therefore would be the aberration of a star in the pole of the ecliptic, and is actually the aberration of the sun, by which it always appears behind its true place.

To the above general observations on aberration it may be added, an effect of a similar kind arises also from the diurnal motion of the earth round its axis combined with the motion of light. This effect, however, is inconsiderable.

### *Aberration of the Planets and Moon.*

(155.) The aberration of the planets and moon, strictly speaking, is the same as for the fixed stars. But there is a farther correction necessary in reducing their apparent places to their true. The earth passes through the stream of light flowing from a planet as from the fixed stars. But fixed stars may be supposed to retain the same situation during the transmission of light, while a planet really changes its situation during the time light passes from it to the earth, and that change is subject to observation and calculation. Hence, at the instant light from a planet enters the eye, there are two reasons why the observed place does not agree with the true. The first is aberration, a correction for which would give the situation of the planet at the instant light left it; but in the mean time the body has moved, and this motion forms a second correction. To compute therefore the true place of a planet from the apparent or observed, aberration must be first allowed as for a fixed star, and then the motion of the planet

as seen from the earth in the interval in which light is transmitted. And conversely, in calculating the apparent place of a planet, its true place must be first found for a point of time preceding the given one by the same interval, and then aberration allowed as for a fixed star.

If the planet be moving round the earth apparently in the same direction with the earth, the two corrections will partly cancel each other. If its velocity were the same as that of the earth, they would do so exactly; which is the case with the moon. If the planet's apparent motion be in the opposite direction to that of the earth, the whole correction will be the sum of the two parts.

### *Proper Motions of Fixed Stars* (see *App.* 9).

(156.) It is necessary, in treating on the apparent deviations of the stars from their places as fixed for some epoch, to add that after the required corrections have been applied on the several accounts enumerated above, still the observed right ascensions and declinations do not agree exactly with the computed ones, which they ought to do provided every source of deviation had been accurately estimated, and the instruments used in observing were either perfect or a sufficient number used to correct one another. As these deviations cannot be reduced to any law for the stars in general, but seem to be as various as the stars themselves, they are called *proper motions*. How far they are real motions in the stars, or arise from some shifting of the whole solar system, or are owing to imperfect computations and instruments, time alone and unceasing attention to the subject can determine.

### *Division of Time into Years, Months, Days, &c.*

(157.) The interval between the sun's leaving an equinox, and coming to the same equinox again, is called a solar year. The number of days, hours, minutes, &c. in this according to sidereal time, and thence according to mean solar time, is found by observing the meridian altitude of the sun on the day before it passes the celestial equator, and again the day after; from which observations the instant of its being at the equinox, as shewn by the clock, may be easily deduced. If several years have elapsed between two observations of this kind, and the whole interval be divided by the number of years, we shall thus get the length of a solar year very nearly.

Since the equinoctial points have an annual motion of about 50″, by which they are carried back to meet the sun in its apparent revolution from west to east, it is evident that the sun will return to the same equinox, sooner than to the same fixed point in the heavens. A solar year therefore is less than the time in which the earth makes a complete revolution round the sun; and moreover, since there is a small variation in the annual motion of the equinoxes, and also an alteration in the position of the earth's orbit, which affects the time of its revolution round the sun, it follows that the length of a year, determined as above at different periods, would not be exactly the same. By comparing the most ancient observations of this kind on record with the most modern, applying the proper corrections, a mean solar year has been found to consist of $365^{d}\ 5^{h}\ 48^{m}\ 47^{s}$ in mean solar time. Delambre makes it $365^{d}\ 5^{h}\ 48^{m}\ 51^{s}.6$ by more than 1200 calculations.

(158.) The time of the sun's describing the arc of the ecliptic, through which the equinoxes according to their mean motion recede, being added to the length of a mean solar year, the result will be the interval in which the earth makes a complete revolution round the sun. This interval is called a sidereal year, and consists of $365^d\ 6^h\ 9^m\ 11^s$.

(159.) The mean solar year is the one made use of in the common division of time, because the same succession of seasons, and the same variation in the length of the days, recur with it periodically. Four of these years amount to $1460^d\ 23^h\ 15^m\ 8^s$, that is, nearly to an exact number of days. In our calendar a common year is made to consist of 365 days, and every fourth year of 366 days. According to this account therefore $44^m\ 52^s$ is reckoned every four years more than four times the period of the seasons, an error which in 128 years amounts very nearly to a whole day. To correct this, in every centenary year, as 1700, 1800, &c., when the number of centuries is not divisible by 4, the additional day is omitted; by which means the calendar is rendered sufficiently exact for all the common purposes of history and chronology.

(160.) Before the period of the sun's apparent revolution in the ecliptic was determined with much precision, the year was divided in such a manner, as to produce great confusion in the arrangement of the seasons, and of the festivals, which generally bore some allusion to the seasons. By the Jewish, Greek, and Roman nations, the lunisolar year, which consists of twelve complete lunations or of 354 days, was used; different corrections being applied to it for the purpose of preserving the same order in the months and seasons, as by the addition of a month every third year, three months every eight, &c. Among the Egyptians the solar year of 365 days was used, and this was at length adopted also by the Romans, through the influence of Julius Cæsar, at the time he possessed the whole power of the government. He began the first year of a new calendar in the 707th year from the foundation of Rome, six days after the winter solstice, that happening to be the time of a new moon. In the 1st, 5th, 9th, &c. year, that is, in every fourth year, he directed an additional day to be included, by reckoning a particular day in February twice, namely, the sixth day before the calends of March; from which circumstance these years are called bissextiles. According to this calendar, the 45th Julian year, in which our Saviour was born, was a bissextile; and hence it happened that the 4th, 8th, and every year of our calendar divisible by 4 without a remainder, is a bissextile or leap year; excepting centenary years, in which the number of centuries is not divisible by 4.

(161.) From the construction of the Julian calendar it is evident that an additional error of $44^m\ 52^s$ would be found in every fourth year, which at length would be sensibly felt in the recurrence of the festivals as connected with the seasons. And this was in reality the case; for the festivals of the Christian Church being arranged by the Council of Nice according to this calendar, Easter Sunday was in process of time found to happen many weeks from the Jewish Passover, which was regulated by the new moon, of which the full moon was the next after the equinox, and near which it was the intention of the Council of Nice to fix it. In 1582, in the reign of Gregory XIII., the head of the Roman Catholic Church, the vernal equinox, instead of taking place on the 21st of March, as at the assembling

of the Council of Nice, fell on the 11th of that month; and to bring back the same days of the month to the same places of the sun with respect to the equinoctial points, it became necessary to substitute in the calendar the 21st for the 11th. Gregory XIII. not only made this correction, but, to prevent the recurrence of a similar error in future, he ordered that every centenary year should be considered only as a common year of 365 days, although according to the Julian calendar it should be a bissextile. Since however the error amounts to a whole day in 128 years, this deviation from the Julian calendar is at present limited to those centenary years in which the number of centuries is not divisible by 4. The error now will be only 0.944 days in 4000 years.

(162.) The year was divided in the calendar of Julius Cæsar into 12 months, seven of thirty-one days, four of thirty, and one of twenty-eight or twenty-nine, according as it was a common or bissextile year. The same division is at present in use, and is applied to the civil purposes of life: but the space of 28 days is also called a month, one-fourth of which is called a week. A natural day consists of 24 mean solar hours, and is either civil or astronomical. The civil day begins and ends at midnight, the astronomical day begins and ends at noon.

Any hour in the first 12 hours of the civil day from midnight to the following noon is said to be such an hour A. M. (ante meridiem); in the latter 12 hours, that is, between noon and the following midnight, it is said to be P. M. (post meridiem). In the astronomical day the hours are reckoned from 0 at noon up to 24, without any distinction of this kind.

The astronomical day begins 12 hours after the civil day of the same name. Thus April 4, 1825 (civil), begins at midnight between Sunday and Monday; April 4 (astronomical) begins at Monday noon.

(163.) Those points of time from which historians and chronologists reckon are called epochs or æras. That from which we reckon, and to which we are accustomed to refer all others, is the commencement of the year immediately following the birth of Christ, which event has been fixed on the 25th of December, in the 45th year of the Julian calendar. The creation of the world is an epoch from which the sacred writers have traced the events recorded in the Scriptures, and it is by observing the course of these events that chronologists have fixed this epoch between 3950 and 4000 years before Christ. The epoch used by the Grecian States was that of the institution of the Olympic Games, which were celebrated every fourth year at Olympia by a general assembly from those states. It is placed 776 years before Christ. The Roman epoch was the building of Rome, 752 years before Christ. The Turkish epoch is the flight of Mahomet, which took place 622 years after Christ.

### *General Motions and Phases of Moon, Planets, &c.*

(164.) The moon describes an orbit round the earth, at the distance of about 240 thousand miles, in a month. We may be supposed to commence our observations on it when it first appears, after having been for several days invisible in the neighbourhood of the sun. The moon is then seen in the west immediately after sunset, at a little elevation above the horizon, or a little to the east of the sun. The illumined or bright part has the form of a thin crescent, or of the letter C, the back of which is turned towards that point where the sun has just set. The next night the

moon is again seen in the same quarter, at the same hour, but at a greater altitude than the preceding evening, or farther to the east of the sun. A perceptible though slight change has likewise taken place in its appearance; the crescent is become something broader, most so towards the middle, and gradually less and less towards its extremities, or, as they are called, towards its cusps, which remain as before sharp and brilliant points. On each succeeding evening a similar change takes place in the relative situation and in the appearance of the moon. It is removed farther towards the east from the point where the sun sets; and the crescent, at first so thin as to be scarcely perceptible, is continually enlarged, and in a few days is distinctly seen in the day.

(165.) When the moon is 90° to the east of the sun, and is on the meridian nearly at sunset, the whole space between the cusps becomes enlightened, and the moon has the appearance of a luminous semicircle. When the distance of its centre from that of the sun, measured on the ecliptic, is exactly 90°, that is, when the difference of the sun's longitude and moon's longitude, as seen from the earth, is 90°, the moon is said to be in quadrature; which relative position of the moon and the sun is denoted by the astronomical symbol □. This is the end of the first quarter, or the beginning of the second.

The moon, that is, the enlightened part as seen at the earth, goes on increasing in distance from the sun and at the same time in apparent magnitude. The light gradually extends beyond the line of cusps, till the visible disk becomes a complete circle. This is the end of the second quarter, or full moon. The sun and moon are seen at this period in opposite points of the heavens; when one rises the other sets, and their distance is about 180°. The moon is said to be in opposition at that particular point of time when the arc of the ecliptic intercepted between circles of latitude passing through the centres of the two bodies, or when the difference of their longitudes, is exactly 180°; which relative position of the moon and the sun, as seen from the earth, is denoted by the symbol ☍.

(166.) A few days after full moon, we find that it does not rise till some time after sunset; and that at sunrise it is at a considerable altitude above the western part of the horizon, returning apparently towards the sun in the east. During this approach the western side of the moon gradually loses its light. At the distance of 90° in longitude from the sun, or when the moon bears about south at sunrise and is again in quadrature (□), the visible disk is again reduced to a luminous semicircle. This is the end of the third quarter.

In the fourth quarter the visible part of the moon again takes the form of a crescent, which regularly decreases with its distance from the sun. At length it is just seen at daybreak, near the point where the sun is about to rise; and then, from its small quantity of light and proximity to the sun, it becomes invisible. It afterwards passes, without being seen, across the sun from west to east, till it is again perceived like a crescent at sunset, as at first. When the moon is in the same point of the heavens with the sun, or at change, it is said to be in conjunction; or, more properly speaking, when its longitude, as seen from the earth, is exactly the same as that of the sun; a coincidence which is expressed by the character ☌.

(167.) When the moon is at full, we frequently observe it to be either partly or wholly deprived, for a short space of time, of its light. The portion shaded is not always the same, but varies in different instances: sometimes the obscuration extends no farther than a very small segment at the bottom or at the top of the disk; sometimes it embraces the whole surface. This is called a lunar eclipse; a phenomenon which we have no great difficulty in accounting for, when we consider that at this time the earth is placed between the sun and the moon, and may therefore be easily supposed to intercept the solar rays in their transit to the latter body. The variety which we observe in the extent and situation of the part thus obscured, may arise from the moon's coming into opposition not always in the very same relative position, but sometimes raised above and sometimes depressed below the earth, so as to be partially seen from the sun. The moon most frequently passes through opposition without being shaded at all, the full moon being in such cases so far raised above or depressed below the earth, as to be wholly seen from the sun, although in the same part of the heavens with the earth.

(168.) The obscuration of that part of the moon which is eclipsed is neither complete, nor does it take place instantaneously. It is faintly illumined by the rays of solar light, which, in their transit close to the earth, pass obliquely through its atmosphere; and are refracted or bent behind the earth, so as to fall on the darkened part of the moon. The eclipse does not take place instantaneously; because, as is manifest, part of the solar rays must be excluded from any given point on the moon's disk by the interposition of the earth, before the whole are. A spectator at the moon, who experiences an eclipse, loses sight of the sun gradually. Hence to a spectator at the earth a slight shade, called the earth's penumbra, is seen on the eclipsed part of the moon's disk before the darkest shadow, which is called the earth's umbra; and from this arises the difficulty of observing the beginning of a lunar eclipse, with sufficient correctness for finding the longitude of any place on the surface of the earth.

(169.) When the moon changes, or is in conjunction with the sun, it frequently intercepts the solar light, and causes an apparent obscuration of the sun. This is called a solar eclipse.

Sometimes at the greatest obscuration a segment only of the sun is darkened, sometimes the whole; and in some cases the central parts of the sun are eclipsed, and a small annulus near the circumference left bright, which is called an annular eclipse. These different appearances depend on the relative situations of the sun and moon, in point of latitude, at their conjunction. Most frequently the moon passes through conjunction without eclipsing the sun at all, owing to its being either too much elevated above or depressed below the sun at that time. It is in fact the earth that is really obscured at such times; and to a spectator at the moon, an umbra and penumbra would seem to pass over the earth, exactly in a similar manner to what from the earth we observe in a lunar eclipse.

This phenomenon is evidently owing to the intervention of the moon between the sun and the earth.

(170.) All the phases of the moon, as they have been briefly described, are easily accounted for on the supposition of its describing an orbit round the earth from west to east, and passing at change between the sun and earth.

At full the moon has the same face turned towards the earth, which is turned towards the sun. It appears therefore to a spectator at the earth to be completely illumined. A spectator at the moon at full would have the sun and earth nearly in the same line. On leaving that point in his revolution round the earth, he would have the sun and earth in different directions; different hemispheres of the moon would therefore be turned towards these bodies. In other words the hemisphere seen at the earth would be partly enlightened and partly dark. The withdrawing of light from the western edge of the moon is thus accounted for. As the moon proceeded in its course, less and less of her enlightened hemisphere would be turned towards the earth, and consequently less and less would be seen there. When the moon passed between the sun and earth, none of the enlightened hemisphere would be seen. From change to full, the moon would turn her enlightened face by degrees to the earth, till at length the whole would be again visible.

(171.) When the new moon first appears after change, we are able to see, not only the thin illumined crescent, which is turned towards the sun as well as the earth; but also the other part of the hemisphere, turned towards the earth alone, and therefore receiving no light directly from the sun. This shaded surface in fact receives, at this time, a faint light from the earth, which shines to a spectator at the moon with nearly a full orb, and it thus becomes visible.

(172.) By the moon's motion in its orbit, it would continually turn different hemispheres to us, if it did not revolve round one of its diameters as an axis, with an angular velocity nearly equal to that with which it is carried round the earth, and in the same direction, or from west to east. It is thus that the hemisphere, which is turned from the earth by the former motion, is brought back towards the earth again by the latter; by which means we always see the same face. Not exactly the same: for while the rotatory motion of the moon is uniform, that in its orbit is variable; through which there is a slight alteration in the face observed, towards the eastern and western edges. This irregularity is called a libration in longitude.

Also, the axis round which the moon revolves, not being perpendicular to the plane of its orbit, sometimes the north pole is inclined towards the earth, and sometimes the south. We thus see the surface of the moon over its poles alternately, in the same manner as a spectator at the sun, in summer, is able to see over the north pole of the earth, and in winter over the south. This is called a libration in latitude.

### *Planet Venus.*

(173.) The planet Venus is sometimes seen in the western part of the heavens immediately after sunset, near the point where the sun has just sunk below the horizon. In a few days it appears to have moved from the sun to the eastward. The difference of the times of their setting increases, till the planet is thus separated from the sun about 46°; when it sets 2 or 3 hours after the sun.

The planet now appears gradually to return westward, till it again sets nearly with the sun. Soon after, from its proximity to the sun, it becomes invisible.

During the interval of its thus leaving and again approaching the sun, Venus is called the *Evening Star*, because it is seen only during the evening.

When the planet is again seen, it appears a little to the west of the sun, just preceding the sun at rising. It afterwards moves westward, till it has gained a distance of about 46° from the sun, and rises 2 or 3 hours before sunrise. It then returns eastward, till it is again lost sight of in the solar rays.

During this interval Venus is called the *Morning Star*.

(174.) The apparent proper motion of the planet Venus is, therefore, a kind of oscillation on each side of the sun, through an arc of about 45°. In passing from east to west, it is sometimes seen to traverse the sun's disk as a black spot. From this we conclude that it then passes between the sun and earth. When its longitude in this transit is exactly the same as that of the sun's centre, it is said to be in *inferior conjunction* (inf. ☌).

In moving from west to east, it is never seen on the sun's disk; from which we conclude that it then passes at a greater distance from the earth than the sun. When its longitude in this transit is exactly the same as that of the sun, it is said to be in *superior conjunction* (sup. ☌).

(175.) The phases of Venus, when seen through a telescope of sufficient magnifying power, are agreeable to the supposition of its describing an orbit round the sun, interior to that of the earth. From inferior to superior conjunction, it increases from a thin brilliant crescent, the back of which is turned towards the sun, to a fully illumined orb; and afterwards passing the sun from west to east, it gradually, in the same manner as the moon from full to change, alters its figure again to a crescent. Its apparent diameter, however, when it appears as a crescent, is much greater than when it appears as a full orb; from which circumstances it is inferred that the planet is nearer the earth in the former case than in the latter.

### *Mercury.*

(176.) The apparent proper motion and phases of Mercury are similar to those of Venus. But the arc, through which it is separated from the sun, at its greatest elongation to the east and west, is never more than 29°; and hence it rarely emerges sufficiently from the splendour of the sun's rays to be visible to the naked eye. Its oscillations to the east and west of the sun, that is, its revolutions round the sun, are also performed in shorter intervals of time than those of the planet Venus.

All the phenomena observed of this planet tend to prove that it describes an orbit round the sun inferior to that of Venus.

### *Mars.*

(177.) The planet Mars is sometimes observed in *opposition* to the sun, and sometimes in *conjunction* with it; although in the latter case it never passes over the sun's disk, as Venus and Mercury do at inferior conjunction. In opposition, when it rises at sunset, and sets at sunrise, it shines with a full orb, and has a much greater degree of apparent magnitude and splendour than at any other period. We suppose it therefore to approach in opposition nearest to the earth. Afterwards, it moves with great rapidity towards the sun in the west, for about 36 days; and then with a

moderated velocity, till it is in conjunction with the sun. During this interval it first changes the form of its disk from an orb completely illumined, to one about three-quarters illumined; and then to a full orb again, much less however than when the planet is in opposition. Emerging from the sun's rays to the west, and rising a little before sunrise, it continues its course westward, with respect to the sun, till it comes again into opposition; the velocity of its motion from the sun and its phases undergoing the same alterations, taken in an inverse order, as in its transit from opposition to conjunction.

Referring the place of the planet Mars to the fixed stars, it appears from opposition to move from east to west, or is retrograde, about 8 degrees. It is then stationary a short time; after which it advances again to the eastward about 307 days, till it comes into conjunction with the sun. From this point it continues to advance eastward among the fixed stars, or is progressive for about 307 days more, at the end of which it is stationary, and then retreats about 8 degrees, till it is again seen in opposition. Upon the whole, from opposition to opposition, it appears to have made a whole revolution (360°) among the fixed stars, and about 48° more.

These apparent motions and phases are agreeable to the supposition that Mars describes an orbit round the sun, exterior to that of the earth, in about two years.

(178.) The apparent motions of the remaining planets, namely, Juno, Vesta, Ceres, Pallas, Jupiter, Saturn, and the Georgian, are similar to those of Mars; we conclude therefore their orbits to be exterior to that of the earth. Their progressive motion from opposition to opposition is less and less in the order in which they are placed, and the interval of the revolution of each increases therefore in that order also.

(179.) The planet Jupiter is accompanied in its revolutions round the sun by four Satellites, which may be distinctly seen through a telescope of moderate power. They move from west to east round the planet with great rapidity, oscillating apparently from one side to the other, exactly in the same manner as Venus does round the sun. In passing from west to east, they are deprived of the solar light, by the interposition of the planet between them and the sun; and, unless telescopes of great power be made use of, they disappear also in passing from east to west, by traversing over the bright disk of the planet. They are, moreover, sometimes hid from the view of the spectator on the surface of the earth, by the body of the planet; in which case they are said to suffer an occultation.

(180.) Saturn has seven Satellites, whose apparent motions and general phenomena are similar to those of Jupiter. This planet is besides remarkable for a flat ring of solid matter, by which it is encompassed; which accompanies the planet round the sun, as if it were attached to its body, and at the same time has a whirling motion in its own plane. At some points of the planet's orbit this ring is not seen: at others it appears as a narrow elliptic zone of light, which afterwards opens more and more, till the breadth is very nearly half the length; when it again contracts its dimensions gradually, till it becomes invisible.

To a spectator at the sun, such an alternate enlargement and contraction of the breadth of the ring might be very easily accounted for. From what was observed in Art. 84 respecting the different seasons of the

earth, it appears that at the equinoxes the plane of the earth's equator passes through the sun; at the solstices the sun is considerably above or below that plane. If the terrestrial equator were distinctly marked out on the earth, or rather a circular flat ring lying in its plane surrounded the earth at a short distance from the surface, we can easily conceive, that at the equinoxes a spectator at the sun would only view the edge of this equatorial ring, which might be too thin to reflect sufficient light for vision. But at the solstices, the light of the sun shining most directly on the flat side, the ring would appear as an oval of considerable breadth, and be seen most distinctly. From the equinox to the solstice, the sun being more and more elevated above or depressed below the ring; or what amounts to the same, by the annual motion of the earth and ring together, its plane being more and more depressed below or elevated above the sun, the light and breadth of the ring would continually increase. From the solstice to the following equinox, for a similar reason, the oval would become narrower and narrower, and its light at the same time would continually decrease.

The same phenomena would take place to a spectator at the sun viewing the ring of Saturn, during a whole revolution. At the points where the plane of the ring cuts the orbit of Saturn, the ring would be invisible; at the distance of 90° from these points, it would be most open and most enlightened. To a spectator at the earth these phenomena are in some measure modified. The ring is not visible there, unless the earth be on the same side of its plane with the sun. When the plane of the ring passes through the earth, or through the sun, or through any intermediate point, it cannot be seen. But in other respects, the same changes in its appearance and apparent dimensions take place at the earth as at the sun.

Uranus, or the Georgian, was discovered in 1781 by Dr. Herschel, who soon after observed six Satellites, which move round it and accompany it round the sun. The Satellites of the Earth, Jupiter, and Saturn move round their primaries from west to east, in orbits very little inclined to the ecliptic; the orbits of the Satellites of the Georgian are nearly perpendicular to the ecliptic.

An exterior planet, since named Neptune, was observed in 1846, about the same time by M. Leverrier at Paris and by Mr. Adams at Cambridge. It has at least one satellite. And an inferior planet, between Mercury and the Sun, is said to have been seen by M. Lescarbault. The list of telescopic planets has been considerably enlarged by Mr. Hind and others.—Ed.

## TABLE OF ELEMENTS OF PLANETS' ORBITS.

| | Mercury. | Venus. | Earth. | Mars. | Vesta. | Juno. | Ceres. | Pallas. | Jupiter. | Saturn. | Uranus, or Georgian. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Distance from Sun . . | 0.3870981 | 0.7233316 | 1.0000000 | 1.5236923 | 2.3676700 | 2.6690090 | 2 7672450 | 2.7728860 | 5.2027760 | 9.5367861 | 19.1823900 |
| Mean Sidereal Revolution . | Days. 87.9692580 | 224.7007869 | 365.2563612 | 686.9796458 | 1325.7431000 | 1592.6608000 | 1681.3931000 | 1686.5388000 | 4332.5848212 | 10759.2198174 | 30686.8208296 |
| Longitude Perihelion . . | 1801. ° ′ ″ 74 21 46.9 | 1801. ° ′ ″ 1:8 43 53.1 | 1801. ° ′ ″ 99 30 5.0 | 1801. ° ′ ″ 332 23 56.6 | 1820. ° ′ ″ 249 33 24.4 | 1820. ° ′ ″ 53 33 46.0 | 1820. ° ′ ″ 147 7 31.5 | 1820. ° ′ ″ 121 7 4.3 | 1801. ° ′ ″ 11 8 34.6 | 1801. ° ′ ″ 89 9 29.8 | 1801. ° ′ ″ 167 31 16.1 |
| Annual Increase. | +55.9 | +47.4 | +61.8 | +55.9 | +94.2 | . . . | +121.3 | . . . | +57.1 | +69.5 | +52.5 |
| Inclination of Orbit to Ecliptic | 7 0 9.1 | 3 23 28.5 | . . . | 1 51 6.2 | 7 8 9.0 | 13 4 9.7 | 10 37 26.2 | 34 34 55 | 1 18 51.3 | 2 29 35.7 | 0 46 28.4 |
| Annual Variation. | +0.18 | −0.04 | . . . | −0.01 | −0.12 | . . . | −0.44 | . . . | −0.23 | −0.15 | +0.03 |
| Longitude of Node | 45 57 30.9 | 74 54 12.9 | . . . | 48 0 3.5 | 103 13 18.2 | 171 7 40.4 | 80 41 24.0 | 172 39 26.8 | 98 26 18.9 | 111 56 37.4 | 72 59 35.3 |
| Annual Increase . | +42.3 | +32.5 | . . . | +29.8 | +15.6 | . . . | +1.5 | . . . | +34.3 | 30.7 | +14 2 |
| Excentricity . . | 0.205514940 | 0.006860740 | 0.016783568 | 0.093307000 | 0.089130000 | 0.257848000 | 0.078439000 | 0.241648000 | 0.048162100 | 0.056150500 | 0.046679380 |
| *Secular* Variation . | +0.000003866 | −.000062711 | −.000041630 | +.000090176 | +.000004009 | . . . | −.000005830 | . . . | +.000159350 | −.000312402 | |
| True Diameter . | 0.389 | 0.975 | 1.000 | 0.517 | *Sun.* 111.454 | *Moon.* 0.275 | . . . | . . . | 10.860 | 9.982 | 4.332 |
| Mass . . . . | 1 / 2025810 | 1 / 405871 | 1 / 354936 | 1 / 2546320 | 1.000 | 1 / 2630200 | . . . | . . . | 1 / 1070.5 | 1 / 3512 | 1 / 17918 |
| Gravity . . . | 1.03 | 0.98 | 1.00 | 0.33 | 27.90 | 0.16 | . . . | . . . | 2.72 | 1.01 | |
| Sidereal Rotation in Sidereal Time | h. m. s. 24 5 28 | h. m. s. 23 21 7 | h. m. s. 24 0 0 | h. m. s. 24 39 21 | d. h. m. 25 12 0 | d. h. m. 27 7 43 | . . . | . . . | 9 55 50 | 10 29 17 | |
| Light and Heat . | 6.680 | 1.911 | 1.000 | 0.431 | . . . | . . . | . . . | . . . | 0.037 | 0.011 | 0.002 |

*Tables of Right Ascension and Declination, &c.*

(181.) In computing the places of the heavenly bodies for any proposed time, it is usual first to consider their motions as uniform, that is, the *mean* or average value of their motion is allowed, and thus their *mean* places are found. The corrections, which it is necessary afterwards to apply in order from their mean places to get their true or apparent places, are called *equations*. Thus a catalogue of the fixed stars being formed, and their mean right ascensions and declinations settled for the beginning of some year, we hence compute the apparent right ascension and declination of any particular star, which may be wanted for the purpose of calculation or observation, as follows. First, the amount of precession is allowed for the years subsequent to the year of the catalogue. This precession is the effect on right ascension or declination of the *mean precession* of the equinox, arising from the attraction of the sun, moon, and planets, and also of proper motion, if any. When the mean right ascension and declination are thus brought up to the beginning of the given year, they are corrected for aberration and nutation, which last includes both the solar and lunar nutations, and also at the same time for the further precession from the beginning of the given year, up to the given day; and lastly, for proper motion, if any, for the fraction of year.

The result is the right ascension and declination of the star for the proposed time, as it is seen through an instrument, that is, its apparent right ascension and declination (see App. 10, 11).

(182.) In the Nautical Almanac the apparent right ascensions and declinations of the principal stars are thus computed and put down for every 10th day in the year, at the instants of their respective transits over the meridian of Greenwich: so that these elements may be taken out at once by inspection. In Tables edited by Mr. Baily under the sanction of the Astronomical Society of London, the mean right ascensions and declinations of nearly 3000 stars are given for the beginning of 1830, together with the amount of precession.

(183.) From Tables of the mean places of the sun, moon, and planets, their true right ascensions and declinations are annually computed, and put down in the Nautical Almanac; for the sun and planets they are put down for every mean noon at Greenwich; for the moon for every hour in mean time at Greenwich. Other elements also are inserted in the Nautical Almanac, as the *equation of time*, *the sun's semidiameter*, *the moon's semidiameter*, *horizontal parallax*, *&c.*; some for Greenwich mean noon each day, others for both Greenwich mean noon and midnight, &c. (see Nautical Almanac).

(184.) Whenever any one of these elements is required for the purpose of nautical computations, the first step is to ascertain at the instant proposed (at least nearly) Greenwich mean time, for which kind of time the Nautical Almanac is arranged. This is done commonly by estimating ship mean time from a pocket-watch, or otherwise expressing it according to the astronomical day (Art. 162); and then by *adding* the longitude in time if *west*, and *subtracting* the longitude in time if *east*, the result is a Greenwich date in mean time. The next step is to take from the Nautical Almanac the element required as put down for the mean noon, mean midnight, or mean hour, immediately preceding the Greenwich date, and

having computed the mean variation of the element from that period up to the Greenwich date, to add or subtract this variation or proportional part according to circumstances. The following rules and examples will explain more particularly the proper mode of proceeding.

*To get a Greenwich Date from Ship Date and Longitude.**

(185.) RULE. If the ship date in mean time be A. M., put the day one back and add 12 to the hours: if the ship date be P.M., write down the same date, merely omitting the letters P.M. When the *longitude is west*, turn it into time,† and add the result to the ship date expressed astronomically: the sum, if less than 24, will be the corresponding Greenwich date in the same day with the ship date; if greater than $24^h$, reject $24^h$, and put the day one forward. When the *longitude is east*, turn it into time, and if less than the hours and minutes of the astronomical ship date, subtract the result; the remainder will be the corresponding Greenwich date in the same day with the ship date: if the east longitude in time be greater than the hours and minutes of the astronomical ship date, add 24 hours to the latter and put the day one back, before the subtraction takes place.

It will be sufficient in general to use the Greenwich date to the nearest minute only.

*Ex.* 1. Required the Greenwich dates to the nearest minutes corresponding to the instants of the following ship dates in mean time and the given longitudes.

1. Ship, Dec. 20, $6^h\ 14^m$ P.M.; longitude $42°\ 17'$ W.
2. Ship, June 3, 7 15 A.M.; longitude 140 14 E.
3. Ship, March 12, 11 20 A.M.: longitude 37 28 W.
4. Ship, April 10, 4 16 P.M.; longitude 68 32 E.

| | | | | | |
|---|---|---|---|---|---|
| (1.) | Sh. Dec. 20 | $6^h\ 14^m$ | (2.) | Sh. June 2 | $19^h\ 15^m$ |
| | Long. in T. | 2 49 W. | | Long. in T. | 9 21 E. |
| | Gr. Dec. 20 | 9 3 | | Gr. June 2 | 9 54 |
| (3.) | Sh. March 11 | $23^h\ 20^m$ | (4.) | Sh. April 9 | $28^h\ 16^m$ adding $24^h$ |
| | Long. in T. | 2 30 W. | | Long. in T. | 4 34 E. |
| | Gr March 12 | 1 50 (rej. $24^h$) | | Gr. April 9 | 23 42 |

*To take out the Sun's Declination for any Ship Date in Mean Time.*

(186.) Get a Gr. date as in Art. 185, or as in note thereto. Take out of the Nautical Almanac the sun's declination for the mean noon preceding the Greenwich date and for the mean noon following it, prefixing the proper names N. or S. *When the names are like*, take the difference, to

* A Greenwich date is in general got most easily by applying to the time shewn by a chronometer its known error on Gr. M. T.

† This may be done easily by means of table of log. haversines (see Naut. Tables).

which prefix the same name with the declinations themselves when the latter is the greater, and a contrary name when the latter is the less. When the declinations have *different names*, add them, and to the sum (which is in fact the change or difference of declination) prefix the name of the latter.

To the *proportional logarithm* of this difference in declination, add the *Gr. date logarithm for sun* of the hours and minutes of the Greenwich date. (See *Naut. Tables*, p. 14.) The sum will be the *proportional logarithm* of the required part; which part mark with the name of the whole difference in declination. The sum or the difference of this and the declination first put down will be the declination required; the *sum*, with the name of either, when the names are *alike;* and the *difference*, with the name of the greater, when the names are *unlike.*

*Ex.* Required the sun's declination for the following Ship dates in mean time.

(1.) Sh. April 10, at $6^h\,10^m$ P. M., in longitude 50° 30′ W.
(2.) Sh. Feb. 16, at $0^h\,40^m$ A. M., in longitude 104° 30′ E.
(3.) Sh. March 21, at $1^h\,10^m$ P. M., in longitude 136° 15′ E.

| (1) | (2) | (3) |
|---|---|---|
| Sh. April 10, $6^h\,10^m$ | Sh. Feb. 15, $12^h\,40^m$ | Sh. March 20, $25^h\,10^m$ |
| Long. in T. 3 22 W. | Long. in T. 6 58 E. | Long. in T. 9 5 E. |
| Gr. April 10, 9 32 | Gr. Feb. 15, 5 42 | Gr. March 20, 16 5 |
| Decl. April 10, 7° 52′ 26.8″ N. | Feb. 15, 12° 43′ 55.2″ S. | Mar. 20, 0° 13′ 53.7″ S. |
| 11, 8 14 35.1 N. | 16, 12 23 14.4 S. | 21, 0 9 47.7 N. |
| 22 8.3 N. | 20 40.8 N. | 23 41.4 N. |
| .91023 | .93965 | .88068 |
| .40097 | .62434 | .17384 |
| 1.31120 | 1.56399 | 1.05452 |
| 0° 8′ 47″.5 N. | 0° 4′ 55″ N. | 0° 15′ 52″.5 N. |
| 7 52 26.8 N. | 12 43 55.2 S. | 0 13 53.7 S. |
| Decl. 8 1 14.3 N. | 12 39 0.2 S. | 0 1 58.8 N. |

*To take out the Sun's Right Ascension.*

(187.) The rule in Art. 186 may be followed for taking out also the sun's right ascension, prefixing the name or sign + to each right ascension taken out for the preceding and following mean noons, the contrary sign being considered —.

When the latter right ascension put down from the Nautical Almanac is less than the former (having gone through $24^h$), the $24^h$ must be restored or added to the latter; and if the right ascension finally computed be greater than $24^h$, the $24^h$ must be rejected.

*Ex.* Required the sun's right ascension for the following Ship dates in mean time.

(1.) Ship, June 12, at $11^h\ 50^m$ A. M., in longitude $162°\ 30'$ W.
(2.) Ship, March 21, at 2 20 P. M., in longitude 37 31 E.

| (1) | | (2) | |
|---|---|---|---|
| Sh. June 11, | $23^h\ 50^m$ | Sh. March 20, | $26^h\ 20^m$ |
| Long. in T. | 10 50 W. | Long. in T. | 2 30 E. |
| Gr. June 11, | 34 40 | Gr. March 20, | 23 50 |
| Gr. June 12, | 10 40 | | |

| | h m s | | h m s | |
|---|---|---|---|---|
| Sun's R.A. June 12, | 5 12 23.18+ | March 20, | 23 57 51.85+ | |
| 13, | 5 16 31.67+ | 21, | 24 1 30.17+ | add. $24^h$ |
| | 4 8.49+ | | 3 38.32+ | |
| | 1.63809 | | 1.69397 | |
| | .35218 | | .00303 | |
| | 1.99027 | | 1.69700 | |
| | $1^m\ 50^s.5+$ | | $3^m\ 37^s+$ | |
| | 5 12 23.18+ | | 23 57 51.85+ | |
| R. A. | 5 14 13.68 | | 0 1 28.85 | rejecting 24 |

*To take out the Sun's Longitude and Latitude.*

(188.) The sun's longitude and latitude are taken out in the same manner as its right ascension and declination. (See Rule, Arts. 186 and 187.)

*To take out Planet's Right Ascension and Declination.*

(189.) A planet's right ascension and declination are inserted in the Nautical Almanac for every Greenwich mean noon, and are taken out for the reduced Greenwich date in the same manner as for the sun (see Arts. 186, 187), using the Greenwich date logarithm for the sun, (*Naut. Tables*, p. 14).

*Ex.* Required the right ascension and declination of the planet Jupiter, for Ship Dec. 5, 1834, at $7^h\ 40^m$ mean time, in longitude $45°\ 27'$ W.

| | R. A. | Decl. |
|---|---|---|
| Sh. Dec. 5, | $7^h\ 40^m$ | Dec. 5, $1^h\ 38^m\ 22^s.24+$ | $8°\ 55'\ 33''.9$ N. |
| Long. in T. | 3 2 W. | 6, 1 38 35.10+ | 8 57 2 .0 N. |
| Gr. Dec. 5, | 10 42 | 12 .86+ | 1 28 .1 N. |
| | 2.92283 | 2.08894 | |
| | .35083 | .35083 | |
| | 3.27366 | 2.43977 | |
| | sec. | " | |
| | h m 5.75+ | h m 39.2 N. | |
| | 1 35 22.24+ | 8 55 33.9 N. | |
| R. A. | 1 38 28.0 | Decl. 8 56 13.1 N. | |

### *To take out the Equation of Time.*

(190.) Get a Gr. date as in Art. 185, or as in note thereto. Take from the Nautical Almanac (p. II.) the equation of time for mean noon of the given day, and mark it A when *additive to Apparent Time*, and S when *subtractive from Apparent Time**. Proceed then as in taking out the sun's declination: using p. 16 of Naut. Tables.

*Ex.* Required the equation of time for the following dates in mean time: (1) Ship, April 3, $1^h\ 20^m$ A.M. in longitude 62° 30′ E. (2) Ship, April 15, $10^h\ 45^m$ P.M. in longitude 53° 45′ W.

| (1) | | (2) | |
|---|---|---|---|
| Ship, April 2, | $13^h\ 20^m$ | Ship, April 15, | $10^h\ 45^m$ |
| Long. in T. | 4 10 E. | Long. in T. | 3 35 W. |
| Gr. April 2, | 9 10 | Gr. April 15, | 14 20 |
| Eq. T. April 2, | $3^m\ 42^s.80$ A. | April 15, | $0^m\ 4^s.30$ A. |
| 3, | 3 24 .74 A. | 16, | 0 10 57 S. |
| | 18 .06 S. | | 14.87 S. |
| | 2.77815 | | 2.86024 Naut. Tab. |
| | .41800 | | .22387 p. 16. |
| | 3.19615 | | 3.08411 |
| | $0^m\ 6^s.9$ S. | | $0^m\ 8^s.9$ S. |
| | 3 42.8 A. | | 0 4 .3 A. |
| | 3 35.9 A. | | 0 4 .6 S. |

The proportional part of the equation of time, and also that of moon's semid. and hor. par., may also be taken from table of prop. parts. (See opp. p. to 216, in Naut. Tables.)

### *To take out the Right Ascension of the Mean Sun.*†

(191.) This may be taken out precisely in the same manner as the right ascension of the true sun (see Art. 187.) Or it may be taken out perhaps more readily and exactly thus:

To the right ascension of the mean sun at the mean noon preceding the reduced Greenwich date, add the increase of the mean sun's right ascension for the hours, for the minutes, and for the seconds of the Greenwich date (see Naut. Tables, p. 12*); the sum (diminished by $24^h$ if greater than $24^h$) will be the right ascension required.

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* This is known from heading of Equation of Time in page I of Nautical Almanac for each month. Care must be taken not to use the heading (as at present) in page II, which it would be useful perhaps to erase, and to mark each Equation of Time from page I with letter A or S as applied to Apparent Time to get Mean Time.

† The right ascension of the mean sun is found in the Nautical Almanac under the head *Sidereal Time*. In the computations of Nautical Astronomy it is an element of very extensive use for general purposes, and the words "R. A. Mean Sun" might be added to the heading, as at present, with advantage.

*Ex.* Required the right ascension of the mean sun for the following date, Ship, Dec. 6, 1834, at $0^h\ 46^m$, in longitude 135° 7′ 30″ E.

| | | | |
|---|---|---|---|
| Ship, Dec. 5, | $24^h\ 46^m\ 0^s$ | Dec. 5, | $16^h\ 55^m\ 13^s.12$ |
| Long. in T. | 9 0 30 E. | For | $15^h$ 2 27 .847 |
| | | For | $45^m$ 7 .393 |
| Gr. Dec. 5, | 15 45 30 | For | 30° 0.082 |
| | | R. A. req$^d$. | 16 57 48.44 |

*To take out the Moon's Declination and Right Ascension.*

(192.) Get a Gr. date as in Art. 185, or as in note thereto. Take out the moon's declination for the hour immediately preceding the Greenwich date, and under it write down the moon's declination at the hour immediately following the Greenwich date, marking each with its proper sign N. or S. When the signs are *like*, take the *difference*, marking it with the name of either when the latter is the greater, and with a contrary name to either when the latter is the less. When the names are *unlike*, take the *sum*, marking it with the name of the latter.

To the *logistic logarithm* of the result (Naut. Tables, p. 13*) add the *logistic logarithm* of the minutes and seconds in the Greenwich date. The sum will be the *logistic logarithm* of the proportional part sought; which part mark with the name of the hourly difference. The sum of this proportional part and the first declination taken out, when their names are *like*, will be the declination required of the same name: their difference, when the names are *unlike*, will be the declination required, having the name of the greater.

(193.) The same rule may be used for finding the moon's right ascension from the Nautical Almanac, by marking those put down for the preceding and following hour with the sign +, adding 24 hours to the latter, when required to make it greater than the former; and rejecting 24 hours from the resulting right ascension, when it is greater than 24 hours.

*Ex.* Required the moon's right ascension and declination for Ship, Dec. 7, 1834, at $5^h\ 40^m\ 26^s$ mean time, in longitude 30° W.

| | | | | | |
|---|---|---|---|---|---|
| | h m s | | h ° ′ ″ | | h m s |
| Ship, Dec. 7, | 5 40 26 | Decl. Dec. 2, at | 7, 11 42 5.5 S. | R.A. | 23 4 5.84+ |
| Long. in T. | 2 0 0 W. | | 8, 11 30 29.3 S. | | 23 6 1.64+ |
| Gr. Dec. 7, | 7 40 26 | | 11 36.2 N. | | 1 55.80+ |
| | .71369 | | 1.49185 | | |
| | .17141 | | .17141 | | |
| | .88510 | | 1.66326 | | |
| | 0° 7′ 49″ N. | | $^h\ 1^m\ 18^s$+ | | |
| | 11 42 5.5 S. | | 23 4 6 + | | |
| Decl. | 11 34 16.5 S. | R. A. | 23 5 24 | | |

(194.) In the above rule, it is supposed that the moon's right ascen sion and declination are wanted only to the nearest second of time or space. When they are wanted with the greatest accuracy, the proportional part may be easily computed from the difference for one hour by the rule of practice. The equation of second differences may also be found by applying the rule given hereafter. But such extreme accuracy can seldom be required in the operations of nautical astronomy, for which the above rule will be found the most convenient, and also sufficiently exact.

### *To take out the Moon's Horizontal Semidiameter and Horizontal Parallax.*

(195.) Get a Gr. date as in Art. 185, or as in note thereto. Take out of the Nautical Almanac that semidiameter which is found at the mean noon or midnight immediately preceding the Greenwich date, and write under it that which is found at the mean midnight or noon immediately following the Greenwich date: marking each with the sign +. Take the difference and mark it + when the latter is the greater, and — when the latter is the less. To the *proportional logarithm* of this difference to the tenth of second (see Naut. Tab. p. 16) add the *Gr. date logarithm for the moon* (Naut. Tab. p. 13) corresponding to the hours and minutes of the Greenwich date, or if the date be more than $12^h$, the hours and minutes above $12^h$. The sum will be the *proportional logarithm* of the part required, which take from Naut. Tab. p. 16, and mark it with the same sign + or — that the whole difference above has. When the sign is + add it to the first semidiameter put down; when the sign is — subtract it therefrom. The result will be the semidiameter required.

The horizontal parallax is taken out in a similar manner.

*Ex.* Required the moon's horizontal semidiameter and horizontal parallax for the following date. Ship Dec. 5, 1834, at $6^h\ 36^m$ A.M. mean time, in longitude 45° E.

| | | Hor. Sem. | Hor. Par. |
|---|---|---|---|
| Sh. Dec. 4, $18^h\ 36^m$ | Dec. 4, at Gr. Midn. | 15′ 33″.9+ | 57′ 7″.1+ |
| Long. in T. 3 0 E. | Dec. 5, at Gr. Noon. | 15 26 .7+ | 56 40 .8+ |
| Gr. Dec. 4, 15 36 | | 7 .2— | 26 .3— |
| | | 3.17609 | 2.61347 |
| | | .52288 | .52288 |
| | | 3.69897 | 3.13635 |
| | | 2″.2— | 7″.9— |
| | | 15 33 .9+ | 57 7 .1+ |
| Hor. Sem. 15 31 .7 | | Hor. Par. 56 59 .2 | |

The required proportional part may be easily got also by the rule of practice, taking aliquot parts of 12 hours, or by page opp. to p. 216 of Naut. Tables.

### *Equation of Second Differences.*

(196.) By the rules given above, different elements may be taken from the Nautical Almanac with sufficient accuracy for the general purposes of nautical astronomy. Should greater accuracy be necessary, it is to be attained by applying to the result of the first proportion accurately got, the equation of second differences. The mode of taking this from the table and applying it is as follows :—

Take from the Nautical Almanac the two elements or quantities immediately preceding the given Greenwich date, and the two immediately following, prefixing to each its proper name or sign, and when no name is given using +.

If the second of the quantities put down be greater than the first, and they have both the same name, put down their difference with the name of either; if the second be less than the first, and they have both the same name, put down their difference with a name different from that of either: if the two quantities have different names, put down their sum with the name of the latter. A similar rule must be followed for the second and third quantities put down, and for the third and fourth. Afterwards, take the difference of these first *differences* in a similar manner, marking the results as directed. Then if the two last results have the same name, take *half* their sum and give it the name of either; if they have different names, take *half* their difference and give it the name of the greater. This call the *mean second difference.*

Enter a table of second differences* with the hours and minutes of the Greenwich date (after the time of the preceding element taken out) at the side, and with the mean second difference at the top, first the minutes and then the seconds. The sum of the parts taken out will be the *equation of second differences*, to which prefix a contrary sign to that of the mean second difference.

Then from the middle first difference compute accurately the first proportional part as usual by the proper rule given for the particular case, prefixing the name of the middle first difference. Under this put the equation of second differences, and if the names be like, take the *sum* with the name of either; if the names be unlike, take the *difference* with the name of the greater. The result will be the proportional part to be applied to the second quantity taken from the Nautical Almanac.

If the quantity be the moon's right ascension or declination taken from the Nautical Almanac for each successive hour, or the moon's distance from the sun or a fixed star put down for every three hours, the mean second difference multiplied by the *Tabular Number* (see Nautical Tables, p. 12*) will be the equation of second differences.

### *From Ship Mean Time to find Ship Sidereal Time or Right Ascension of Meridian.*

(197.) Get a Gr. date as in Art. 185, or the note thereto. For this date take out of the Nautical Almanac (p. II of each month) the *right ascension of mean sun* (note Art. 191) by rule Art. 191. Add this so taken out to *ship mean time* expressed astronomically: the sum (rejecting $24^h$

* The one in Naut. Tables is for intervals of 12 hours.

if greater than $24^h$) will be sidereal time or right ascension of meridian (see App. 12).

*Ex.* 1. Ship May 10, 1834, $4^h\,25^m\,15^s.7$ P.M. mean time, longitude $71°\,15'\,30''$ E.: required sidereal time. R. A. of mean sun on May 9, at Gr. mean noon $3^h\,7^m\,16^s.44$; on May 10, $3^h\,11^m\,13^s.00$.

*Ex.* 2. Ship Dec. 21, 1834, $2^h\,55^m\,19^s.2$ A.M. mean time, longitude $45°\,45'\,15''$ W.: required sidereal time. R. A. of mean sun on Dec. 20, at Gr. mean noon $17^h\,54^m\,21^s.50$; on Dec. 21, $37^h\,58^m\,18^s.05$.

| (1.) | | | | | (2.) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ship, May 9 . . | $28^h$ | $25^m$ | $15^s.7$ | | Ship, Dec. 20 . | $14^h$ | $55^m$ | $19^s.2$ | |
| Long. in T. . . | 4 | 45 | 2 | E. | Long in T. . . | 3 | 3 | 1 | W. |
| Gr. May 9. . . . | 23 | 40 | 13.7 | | Gr. Dec. 20 . . | 17 | 58 | 20.2 | |
| R. A. mean Sun | 3 | 11 | 9.75 | | R. A. mean Sun | 17 | 57 | 18.64 | |
| Ship, May 10 . | 4 | 25 | 15.7 | | Ship, Dec. 20 . | 14 | 55 | 19.2 | |
| Sid. T. . . . . | 7 | 36 | 25.45 | | Sid. T. . . . . | 8 | 52 | 37.84 | |

### *From Ship Sidereal Time or Right Ascension of Meridian to find Ship Mean Time.*

(198.) Get a Gr. date as in Art. 185, or as in note thereto. For this date take from the Nautical Almanac the *right ascension of mean sun* (see note, Art. 191), which subtract from the *given sidereal time* (increased by $24^h$ if less than the right ascension of mean sun): the remainder will be ship mean time. (See App. 12.)

If the assumed ship mean time has been erroneous, repeat the operation, using the last resulting ship mean time for estimated ship mean time.

*Ex.* 1. Ship May 10, 1834, at $4^h\,10^m$ P.M. (mean time nearly), in longitude $80°\,15'\,30''$ E., sidereal time was $7^h\,36^m\,25^s.4$: required correct ship mean time. R. A. of mean sun on May 9 at Gr. mean noon $3^h\,7^m\,16^s.44$; on May 10, $3^h\,11^m\,13^s.0$.

*Ex.* 2. Jan. 3, 1834, at $6^h$ A. M. (mean time nearly), in longitude $110°\,30'$ W., sidereal time was $0^h\,50^m\,12^s.5$: required correct ship mean time. R. A. mean sun on Jan. 3, at Gr. mean noon $18^h\,50^m\,30^s.58$; on Jan. 4, $18^h\,54^m\,27^s.13$.

| (1.) | | | | | (2.) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sh. May 9 . . . | $28^h$ | $10^m$ | $0^s$ | | Sh. Jan. 2 . . . | $18^h$ | $0^m$ | $0^s$ | |
| Long. in T. . . | 5 | 21 | 2 | E. | Long. in T. . . | 7 | 22 | 0 | W. |
| Gr. May 9 . . . | 22 | 48 | 58 | | Gr. Jan. 3 . . . | 1 | 22 | 0 | |
| R. A. mean Sun. | $3^h$ | $11^m$ | $1^s.3$ | | R. A. mean Sun. | $18^h$ | $50^m$ | $44^s.0$ | |
| S. T. . . . . | 7 | 36 | 25.4 | | S. T. . . . . | 24 | 50 | 12.5 | |
| Sh. mean T. . . | 4 | 25 | 24.1 | | Sh. mean T. . . | 5 | 59 | 28.5 | |
| By repetition . | 4 | 25 | 20.7 | | | | | | |

*From Ship Mean Time to find the Hour Angle in Time of a Heavenly Body.*

(199.) Get a Gr. date as in Art. 185, or as in note thereto. For this Greenwich date take from the Nautical Almanac the right ascension of the mean sun (note Art. 191); also the right ascension of the heavenly body. Add together *ship mean time* (expressed astronomically) and the *right ascension of the mean sun*: from the sum, increased if necessary by $24^h$, subtract the *right ascension of the heavenly body*: the remainder, diminished by $24^h$ if greater than $24^h$, will be the hour angle in time *west* of meridian. If the hour angle be wanted *east* of meridian, subtract the hour angle thus found from $24^h$. (See App. 13.)

*Ex.* 1. Ship, Dec. 10, 1834, at $9^h\ 10^m\ 42^s$ P.M. mean time, in longitude $72°\ 25'\ 30''$ E.; required the hour angle in time of $\alpha$ Tauri (Aldebaran). R. A. mean sun on Dec. 10 at Gr. mean noon $17^h\ 14^m\ 55^s.91$; on Dec. 11, $17^h\ 18^m\ 52^s.47$. R. A. $\alpha$ Tauri $4^h\ 26^m\ 27^s.6$.

*Ex.* 2. Ship, Oct. 17, 1834, at $0^h\ 40^m\ 15^s$ A.M. mean time, in longitude $110°\ 20'$ W.; required the hour angle of the moon. R. A. mean sun on Oct. 16 at Gr. mean noon $13^h\ 38^m\ 5^s.34$; on Oct. 17, $13^h\ 42^m\ 1^s.89$. R. A. moon, Oct. 16 at $20^h$, $1^h\ 19^m\ 11^s.66$; at $21^h$, $1^h\ 20^m\ 59^s.47$.

| (1.) | | | | (2.) | | | |
|---|---|---|---|---|---|---|---|
| Sh. Dec. 10 . . | $9^h$ | $10^m$ | $42^s$ | Sh. Oct. 16 . . | $12^h$ | $40^m$ | $15^s$ |
| Long. in T. . . | 4 | 49 | 42 E. | Long. in T. . . | 7 | 21 | 20 W. |
| Gr. Dec. 10 . . | 4 | 21 | 0 | Gr. Oct. 16 . . | 20 | 1 | 35 |
| R. A. mean Sun | 17 | 15 | 38.8 | R. A. mean Sun. | 13 | 41 | 22.73 |
| Sh. mean T. . | 9 | 10 | 42 | Ship mean T. . | 12 | 40 | 15 |
| S. T. . . . . | 26 | 26 | 20.8 | S. T. . . . . | 26 | 21 | 37.73 |
| R. A. $\alpha$ Tauri . | 4 | 26 | 27.6 | R. A. moon . . | 1 | 19 | 14.5 |
| Hour angle . . | 21 | 59 | 53.2 W. | Hour angle . . . | 1 | 2 | 23.2 W. |
| Or . . . . . | 2 | 0 | 6.8 E. | | | | [rejecting $24^h$ |

*From Ship Mean Time to find the Hour Angle in Time of the Sun.*

(200.) Get a Gr. date as in Art. 185, or as in note thereto. For this Greenwich date take from the Nautical Almanac the equation of time with its proper sign (Art. 190), putting A for *additive* and S for *subtractive*. When the equation of time is *additive*, subtract it from ship mean time expressed astronomically (adding $24^h$ if necessary); when the equation of time is *subtractive*, add it to ship mean time expressed astronomically: the result (rejecting $24^h$ if greater than $24^h$) will be the hour angle in time WEST of meridian.

If the hour angle of the sun be required *east* of meridian, subtract the result from 24 hours.

*Ex.* 1. Jan. 10, 1834, at $3^h\ 10^m\ 15^s$ P.M. (mean time) in longitude $100°\ 20'$ E., required the hour angle (in time) of the sun *west* of meridian, Equation of Time on Jan. 9 at Gr. mean noon $7^m\ 24^s.19$ A.; on Jan. 10, $7^m\ 48^s.91$ A.

*Ex.* 2. Oct. 16, 1834, at $9^h\ 50^m\ 26^s$, A.M. (mean time) in longitude $73°\ 46'$ W.: required the hour angle in time of the sun *west* of meridian, also *east* of meridian. Equation of Time on Oct. 16, at Gr. mean noon $14^m\ 17^s.9$ S.; on Oct. 17, $14^m\ 30^s.3$ S.

| (1.) | | | | (2.) | | | |
|---|---|---|---|---|---|---|---|
| Sh. Jan. 9 . . | $27^h$ | $10^m$ | $15^s$ | Sh. Oct. 15 . . | $21^h$ | $50^m$ | $26^s$ |
| Long. in T. . . | 6 | 41 | 20 E. | Long. in T. . . | 4 | 55 | 4 W. |
| Gr. Jan. 9 . . | 20 | 28 | 55 | Gr. Oct. 16 . . | 2 | 45 | 30 |
| Eq. T. . . . . | | 7 | 45.3 A. | Eq. T. . . . . | | 14 | 19.3 S. |
| Sh. mean T. . . | 3 | 10 | 15 | Sh. mean T. . | 21 | 50 | 26 |
| Hour angle . . | 3 | 2 | 29.7 W. | Hour angle . . | 22 | 4 | 45.3 W. |
| | | | | Or . . . . . | 1 | 55 | 14.7 E. |

### *From the Hour Angle of a Heavenly Body to find Ship Mean Time.*

#### HOUR ANGLE WEST OF MERIDIAN.

(201.) Get a Gr. date as in Art. 185, or as in note thereto. For this date take from the Nautical Almanac the right ascension of the mean sun (Art. 191), and also the right ascension of the heavenly body. To the *hour angle* (supposed west of meridian) add the *right ascension of the body:* the sum will be sidereal time or right ascension of meridian. From this (increased if necessary by $24^h$) subtract the *right ascension of the mean sun:* the remainder will be ship mean time. (See App. 13.)

When the resulting ship mean time differs considerably from that assumed in getting a Greenwich date, go through the work again with the resulting ship mean time instead of that first estimated.

#### HOUR ANGLE EAST OF MERIDIAN.

Subtract the hour angle from $24^h$; the remainder may be considered as an hour angle *west* of meridian: proceed with this remainder as in the last case.

*Ex.* 1. Ship, Dec. 12, 1834, at $1^h\ 6^m$ A.M. mean time nearly, in longitude $65°\ 25'$ E., the hour angle of $\alpha$ Taurus (Aldebaran) was $2^h\ 0^m\ 6^s.6$ W.: required correct ship mean time. R. A. mean sun on Dec. 11 at Gr. mean noon $17^h\ 18^m\ 52^s.47$; on Dec. 12, $17^h\ 22^m\ 49^s.03$; R. A. $\alpha$ Taurus, $4^h\ 26^m\ 27^s.6$.

*Ex.* 2. Ship, Jan. 3, 1834, at $0^h\ 9^m$ A. M. (mean time nearly), in longitude $111°\ 30'$ E., the hour angle of the moon was $5^h\ 56^m\ 8^s.7$ E.: required correct ship mean time. R. A. mean sun on Jan. 2 at Gr. mean noon $18^h\ 46^m\ 34^s.02$, on Jan. 3, $18^h\ 50^m\ 30^s.58$; R. A. of moon on Jan. 2, at $4^h$, $12^h\ 51^m\ 25^s.42$; at $5^h$, $12^h\ 53^m\ 34^s.26$.

| (1.) | | | | | (2.) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sh. Dec. 11 . . | 13h | 6m | 0s | | Sh. Jan. 2 . . | 12h | 9m | 0s | |
| Long. in T. . . | 4 | 21 | 40 | E. | Long. in T. . . | 7 | 26 | 0 | E. |
| Gr. Dec. 11 . . | 8 | 44 | 20 | | Gr. Jan. 2 . . | 4 | 43 | 0 | |
| Hour Angle . . | 2 | 0 | 6.6 | W. | Hour Angle . . | 18 | 3 | 51.3 | W. |
| R. A. $\alpha$ Taurus. | 4 | 26 | 27.6 | | R. A. Moon . . | 12 | 52 | 57.5 | |
| Adding 24h . . | 30 | 26 | 34.2 | | | 30 | 56 | 48.8 | |
| R. A. mean Sun | 17 | 20 | 18.6 | | R. A. mean Sun | 18 | 47 | 20.5 | |
| Sh. mean T. . . | 13 | 6 | 15.6 | | Sh. mean T. . . | 12 | 9 | 28.3 | |

*From the Hour Angle in Time of the Sun* WEST *of Meridian, or Apparent Time, to find Ship Mean Time.*

(202.) The rule given in the last article may be applied to the hour angle of the sun, but the following rule will be more easy.

Get a Gr. date as in Art. 185, or as in note thereto. For this Greenwich date take from the Nautical Almanac the equation of time with its proper sign A. or S. (see Art. 190). Apply this *equation of time* to the given *hour angle* with its proper sign (adding 24h if necessary): the result (rejecting 24h if greater than 24h) will be ship mean time.

If the hour angle (in time) of the sun be given *east* of the meridian, subtract it from 24h to get the hour angle *west* of meridian or apparent time, with which proceed as above.

*Ex.* 1. Ship, April 10, 1834, at 3h 10m P.M. mean time nearly, in longitude 38° 6′ 30″ W. the hour angle of the sun W. or app. time was 3h 9m 25s.7; required correct ship mean time. Eq. T. on April 10, at Gr. mean noon 1m 23s.39 A.; on April 11, 1m 7s.0 A.

*Ex.* 2. Oct. 16, 1834, at 10h 25m A.M. mean time nearly, in longitude 52° 10′ E. the hour angle of the sun W. or app. time was 22h 39m 45s; required correct ship mean time. Eq. T. on Oct. 15 at Gr. mean noon 14m 4s.93 S.; on Oct. 16, 14m 17s.9 S.

| (1.) | | | | (2.) | | | |
|---|---|---|---|---|---|---|---|
| Sh. April 10 . . | 3h | 10m | | Sh. Oct. 15 . . . . | 22h | 25m | |
| Long. in T. . . . | 2 | 32 | W. | Long. in T. . . . . | 3 | 29 | E. |
| Gr. April 10 . . . | 5 | 42 | | Gr. Oct. 15 . . . . | 18 | 56 | |
| Eq. T. . . . . | 1m | 19s.5 | A. | Eq. T. . . . . | 14m | 15s.2 | S. |
| Hour Angle . | 3 | 9 | 25.7 | Hour Angle . | 22 | 39 | 45 |
| Sh. M. T. . . | 3 | 10 | 45.2 | Sh. M. T. . | 22 | 25 | 29.8 |

*To find Ship Mean Time when any Heavenly Body is on the Meridian.*

(203.) Get a Gr. date* as in Art. 185, or as in note thereto. For this Greenwich date take from the Nautical Almanac the right ascension of

* Ship mean time may be known nearly by subtracting the right ascension of mean sun taken out of the Nautical Almanac by inspection for the estimated nearest noon, from the right ascension of the heavenly body, increased if necessary by 24 hours.

mean sun (Art. 191), and the right ascension of the heavenly body, which at the instant of its meridian passage is the right ascension of the meridian or sidereal time. From the *right ascension of the heavenly body*, increased if necessary by $24^h$, subtract the *right ascension of mean sun*. The remainder will be ship mean time. (See App. 12.)

*When the M. T. of the inferior meridian passage is required:* find a Gr. date as in Art. 185, or as in note thereto (the ship M. T. being known nearly by adding $12^h$ to the time of the superior mer. passage*). For that date take from the Naut. Almanac the R. A. of the body, to which add $12^h$. Take out also the R. A. of the mean sun. Subtract the latter from the former, adding $24^h$ to the former if the less of the two. The result will be the M. T. required.

*For the sun*, the M. T. of the inferior meridian passage is got by applying to $12^h$ the equation of time, taken out for Gr. date, with its proper sign, that is, its sign as applied to apparent time. (See Art. 190.)

If the result differ much from the first estimated ship mean time, the work must be repeated, using the resulting time for estimated ship time.

*Ex.* 1. Ship, June 1, at $2^h\ 57^m$ P.M. mean time nearly, in longitude $65°\ 15'$ E., required the ship mean time of the meridian passage of $\beta$ Gemini (Pollux). R. A. mean sun on May 31, at Gr. mean noon $4^h\ 34^m\ 0^s.68$, on June 1, $4^h\ 37^m\ 57^s.24$. R. A. of $\beta$ Gemini $7^h\ 35^m\ 8^s.0$.

*Ex.* 2. Ship, Feb. 21, 1834, at $0^h\ 1^m$ A.M. mean time nearly, in longitude $150°\ 30'$ W., required the ship mean time of the meridian passage of $\alpha$ Leo (Regulus). R. A. M. sun on Feb. 20, at Gr. mean noon, $21^h\ 59^m\ 45^s.26$, on Feb. 21, $22^h\ 3^m\ 41^s.82$; R. A. of $\alpha$ Leo $9^h\ 59^m\ 32^s.3$.

| (1.) | | | | (2.) | | | |
|---|---|---|---|---|---|---|---|
| Sh. May 31 . . . | $26^h$ | $57^m$ | | Sh. Feb. 20 . . . | $12^h$ | $1^m$ | |
| Long. in T. . . . | 4 | 21 | E. | Long. in T. . . . | 10 | 2 | W. |
| Gr. May 31 . . . | 22 | 36 | 0 | Gr. Feb. 20 . . . | 22 | 3 | 0 |
| | | | | R. A. $\alpha$ Leo. . . | 33 | 59 | 32.3 |
| R. A. $\beta$ Gem. . . . | 7 | 35 | 8.0 | R. A. M. Sun. . | 22 | 3 | 22.6 |
| R. A. M. Sun. . . | 4 | 37 | 43.4 | | | | |
| | | | | Sh. mean T. . . | 11 | 56 | 9.7 |
| Sh. mean T. . . . | 2 | 57 | 24.6 | | | | |
| | | | | Work repeated . | 11 | 56 | 5.1 |

*To find Ship Mean Time when the Sun is on the Meridian, or the Ship Mean Time of Apparent Noon.*

(204.) Get a Gr. date* as in Art. 185, or as in note thereto. For this Greenwich date take from the Nautical Almanac the equation of time. When *additive* (see note to Art. 190) add *the equation of time* to $0^h\ 0^m\ 0^s$, and the result will be ship mean time on the given day: when *subtractive*,

* To get ship mean time nearly, the eq. of time may be taken out at the estimated nearest Greenwich mean noon. If additive, add it to 0h. 0m. 0s., and put the given day; if subtractive, subtract it from 24 hours, and put the preceding day to the given one.

subtract it from $24^h$, and the result will be ship mean time, putting the day one back.

*Ex.* 1. Required the ship mean time, when the sun passed the meridian on Oct. 15, 1834, in longitude 75° 15′ W.; and also on Jan. 28, 1834, in longitude 25° 10′ E. Eq. T. on Oct. 15, at Gr. mean noon, $14^m 4^s.93$ S.; on Oct. 16, $14^m 17^s.90$ S.; on Jan. 27, $13^m 4^s.24$ A.; on Jan. 28, $13^m 15^s.84$ A.

| (1.) | | | | | (2.) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sh. Oct. 14 . . . | $23^h$ | $46^m$ | | | Sh. Jan. 27 . . . | $24^h$ | $13^m$ | | |
| Long. in T. . . . | 5 | 1 | W. | | Long. in T. . . . | 1 | 41 | E. | |
| Gr. Oct. 15 . . . | 4 | 47 | | | Gr. Jan. 27 . . . | 22 | 32 | | |
| | 24 | 0 | 0 | | | 0 | 0 | 0 | |
| Eq. T. . . . . | | 14 | 7.4 | S. | Eq. T. . . . . | | 13 | 15.1 | A. |
| Sh. M. T. Oct. 14, | 23 | 45 | 52.6 | | Sh. M. T. Jan. 28, | 0 | 13 | 15.1 | |

(205.) The ship mean time of the meridian passage of a planet or the moon may be found correctly as in Art. 203. But for many purposes that of a planet may be taken out by inspection from the Nautical Almanac for the nearest Greenwich mean noon; and that of the moon with sufficient accuracy as follows:—

*For the Moon:* take the Greenwich mean time of the moon's meridian passage from the Nautical Almanac on the given day *expressed astronomically* (see Art. 162); also take out the difference between this and the following meridian passage when the longitude is W., and the difference between this and the preceding one when the longitude is E. With this difference and the longitude enter Naut. Tab. (*k*), p. 5, and take out the corresponding correction, which *add* to the time of Greenwich meridian passage in W. longitude, and *subtract* it in E. longitude. The result will be the ship mean time of meridian passage.

*Ex.* 1. Required the ship mean time of moon's meridian passage on July 19, 1834 (astronomical day), in longitude 60° W.; and on July 27, 1834 (astronomical day), in longitude 175° E.

| (1.) | h | m | | (2.) | h | m | |
|---|---|---|---|---|---|---|---|
| Gr. mer. pass. July 19, | 11 | 24.3 | + | Gr. mer. pass. July 27, | 17 | 30.1 | + |
| 20, | 12 | 19.2 | + | 26, | 16 | 49.5 | + |
| Diff. . . . . | | 54.9 | + | Diff. . . . . | | 40.6 | − |
| Tab. Corr. . . . . | | 9 | + | Tab. Corr. . . . . | | 19 | − |
| Sh. mer. pass. July 19, | 11 | 33.3 | | Sh. mer. pass. July 27, | 17 | 11.1 | |
| | | | | Or July 28 . . . . | 5 | 11.1 | A.M. |

### *To find the Meridian Zenith Distance of a Heavenly Body.*

(206.) Get a Gr. date as in Art. 185, or as in note thereto. For this take from the Nautical Almanac the declination of the heavenly body. Under the *latitude* of the place put the *declination*, marking each with its

proper sign N. or S. When the names are *like*, take the difference; marking it with the *common* name if the declination be the greater; and with a *contrary* sign to the common one if the declination be the less. When the names are *unlike*, take the sum, and put to it the name of the declination. The result in every case will be the meridian zenith distance N. or S. of the zenith. (See App. 14.)

| (1.) | (2.) | (3.) |
|---|---|---|
| Lat. 20° 48′ 0″ N. | Lat. 50° 48′ 0″ N. | Lat. 22° 15′ 0″ S. |
| Decl. 25 25 17.5 N. | Decl. 28 25 17 N. | Decl. 12 46 30 N. |
| M. Z. 4 37 17.5 N. | M. Z. 22 22 43 S. | M. Z. 35 1 30 N. |

*To find what principal Stars will pass the Meridian between any given Ship Dates in Mean Time.*

(207.) For each given ship mean time get a Greenwich date as in Art. 185, or as in note thereto. For each date take from the Nautical Almanac the right ascension of mean sun (Art. 191). Add together each *ship mean time* and the corresponding *right ascension of mean sun* (rejecting $24^h$ from either sum if greater than $24^h$). Then all the stars in the catalogue of the Nautical Almanac whose right ascensions are found to be between the two results taken in order as limits, will pass the meridian between the given ship times. (See App. 12.)

*Ex.* What principal fixed stars will pass the meridian in longitude 75° 15′ W. between $11^h$ P.M. on Oct. 24, 1834, and $1^h$ $1^m$ A.M. on Oct. 25? R. A. M. Sun on Oct. 24, at Gr. noon $14^h$ $9^m$ 37ˢ.77, on Oct. 25, $14^h$ $13^m$ 34ˢ.32.

| | |
|---|---|
| Sh. Oct. 24 . . . $11^h$ $0^m$ | Sh. Oct. 24 . . . $13^h$ $0^m$ |
| Long. in T. . . . 5 1 W. | Long. in T. . . . 5 1 W. |
| Gr. Oct. 24 . . . 16 1 | Gr. Oct. 24 . . . 18 1 |
| R. A. M. Sun . . $14^h$ $12^m$ 15ˢ.6 | R. A. M. Sun . . $14^h$ $12^m$ 35ˢ.3 |
| Sh. M. T. . . . . 11 0 0 | Sh. M. T. . . . . 13 1 0 |
| R. A. Mer. . . . 1 12 15.6 | R. A. Mer. . . . . 3 13 35.3 |

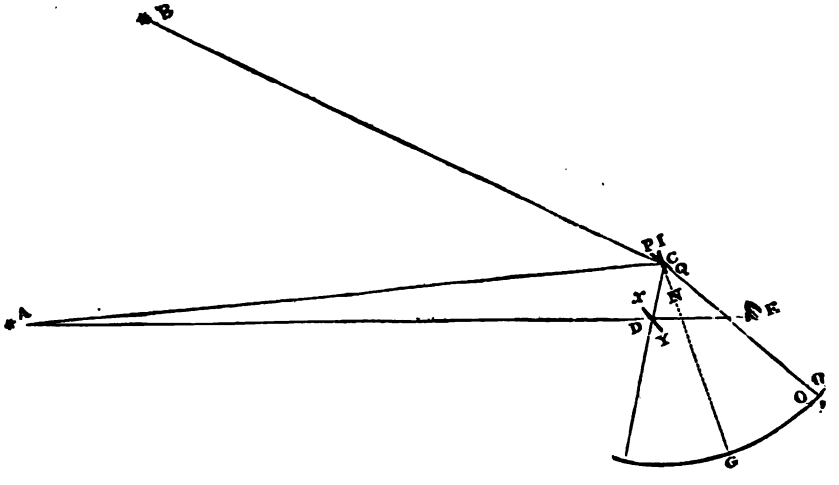
The required stars are from $\theta'$ Cetus to $\alpha$ Perseus inclusive.

# CHAPTER III.

*Finding Latitude and Longitude of Ship, &c., by Astronomical Observations.*

(208.) In this Chapter we shall enter on the main business of Nautical Astronomy, which is to determine by astronomical observations the latitude and longitude of a ship at sea, and the variation of the compass. It may be proper, however, to say a few words in the first place on the mode of observing the altitude of a heavenly body at sea, and on the corrections necessary to be applied, in order from the observed altitude to get the true altitude. The instrument used in taking the altitude of a heavenly body at sea is Hadley's Sextant, of which the following may serve as a slight sketch; hereafter a fuller account will be given of it.

Two plane reflectors are placed on a brass sextant (see *fig.*), one C at the centre, and the other D at some distance from the centre on the farther limb; both are perpendicular to the plane of the instrument. To the central reflector a radius of the sextant with an index G is attached, by moving which on the graduated arc the reflector is turned round, still remaining perpendicular to the sextant. The other reflector is fixed.




The observer places his eye at E opposite to the fixed reflector, and in taking the altitude of a heavenly body as B, directs his view to the point of the visible horizon as A immediately under the body. He then pushes

forward on the arc the moveable radius, and thereby turns round the central glass C, till a ray of light coming from the heavenly body is reflected by it to the fixed glass D, which again reflects the same ray to the eye; so that it enters the eye in the same line as a ray coming from the before-mentioned point A of the horizon viewed directly.

The effect is, that the heavenly body is seen at this point. The degrees, &c., through which the index on the moveable radius has been carried on the arc is then read off: this reading off is *nearly* the apparent altitude of the body. There may be two reasons why it is not so *exactly*. First, the divisions on the arc should commence from the point where the index stands, when the two reflectors are parallel, which is seldom the case. Hence it happens, that the reading off may be something too great or too little. The necessary correction is called the *index correction*, and is sometimes additive (+) and sometimes subtractive (—). Secondly, it must be considered, that the apparent altitude is the angular distance of the body from a horizontal plane passing through the observer's eye; whereas its elevation is taken above a point of the sea, which lies a little below the level of the eye. The observed altitude therefore must on this account be too great. The necessary corrections for different heights of the eye are computed, and put in a table under the name of *dip of the horizon*, whence they may be taken by inspection (see Nautical Table (*e*), p. 3).

When the sun is observed, the altitude of the lower limb is usually taken: this being corrected for index correction and dip, we have the apparent altitude of the lower limb. To this the sun's semidiameter taken from the Nautical Almanac being added, we have the apparent altitude of the centre (A.A.). In this case, therefore, the sun's semidiameter may be considered as a third correction. When the moon is observed, sometimes the altitude of the lower limb is taken, and sometimes that of the upper limb: in the former case the moon's semidiameter must be added, and in the latter subtracted.

The observed altitude, after being corrected as above, is afterwards farther corrected for parallax and refraction, as in Art. 130. The result is the true altitude (T.A.).

### *To find the Latitude by the Meridian Altitude of a Heavenly Body.*

(209.) The meridian altitude of a heavenly body is observed at sea as follows. About a quarter of an hour before the heavenly body will be on the meridian, the observer goes on deck and takes its altitude (208): in a minute or two he again looks at the point of the horizon under the body without altering the place of the index on his instrument; and if the altitude has increased, the point of the image that before touched the horizon will now be separated a little from it. Should this be the case, he pushes forward the index till a fresh contact is made.

A similar process is gone through till the altitude increases very slowly, and the separation of the image from the horizon is scarcely perceptible. This shews that the body is very nearly on the meridian; and it is then necessary to make the contact with greater nicety, to examine it constantly, and if the slightest new separation appear, to alter the index very gradually and carefully by the tangent screw, till at length the image is quite stationary. The body is at that instant on the meridian, after passing which its altitude will diminish and the image will appear to dip a little

below the horizon. The observer usually waits till this is the case, taking care not to alter the index after the stationary appearance of the image, unless it again rise: he then reads off the degrees, minutes, and seconds on the arc, and thus gets the observed meridian altitude of the body, or rather of that point of the body which is made to touch the horizon. This being corrected for the index correction of the instrument, dip, semidiameter, refraction, and parallax, the true altitude is deduced; and by subtracting the true altitude from 90° the true *zenith distance* is found. Now if we know the declination of the body, or the distance of the body from the equator, and also, as above, its meridian distance from the zenith, it is manifest that we can find, from these two arcs, the distance of the equator from the zenith, or the latitude.

(210.) RULE. Get a Gr. date as in Art. 185, or as in note thereto. For this date take from the Nautical Almanac:

(1.) *For Sun;* the declination and semidiameter as in Art. 186.

(2.) *For Moon;* the declination, hor. semidiameter, and hor. parallax as in Arts. 192, 195.

(3.) *For Planet;** the declination as in Art. 189.

(4.) *For Fixed Star;* the declination.

(211.) Correct the observed meridian altitude as follows:

(1.) *For Sun;* index correction + or − according to its sign; dip −; semidiameter + (L. L. being observed); parallax and refraction −.

(2.) *For Moon;* index correction + or −; dip −; semidiameter + when L. L. observed; − when U. L. observed; parallax and refraction +.

(3.) *For Planet,* its centre being observed; index correction + or −; dip −; refraction as for a fixed star −; in strictness for parallax +.

(4.) *For Fixed Star;* index correction + or −; dip −; refraction −.

Take the result from 90° and call it M. Z. (meridian zenith distance), N. when the zenith is *north* of the body, and S. when the zenith is *south* of the body.

Put under M. Z. the declination with its proper name N. or S. If the names be *like*, take the *sum*, which will be the latitude of the same name with either: if the names be *unlike*, take the *difference*, which will be the latitude having the name of the greater. (See App. 14.)

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* The centre of the planet, as nearly as the eye can judge, is supposed to be brought down to the horizon. The small correction for parallax *additive*, which would require the hor. parallax (see Naut. Tables), is here supposed to be neglected.

*Ex.* 1. Oct. 25, 1834, at $11^h\ 44^m$ A.M. (see note Art. 204), in longitude 43° 30′ W. the observed meridian altitude of the sun's L. L. was 43° 25′ 10″ zenith S. of sun; the index correction was — 2′ 10″, and the height of the eye above the sea was 16 feet: required the latitude. Decl. on Oct. 25 at Gr. mean noon 12° 2′ 42″ S.; on Oct. 26, 12° 23′ 23″ S.; semid. 16′ 7″.

*Ex.* 2. Sept. 17, at $11^h\ 59^m$ P.M. mean time nearly, in longitude 84° 40′ W. the observed meridian altitude of the moon's U. L. was 39° 25′ 40″ zenith N. of moon; the index correction was + 2′ 50″, and the height of the eye above the sea was 0 feet: required the latitude. Decl. on Sept. 17, at $17^h$, 5° 35′ 34″.3 S., at $18^h$, 5° 23′ 24″.6 S.; hor. semid. on Sept. 17 at Gr. mean midn. 14′ 45″.9, on Sept. 18 at Gr. mean noon 14′ 44″.5; corresponding hor. par. 54′ 11″ and 54′ 5″.7.

| (1.) | | | | | (2.) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sh. Oct. 24 . . | $23^h$ | $44^m$ | | | Sh. Sept. 17 . | $11^h$ | $59^m$ | | |
| Long. in T. . . | 2 | 54 | | W. | Long. in T. . . | 5 | 39 | | W. |
| Gr. Oct. 25 . . | 2 | 38 | | | Gr. Sept. 17 . | 17 | 38 | | |
| Sun's decl. . | 12° | 4′ | 58″ | S. Art. 186. | Moon's decl. | 5° | 27′ | 52″ | S. Art. 192. |
| Obs. Alt.. . | 43 | 25 | 10 | | Hor. semid. | | 14 | 45.3 | |
| Ind. Cor.. . | | 2 | 10 | — | Hor. Par. . | | 54 | 8.5 | |
| | | | | | Obs. Alt. | 39° | 25′ | 40 | |
| Obs. Alt. | 43 | 23 | 0 | | Ind. Cor. . | | 2 | 50 | + |
| Dip. . . . | | 3 | 56 | — | | | | | |
| | | | | | | 39 | 28 | 30 | |
| | 43 | 19 | 4 | | Semid. Aug. | | 14 | 54 | |
| Semid. . . | | 16 | 7 | + | | | | | |
| | | | | | A. A. . . . | 39 | 13 | 36 | |
| A. A. . . . | 43 | 35 | 11 | | Refr. & Par. | | 40 | 39 | + |
| Refr. & Par. | | | 55 | — | | | | 7 | + |
| T. A. . . . | 43 | 34 | 16 | | T. A. . . . | 39 | 54 | 22 | |
| M. Z. . . . | 46 | 25 | 44 | S. | M. Z. . . . | 50 | 5 | 38 | N. |
| Decl. . . . | 12 | 4 | 58 | S. | Decl. . . . | 5 | 27 | 52 | S. |
| Lat. . . . | 58 | 30 | 42 | S. | Lat. . . . | 44 | 37 | 46 | N. |

*Ex.* 3. Nov. 14, 1834, at $0^h\ 58^m$ A.M. mean time nearly, in longitude 75° 15′ W., the observed meridian altitude of the planet Jupiter was 47° 10′ 50″, zenith N. of planet; the index correction was — 4′ 10″, and the height of the eye above the sea was 14 feet: required the latitude. Planet's decl. on Nov. 13 at Gr. mean noon 20° 53′ 35″.1 N., Nov. 14, 20° 52′ 29″.4 N.

*Ex.* 4. Oct. 25, 1834, the observed meridian altitude of $\alpha$ Aquilæ (Altair) was 34° 40′ 10″, zenith S. of star; the index correction was —3′ 20″, and the height of the eye above the sea was 18 feet: required the latitude. Decl. $\alpha$ Aquilæ 8° 26′ 19″ N.

(3.)

| | | | | |
|---|---|---|---|---|
| (1.) | Sh. Nov. 13 . . . . | 12h | 58m | |
| | Long. in T. . . . . | 5 | 1 | W. |
| | Gr. Nov. 13 . . . | 17 | 59 | |
| | Planet's Decl. . . . | 20° | 52′ | 45″ N. |
| | Obs. Alt. . . . . | 47 | 10 | 50 |
| | Ind. Cor. . . . . | | 4 | 10— |
| | | 47 | 6 | 40 |
| | Dip. . . . . | | 3 | 41— |
| | A. A. . . . . | 47 | 2 | 59 |
| | Refr. (Par. neglected) | | | 54— |
| | T. A. . . . . | 47 | 2 | 5 |
| | M. Z. . . . . | 42 | 57 | 55 N. |
| | Decl. . . . . | 20 | 52 | 45 N. |
| | Lat. . . . . | 63 | 50 | 40 N. |

(4.)

| | | | | |
|---|---|---|---|---|
| (2.) | Decl. . . | 8° | 26′ | 19″ N. |
| | Obs. Alt. . | 34 | 40 | 10 |
| | Ind. Cor. . | | 3 | 20— |
| | Obs. Alt. | 34 | 36 | 50 |
| | Dip. . . . | | 4 | 11— |
| | A. A. . . | 34 | 32 | 39 |
| | Refr. . . | | 1 | 24— |
| | T. A. . . | 34 | 31 | 15 |
| | M. Z. . . | 55 | 28 | 45 S. |
| | Decl. . . | 8 | 26 | 19 N. |
| | Lat. . . . | 47 | 2 | 26 S. |

(212.) Hadley's sextant is used in observing the double altitude of a heavenly body by means of an artificial horizon, as the surface of quiescent quicksilver, oil, water, or the surface of glass or polished metal rendered horizontal. This being placed on steady ground, the observer steps back from it till he sees distinctly below the surface the image of the heavenly body. Then holding the sextant with its plane in a circle of altitude passing through the body, he sweeps forward the index, and thus brings the image formed by the two glasses to coincide with or touch the one seen in the artificial horizon. The reading off he corrects for index correction, and divides the result by 2: the quotient is the apparent altitude of the body; of its lower limb (L. L.) or upper limb (U. L.) according to circumstances. (See explanation of Nautical Instruments.)

*For the Sun.* The L. L. of image reflected from the glasses is made to touch the U. L. of the image seen in the artificial horizon.* To the reading off the index correction is applied, then *half* the result is taken, to which the sun's semidiameter is added: the sum is A. A. of centre, from which subtracting the correction for refraction and parallax, the result is T. A. which is taken from 90° for the meridian zenith distance (M. Z.) From this and the declination, the latitude is got as in Art. 211.

*For the Moon.* When the L. L. of the moon is enlightened, proceed as for the sun, taking care to augment the hor. semidiameter from Nautical Almanac. When the U. L. is enlightened, the image formed by the glasses must be brought below the image seen in the artificial horizon, so that the U. L. of the former may touch the L. L. of the latter.* Having applied the index correction to the reading off, and divided by 2, the semidiameter (augmented) must be *subtracted* to get the A. A. The correction

* When an *inverting telescope* is used, the L. L., as it appears through the telescope, is in fact the U. L. for either image, and the L. L. *apparently* is in fact the L. L.

for refraction and parallax must then be added to get the T. A., which being subtracted from 90° the result is M. Z.; from which and the declination the latitude is found as in Art. 211.

*For a Star or Planet.* The image formed by the glasses must be brought to pass exactly over the image seen in the artificial horizon. Having applied the index correction to the reading off, and divided by 2, subtract the correction for refraction*: the result will be the T. A., whence get M. Z. as for the sun, and from this and the declination get the latitude.

*Ex.* 1. On Nov. 3, 1834, at $11^h\ 44^m$ A.M. mean time nearly, in longitude 36° 29′ W. the observed *double* meridian altitude of the sun's L. L. was 50° 25′ 30″, zenith N. of the sun; the index correction was + 1′ 50″: required the latitude. Sun's decl. on Nov. 3 at Gr. mean noon 15° 1′ 20″.2 S., on Nov. 4, 15° 20′ 2.9 S.; semid. 16′ 9″.

*Ex* 2. On Nov. 3, 1834, the observed *double* meridian altitude of $\alpha$ Pavo was 160° 25′ 52″ zenith N. of Star; the index correction was + 2′ 10″: required the latitude. Decl. of $\alpha$ Pavo on Nov. 3. 57° 15′ 36″ S.

(1.)

| | | | |
|---|---|---|---|
| Sh. Nov. 2 | $23^h$ | $44^m$ | |
| Long. in T. | 2 | 26 | W. |
| Gr. Nov. 3 | 2 | 10 | |
| Sun's Decl. | 15° | 3′ | 1″ S. |
| Obs. 2 Alt. | 50 | 25 | 30 |
| Ind. Corr. | | 1 | 50+ |
| 2) | 50 | 27 | 20 |
| | 25 | 13 | 40 |
| Semid. | | 16 | 9+ |
| A. A. | 25 | 29 | 49 |
| Refr. & Par. | | 1 | 54− |
| T. A. | 25 | 27 | 55 |
| M. Z. | 64 | 32 | 5 N. |
| Decl. | 15 | 3 | 1 S. |
| Lat. | 49 | 29 | 4 N. |

(2.)

| | | | |
|---|---|---|---|
| Nov. 3. | | | |
| Decl. $\alpha$ Pavo. | 57° | 15′ | 36″ S. |
| Obs. 2 Alt. | 160 | 25 | 52 |
| Ind. Corr. | | 2 | 10+ |
| 2) | 160 | 28 | 2 |
| A. A. | 80 | 14 | 1 |
| Refr. | | | 10− |
| T. A. | 80 | 13 | 51 |
| M. Z. | 9 | 46 | 9 N. |
| Decl. | 57 | 15 | 36 S. |
| Lat. | 47 | 29 | 27 S. |

### *Latitude by Meridian Altitude under Pole.*

(213.) Sometimes the meridian altitude of a heavenly body may be observed at its inferior passage from W. to E. under the pole; in this case

* The parallax of planet is neglected. When it is necessary to attend to so small a correction, it must be added after refraction has been applied. (See Naut. Table (*e*), p. 2.)

the observed altitude previous to the meridian altitude diminishes, and the meridian altitude is the least. The rule for finding the latitude therefrom is the same nearly as in Arts. 210, 211, with this difference: instead of subtracting the true altitude (T. A.) from 90°, add it to 90°, and then subtract the declination. The result will be the latitude of the same name with the declination. (See App. 15.)

*Ex.* 1. On Jan. 20, 1834, at $0^h\ 11^m$ A.M. in longitude 92° 30′ E., the observed meridian altitude of the sun's L. L. under the south pole was 6° 10′ 40″, the index correction was +3′ 40″, and the height of the eye above the sea was 15 feet: required the latitude. Sun's decl. on Jan. 19 at Gr. mean noon 20° 22′ 27″.5 S.; on Jan. 20, 20° 9′ 41″.6 S.; semid. 16′ 16″.

*Ex.* 2. On Nov. 5, 1834, the observed meridian altitude of $\alpha$ Urs. Maj. (Dubhe) under the north pole was 10° 46′ 50″; the index correction was −1′ 15″, and the height of the eye above the sea was 16 feet: required the latitude. Decl. $\alpha$ Urs. Maj. 62° 38′ 23″ N.

(1.)

| | |
|---|---|
| Sh. Jan. 19. . | $12^h\ 11^m$ |
| Long. in T. . | 6 10 E. |
| Gr. Jan. 19 . | 6 1 |
| Sun's Decl.. . | 20° 19′ 15″ S. |
| Obs. Alt. . . | 6 10 40 |
| Ind. Corr. . . | 3 40+ |
| | 6 14 20 |
| Dip. . . . . | 3 49— |
| | 6 10 31 |
| Semid. . . . | 16 16+ |
| A. A. . . . . | 6 26 47 |
| Refr. and Par. | 7 54— |
| T. A. + 90° . | 96 18 53 |
| Decl. . . . . | 20 19 15 S. |
| Lat. . . . . | 75 59 38 S. |

(2.)

| | |
|---|---|
| Decl. of $\alpha$ Urs. Maj.. | 62° 38′ 23″ N. |
| Obs. Alt. . . . . | 10 46 50 |
| Ind. Corr. . . . . | 1 15— |
| | 10 45 35 |
| Dip. . . . . | 3 56— |
| A. A. . . . . | 10 41 39 |
| Refr.. . . . . | 4 59— |
| T. A. + 90° . . . | 100 36 40 |
| Decl. . . . . | 62 38 23 N. |
| Lat. . . . . | 37 58 17 N. |

### *Latitude from Altitude of a Heavenly Body in Bearing near the Meridian and Ship Mean Time.*

(214.) The altitude of a heavenly body may frequently be observed at sea, when it is in bearing near the meridian, that is, when it bears nearly N. or S.; although it may not be possible, on the same day, to get the meridian altitude of the body. In such a case, if ship mean time be known nearly at the instant of the observation, the latitude may still be computed with sufficient accuracy for the purpose of navigating the ship safely.* To

* At a bearing of one point from N. or S. an error of one minute of time in the hour angle will produce no greater error in the computed lat. than 2′ or 3′. (See App. 17.)

find ship mean time nearly, the time by chronometer or by a good pocket watch may be noted when the altitude is observed; then proceed as follows.

(215.) *When time is taken by a chronometer whose error is supposed known on Gr. M. T.* Apply the supposed error, and thus get Gr. M. T. When the longitude is *east*, add it in time (note Art. 185) to Gr. M. T., rejecting $24^h$ if the sum be greater than $24^h$, and putting the day one forward. When the longitude is *west*, subtract it in time from the Gr. M. T., first adding $24^h$ if necessary to Gr. M. T. and putting the day one back. The result will be ship M. T. (See *Ex.* 1.)

(216.) *When time is taken by chronometer or by a common watch, whose error is supposed known on Sh. M. T.* Apply the supposed error, and thus get Sh. M. T., from which the Gr. date may be got as in Art. 185.

(217.) For the Gr. date take from the Nautical Almanac: *For the sun*: its decl., semidiameter, and the equation of time. *For any other heavenly body*: its R. A. and decl., and the R. A. of the mean sun: *if it be the moon*, also its semidiameter and the hor. par.

(218.) From the observed altitude deduce the true zenith distance (Z. D.) as in Art. 211. Find the hour angle as in Arts. 199, 200. Then proceed by one of the following rules.

(219.) RULE 1. To the log. *havers.* of hour angle add the log. *cos.* decl. and mark the sum (*a*). To (*a*) add the log. *cos.* lat. by account, rejecting the tens in the index of sum. Find the arc *in degrees* corresponding to the result as a log. *havers.* Then take out the *nat. versine* corresponding to this arc, and subtract it from the *nat. versine* of the true zenith distance (Z. D.). The result will be the *nat. versine* of the meridian zenith distance (M. Z.), which take from the table of *nat. versines*, and mark it N. or S., according as the zenith is to the north or south of the body. Under it so marked put the declination with its proper sign N. or S. When the names are *like*, the *sum*, with the name of either, will be the *first computed latitude;* when the names are unlike, the *difference*, with the name of the *greater*, will be the *first computed latitude.*

If the *first* computed latitude differ considerably from the latitude by account, repeat the operation, by adding the log. *cos.* of first computed latitude to (*a*), and going through the rest as before. Thus get a *second computed latitude*, from which, if necessary, a third may be derived, and so on, till the two last computed latitudes do not differ essentially. (See *App.* 17.)

(220.) RULE 2. Add together log. *havers.* of hour angle, log. *cos.* decl., and 6.301030, and mark the sum (*b*). To (*b*) add log. *cos.* lat. by accoun., rejecting the tens in the sum of indices. Find the *nat. number** corresponding to the resulting logarithms, and subtract it from the *nat. versine* of the true zenith distance (Z. D). The remainder will be the *nat. versine* of the meridian zenith distance (M. Z.); from which, and the declination, find the *first computed lat.* as above in Rule 1. If the first

* If this rule be used, care must be taken to write down one more integral figure in the *nat. number* taken from the tables than the index in the logarithm expresses. For instance, if the index be 0, *one* integral figure must be written down under or over the last figure of the *nat. versine* of Z. D : if it be 1, *two* figures under or over the last two figures of the said *nat. versine;* and so on.

computed lat. *differ* considerably from the lat. by account, repeat the work, by adding the log. *cos.* of first computed lat. to (*b*), and going through the rest as before. Thus get a *second computed lat.*, and if necessary a *third*, till the last agrees sufficiently with the preceding one. (See *App.* 17.)

*Ex.* 1. Nov. 5, 1834, P.M., at $7^h\ 14^m\ 20^s$, by a chronometer which was *fast* on Gr. M. T. $1^m\ 20^s$, in latitude by account 51° N., and longitude by account 105° 15′ W., the observed altitude of the sun's L. L. was 24° 45′ 30″, bearing at the same time nearly S., and having the zenith to the N. The index correction was −2′ 10″, and the height of the eye above the sea was 14 feet: required the true latitude.

Sun's decl. on Nov. 5, at Greenwich mean noon, 15° 38′ 30″ S.; on Nov. 6, 15° 56′ 42″ S.; corresponding Eq. T. $16^m\ 14^s.4$ S., and $16^m\ 12^s.1$ S.

Gr. Nov. 5, $7^h\ 13^m$; sun's decl. 15° 43′ 58″ S.; semid. 16′ 10″ S.; Eq. T. $16^m\ 13^s.7$ S.; Tr. Z. D. 65° 6′ 7″. Hour angle $0^h\ 28^m.\ 13^s.7$.

| | First operation. | Second operation. | Third operation. |
|---|---|---|---|
| By Rule 1. | 7.578504 | | |
| | 9.983416 | | |
| (*a*) | 7.561920 | 7.561920 | 7.561920 |
| | 9.798872 | 9.816256 | 9.816361 |
| | 7.360792 | 7.378176 | 7.378281 |
| | 5° 29′ 31″ | 5° 36′ 11″ | 5° 36′ 10″.6 |
| *Nat. vers.* | 0004590 | 0004778 | 0004778 |
| | 0578990 | 0578990 | 0578990 |
| | 0574400 | .0574212 | 0574212 |
| M. Z. | 64° 48′ 41″ N. | 64° 47′ 58″ N. | 64° 47′ 58″ N. |
| | 15 43 58 S. | 15 43 58 S. | 15 43 58 S. |
| Lat. | 49 4 43 N. | 49 4 0 N. | 49 4 0 N. |

| | First operation. | Second operation. | Third operation. |
|---|---|---|---|
| By Rule 2. | 7.578504 | | |
| | 9.983416 | | |
| | 6.301030 | | |
| (*b*) | 23.862950 | 23.862950 | 23.862950 |
| | 9.798872 | 9.816256 | 9.816361 |
| | 3.661822 | 3.679206 | 3.679311 |
| *Nat. N.* | 4590 | 4778 | 4778.8 |
| | 0578990 | 0578990 | 0578990 |
| | 0574400 | 0574212 | 0574211.2 |
| M. Z. | 64° 48′ 41″ | 64° 47′ 58″ N. | 64° 47′ 57″.6 N. |
| Decl. | 15 43 58 | 15 43 58 S. | 15 43 58 S. |
| Lat. | 49 3 43 N. | 49 4 0 N | 49 3 59.6 N. |

*Ex.* 2. Oct. 23, 1834, P.M., at $4^h\ 50^m\ 0^s$, by chronometer which was *slow* on ship mean time $9^m\ 6^s$ nearly, in lat. by account 49° N., and long. by account 80° 25′ E., the obs. alt. of $\alpha$ Aquila (Altair) was 48° 2′ 20″; the bearing being nearly S., and the zenith being N. of star. The index corr. was +1′ 40″, and the height of the eye above the sea was 16 feet: required the true latitude.

R. A. mean sun, Oct. 22, at Gr. mean noon, $14^h\ 1^m\ 44^s.66$; on Oct. 23, $14^h\ 5^m\ 41^s.21$; R. A. $\alpha$ Aquila $19^h\ 42^m\ 42^s.3$; decl. $\alpha$ Aquila 8° 26′ 20″ N.

Gr. Oct. 22, $23^h\ 37^m\ 26^s$. R. A. mean sun $14^h\ 5^m\ 37^s.6$. Tr. Z. D. 42° 0′ 58″. Hour angle $23^h\ 22^m\ 1^s$ W., or $0^h\ 37^m\ 59^s$ E.

| | First operation. | Second operation. | Third operation. |
|---|---|---|---|
| By Rule 1. | 7.835766 | | |
| | 9.995274 | | |
| (*a*) . . . | 17.831040 | 17.831040 | 17.831040 |
| | 9.816943 | 9.810912 | 9.810064 |
| | 7.647983 | 7.641952 | 7.641104 |
| | 7° 38′ 48″ | 7° 35′ 37″ | 7° 35′ 10″ |
| *Nat. vers.* . | 0008893 | 0008769 | 0008752 |
| | 0257011 | 0257011 | 0257011 |
| | 0248118 | 0248242 | 0248259 |
| M. Z. . . . | 41° 14′ 47″ N. | 41° 15′ 26″ N. | 41° 15′ 31″ N. |
| Decl. . . . | 8 26 20 . | 8 26 20 N. | 8 26 20 N. |
| Lat. . . . | 49 41 7 | 49 41 46 N. | 49 41 51 N. |

(221.) The above method of finding the latitude from altitudes observed near the meridian in bearing has been supposed to be applied at sea. An erroneous latitude by account may often be thus corrected, and the true latitude ascertained with sufficient accuracy for the purpose of navigating the ship so far in security. *On shore*, the error of a chronometer on mean time at the place may be frequently ascertained correctly, either by equal altitudes (see Art. 258), or even by single altitudes sufficiently far from the meridian (see Art. 253). From the chronometer therefore (by applying this error corrected by rate if necessary) mean time at the place may be accurately found, when an altitude is observed near the meridian; and since the mean time of the mer. passage is known, as in Arts. 203, 204, the difference of the two will be the *hour angle* measured in M. T., which, supposing the said angle to be small, will *for the sun* be the hour angle in time with sufficient accuracy. *For a fixed star*, the hour angle measured in M. T. must be increased by the seconds corresponding thereto taken from Naut. Table p. 12* (*o*) 1; and *for the moon or planet* it may be corrected as in Arts. 230, 231.

By proceeding thus, the result of a single altitude near the meridian in bearing will be at least as exact as that got from the mer. altitude. And, since a considerable number of such altitudes may be often got, even on both sides of the meridian, it appears that as great accuracy may be

expected in the mean result of the whole as the instrument used is capable of giving. The altitudes are commonly observed by means of an artificial horizon (see Art. 212), the corresponding times by chronometer being noted. The observations, if numerous, are divided into sets, each set not taking up more than 2 or 3 minutes of time. A mean of the times and a mean of the readings off are then taken for each set. The mean of the readings off is corrected for index correction, and then divided by 2, and the Tr. Z. D. found as in Art. 211. From the mean of the times the M. T. and hour angle are found as explained above.

*Ex.* June 27, 1834, A.M., in lat. by account 50° 56′ 15″ N. and long. by account 3° W., the observations below were made by means of an artificial horizon. The index corr. was +1′ 1″; the error of the chronometer on M. T. at the place was 8ᵐ 26ˢ.2 *slow*. The zenith was N. of the sun. The barʳ. stood at 29, and the therʳ. at 70: required the correct latitude.

Suns decl., June 27, at Gr. mean noon, 23° 21′ 19″.5 N.; June 28, 23° 18′ 50″.3 N., corresponding Eq. T., 2ᵐ 31ˢ.72 A., and 2ᵐ 44ˢ 10 A.; sun's semid. 15′ 45″.2.

| Chronometer. | | Readings off. | First Operation. Rule 2. | |
|---|---|---|---|---|
| h m s | | ° ′ ″ | | |
| 11 46 15.5 | | 124 16 55 | 6.268072 | |
| 11 48 10.0 | | 124 19 10 | 9.962877 | |
| 11 49 7.5 | | 124 19 47 | 6.301030 | Second Operation. |
| Mean . . . | 11 47 51 | 124 18 37.3 | (a) . 22.531979 . . . | 22.531979 |
| | 8 26.2+ | 1 1+ | 9.799456 | 9.799717 |
| Sn. June 26, | 23 56 17.2 M.T. | 2) 124 19 38.3 | 2.331435 | 2.331696 |
| Long. . . . | 12 0 W. | | Nat.Nʳ. 214 | 214 5 |
| | | 62 9 49.1 | 0113639 | 0113639 |
| Gr. June 27, | 0 8 17.2 | Semid. 15 45.1+ | 0113425 | 0113424.5 |
| Decl. . . . | ° ′ ″ 23 21 18.7 | 62 25 34.2 | | |
| | | Refr. par. 24.2− | M.Z. ° ′ ″ 27 33 15 N. | 27 33 14.5 N |
| Eq. T. . . | m s 2 31.79 A. | | Decl. 23 21 18.7 N. | 23 21 18.7 N |
| | | W. A. 62 25 10 | | |
| (Art. 204) . | 24 2 31.79 | | Lat. . 50 54 33.7 | 50 54 33.2 N |
| | 23 56 17.2 | Z. D. 27 34 50 | | |
| Hour Angle | 0 6 14.59 | | | |

*Latitude by Altitudes of Bodies in Bearing near the Meridian under the Pole.* (See *App.* 18.)

(222.) Proceed as in Art. 215, &c., with the following alterations:—

1. For *hour angle* use the difference between hour angle and 12ʰ.

2. Instead of subtracting T. A. from 90°, add it to 90°, and use the sum as the Z. D. is used in rules Arts. 219 and 220.

The result of the computation will then be the true meridian altitude (M. A.) +90°. From this subtract the *declination* of the body, and the remainder will be the latitude of the *same name* with the declination. (See *App.* 15.)

*Ex.* 1. On Dec. 12, 1834, at 0ʰ 28ᵐ, A.M., ship M. T. nearly, in lat. by acct. 70° 20′ S., and long. by acct. 76° 30′ W., the observed altitude of the sun's L. L. was 3° 0′ 15″, being at the time in bearing near the inferior

mer. passage. The index correction was +3′ 10″, and the height of the eye above the sea was 17 feet: required the true latitude.

Sun's decl., on Dec. 11, at Gr. mean noon, 23° 0′ 30″ S.; on Dec. 12, 23° 5′ 17″ S.; corresp$^{g}$. Eq. T. 6$^{m}$ 34$^{s}$.17 S. (see note Art. 190) and 6$^{m}$ 6$^{s}$.29 S.; sun's semid. 16′ 16″.

Gr., Dec. 11, 17$^{h}$ 34$^{m}$, sun's decl. 23° 4′ 0″ S.; semid. 16′ 16″, Eq. T. 6$^{m}$ 13$^{s}$.7 S., T. A. +90° is 93° 1′ 56″. Difference between the hour angle and 12$^{h}$ is 0$^{h}$ 34$^{m}$ 13$^{s}$.7.

| | First operation. | Second operation. | Third operation. |
|---|---|---|---|
| By Rule 1. | 7.745525 | | |
| | 9.963811 | | |
| (*a*). . . . | 17.709336 | 17.709336 | 17.709336 |
| | 9.527046 | 9.538880 | 9.538978 |
| | 7.636382 | 7.248216 | 7.248314 |
| | 4° 45′ 30″ | 4° 49′ 26″ | 4° 49′ 28″ |
| *Nat. vers.* . | 0003446 | 0003541 | 0003543 |
| | 1052887 | 1052887 | 1052887 |
| | 1049441 | 1049346 | 1049344 |
| M.A.+90°. | 92° 50′ 2″ | 92° 49′ 43″ | 92° 49′ 42″ |
| Decl. . . . | 23 4 0 S. | 23 4 0 S. | 23 4 0 S. |
| Lat. . . . | 69 46 2 | 69 45 43 S. | 69 45 42 S. |

*Ex.* 2. Oct. 20, 1834, at 8$^{h}$ 15$^{m}$, P.M., ship mean time nearly, in lat. by acct. 50° 30′ N., and long. by acct. 47° 15′ E., the obs. alt. of $\alpha$ Urs. Maj. (*Dubhe*) was 22° 50′ 15″, bearing nearly N. The index corr. was +1′ 20″, and the height of the eye above the sea was 15 feet: required the true latitude.

R. A. mean sun, Oct. 20, at Gr. mean noon, 13$^{h}$ 53$^{m}$ 51$^{s}$.55; on Oct. 21, 13$^{h}$ 51$^{m}$ 48$^{s}$.11. R. A. $\alpha$ Urs. Maj. 10$^{h}$ 53$^{m}$ 25$^{s}$; decl. 62° 38′ 28″ N.

Gr., Oct. 20, 5$^{h}$ 6$^{m}$. R. A. mean sun 13$^{h}$ 54$^{m}$ 42$^{s}$. Difference between hour angle and 12$^{h}$ is 0$^{h}$ 43$^{m}$ 43$^{s}$. T. A. +90° is 112° 45′ 28″.

| | First operation. | Second operation. | Third operation. |
|---|---|---|---|
| By Rule 2. | 7.957552 | | |
| | 9.662337 | | |
| | 6.301030 | | |
| (*b*) . . . | 23.920919 | 23.920919 | 23.920919 |
| | 9.803510 | 9.809980 | 9.810022 |
| | 3.724429 | 3.730899 | 3.730941 |
| *Nat. N$^{r}$* . | 0005302 | 0005382 | 0005382 |
| | 1386836 | 1386836 | 1386836 |
| | 1381534 | 1381454 | 1381454 |
| M. A.+90°. | 112° 25′ 43″ | 112° 25′ 26″ | 112° 25′ 26″ |
| Decl. . . . | 62 38 28 N. | 62 38 28 N. | 62 38 28 N. |
| Lat. . . . | 49 47 15 N. | 49 46 58 N. | 49 46 58 N. |

*Latitude by Altitude of Pole Star.* (See *App.* 19.)

(223.) In accessible north latitudes the bearing of $\alpha$ Urs. Min. (Polaris), which lies within 2° of the north pole, is always very small, and its motion in altitude so slow, that an error of three or four minutes in the hour angle is of no consequence, when the latitude is to be determined only in an approximate degree. The mode of computation given in Arts. 214, 215, &c. might be used, if an easier one were not sufficiently accurate. The correction to be applied to the true altitude, in order to get the true altitude of the pole or the latitude of the ship, is computed for different latitudes and different years, and inserted in a table (see Nautical Tables, p. 10), from which it may be taken by inspection. The mode of observing the altitude of this star with the sextant is as follows. Bring the index nearly to 0 on the arc, holding the instrument in a plane passing through the star and the north point of the horizon; and direct the view to the star through the transparent part of the fixed reflector. Move the index slowly by hand and watch in the quicksilvered part for the motion of the image of the star, which then bring down and follow slowly to the horizon; taking care not to lose sight of the image till a contact is made with the nearest point of the horizon. The rule for the necessary computation is as follows.

(224.) RULE. Get a Gr. date as in Art. 185, or as in note thereto. For this date take from the Nautical Almanac the R. A. of mean sun (which may be done by inspection). To *ship mean time* expressed astronomically add *R. A. of mean sun*, rejecting $24^h$ from the sum if greater than $24^h$, the result will be the *meridian* R. A.; correct the observed altitude for index correction, dip, and refraction (see Art. 211), and thus get the true altitude (T. A.). Enter the table of correction for Pole Star with the *meridian* R. A. and at the top with the nearest latitude to that by account. The correction being taken out and applied with its proper sign to the T. A., the result will be the required latitude. (See *App.* 19.)

*Ex.* 1. April 14, 1835, at $2^h\ 30^m$, A.M., mean time nearly, in latitude by account 66° N. and longitude by account 150° 15′ E., the observed altitude of $\alpha$ Urs. Min. (Polaris) was 65° 10′ 40″; the index correction was +2′ 50″, and the height of the eye above the sea was 15 feet: required the true latitude. R. A. mean sun on April 13, at Gr. mean noon $1^h\ 23^m\ 48^s.78$, on April 14, $1^h\ 27^m\ 45^s.34$.

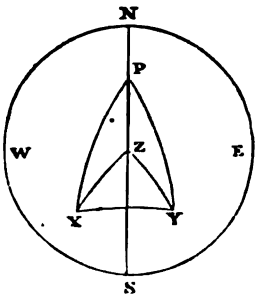
*Ex.* 2. Oct. 15, 1835, at $10^h\ 25^m$, P.M., mean time nearly, in latitude by account 49° 30′ N. and longitude 55° 12′ W., the observed altitude of $\alpha$ Urs. Min. (Polaris) was 50° 47′ 15″; the index correction was −3′ 10″, and the height of the eye above the sea was 18 feet: required the true latitude. R. A. mean sun on Oct. 15 at Gr. mean noon $13^h\ 33^m\ 11^s.62$, on Oct. 16, $13^h\ 37^m\ 8^s.18$.

| (1) | | | (2) | |
|---|---|---|---|---|
| Sh. April 13 . . | $14^h\ 30^m$ | 65° 10′ 40″ | Sh. Oct. 15 . . | 10 25 M. | 50° 47′ 15″ |
| Long. in T. . . | 10 1 E. | In corr. 2 50+ | Long. in T.. . | 3 41 W. | 3 10− |
| Gr. April 13 . . | 4 29 | 65 13 30 | Gr. Oct. 15. . | 14 6 | 50 44 5 |
| | | Dip. 3 49− | R. A. M. sun . | 13 35½ | 4 11− |
| | h m s | | Sh. M. T. . . | 10 25 | |
| R. A. M. sun . | 1 24 33 | 65 9 41 | | | 50 39 54 |
| Sh. mean time | 14 30 0 | Refr. 27− | Mer. R. A.. . . | 0 0½ | 48− |
| Mer. R. A. . | 15 54 33 | 65 9 14 | | | 50 39 6 |
| | | Tab. corr. 1 9 20 | | | corr. 1 30 43− |
| | | Lat. 66 18 34 N. | | | Lat. 49 8 23 N |

When the altitude of Polaris can be taken correctly, and mean time at the ship is known also correctly, the latitude may be found with great accuracy, as in Art. 221.

*Latitude from two Altitudes of the same, or different Heavenly Bodies, off the Meridian.*

(225.) One of the most important methods of determining the latitude at sea, is by taking with Hadley's Sextant two altitudes of the same or different heavenly bodies off the meridian, under certain limitations in bearing; the interval between the observations, if there be any, being measured by a chronometer or watch.




Let NWSE be the rational horizon, NS the meridian, Z the zenith, and P the pole of the heavens. Let X and Y be the same or different heavenly bodies; ZX, ZY, PX, PY, XY, arcs of great circles. Then PZ is the colatitude of the place, PX and PY are respectively the polar distances of X and Y, ZX and ZY their zenith distances, ZPX, ZPY their hour angles, SZX, SZY their true bearings from the S. Now in this figure we know by observation ZX and ZY, and from the Naut. Almanac PX and PY; also by means of the elapsed time as measured by a chronometer, or from the right ascensions of the bodies, or from both, we know the *polar angle* XPY. Hence the arc PZ, and consequently what it wants of 90°, or the latitude, may be found.

For in the triangle PXY we know PX, PY, and the included angle XPY, from which XY may be found. Then in each of the triangles PXY, ZXY, we know three sides; whence may be computed the angles PXY and ZXY, from which we deduce the angle PXZ, their difference or sum. Lastly, in the triangle PXZ, knowing the two sides ZX, PX, and the included angle PXZ, we can determine PZ the colatitude, and thence the latitude. (See App. 21.)

(226.) *Limits to be attended in the Two Bearings.* (See App. 23.)

(1.) *Both observations E. or both W. of meridian.* The difference of the two bearings (or change of bearing) should exceed the less bearing.

(2.) *One observation E. and the other W. of meridian.* The limit just given in (1) will hold good, if for the greater bearing be substituted the bearing opposite thereto, as NE. for SW.

(3.) By the *less bearing* is to be understood the less of the two, whether they are reckoned from the N. or S.

(4.) When the bearings on different sides of the meridian are equal, *either* may be considered as the *less*.

(227.) The seaman may in most cases determine with sufficient accuracy by the eye, when the two bearings fall within the above limits.

Should a compass be used for this purpose, the variation (Art. 31) should be applied so as to get the true bearings.

The nearest arc on the celestial concave drawn between the places of the body or bodies should not pass (if necessary when produced) near the zenith or celestial pole*, but *distinctly* on the same side of both, or distinctly between them. This arc may be traced by the eye.

### *Finding Polar Distances.*

(228.) From the chronometer, or from ship mean time nearly, and the longitude, get a Greenwich date as in Art. 185, or as in note thereto, for each observation. For this date take from the Nautical Almanac the declination (see Arts. 185, &c.). When the latitude by account and declination have the *same* names, *subtract* the declination from 90°, the result will be the polar distance (P. D.). When the declination and latitude by account have *different* names, *add* 90° to the declination: the result will be the polar distance (P.D.).

For a fixed star no Greenwich date need be found as above; the declination taken out for the day will be sufficiently correct.

### *Finding Polar Angle.*

(229.) *For two altitudes of the Sun.* Note the time shewn by a chronometer or good pocket watch at each observation, and thence get the amount of the interval between the observations, or the time elapsed. Correct this for the amount of any known rate, adding if *losing*, and subtracting if *gaining*. Correct then in strictness for any variation of the equation of time in the interval; *adding* if the equation of time be additive to app. time and decreasing, or subtractive from app. time and increasing; otherwise *subtracting*: the result will be the polar angle in time.

(230.) *For two altitudes of the Moon.* Get the time elapsed by the chronometer or watch, and correct it for rate. Find the difference between the increase of the moon's right ascension† and that of the right ascension of mean sun, and subtract this difference: the result will be the polar angle.

(231.) *For two altitudes of a Planet.* As for the moon; taking care to *add* the difference of increase in right ascension for the planet and mean sun, when that for the mean sun is the *greater*; and to *subtract* this difference when that for the mean sun is the *less*.

(232.) *For two altitudes of the same fixed Star.* Get the time elapsed by a watch or chronometer and correct it for rate. Add to the correct time elapsed the increase of the right ascension of the mean sun in the interval (see note): the result will be the polar angle in time.

(233.) *For two altitudes of different bodies observed at the same instant.* Get a Greenwich date as in Art. 185, or as in note thereto. For

* The celestial pole is at an altitude equal to the latitude above the N. or S. point of the horizon, according as the latitude is N. or S.

† This increase may be supposed to commence at the hour of the first Greenwich date, and to be proportioned for the interval. The increase of R. A. of mean sun may be taken for the interval by a table. (See Naut. Tables, p. 12* (o) l.)

this date take from the Nautical Almanac the right ascensions of the bodies. Their difference, or (if greater than $12^h$) what it wants of 24 hours, will be the polar angle in time.

(234.) *For two altitudes of different bodies observed at different times.* Get the correct elapsed time by means of a watch or chronometer and its rate; and add thereto the increase of the right ascension of the mean sun in the interval *. Get a Greenwich date for each observation, and take out of the Nautical Almanac the right ascension of each body. To the right ascension of the body *first observed* add the corrected time elapsed. Take the difference between the sum and the right ascension of the body *last observed*, rejecting if necessary 24 hours. The result, or (if greater than $12^h$) what it wants of 24 hours, will be the polar angle in time.

(235.) The correctness of the above rules for finding the polar angle will appear as follows.

When the sun is twice observed, the interval, as shewn by a watch going correctly according to *apparent* solar time, would be the angle described by the sun round the pole. The interval measured by a mean solar watch going regularly will therefore want correcting for the gain or loss of the latter watch on the former. This gain or loss will be the change of the equation of time in the interval applied as in the rule. It is evidently necessary also first to apply a correction for the rate of the watch.

(236.) When the moon is twice observed, the interval, as shewn by a watch adjusted to go with the moon, would be the polar angle. But a watch is supposed to go with the mean sun, and goes faster than a lunar watch: it shews more time in the interval of the observations than the latter by the excess of the moon's motion in right ascension (in time) over that of the mean sun; which last is at the rate of $3^m\ 56^s.6$ in 24 hours. A similar explanation applies to a planet.

(237.) When the same star is twice observed, the interval measured by a *sidereal* clock would be the angle at the pole described by the star. The same interval measured by a mean solar watch will be too little, since a mean solar watch goes more slowly than a sidereal clock by about 10 seconds in a hour, and 1 second in 6 minutes. The propriety of the correction pointed out in the rule is therefore manifest. When two bodies are observed at the same instant, the polar angle is evidently the difference of the right ascensions, or what that difference wants of 24 hours; the *log. havers.* of either will be the same. When two different bodies are observed, and there is an interval between the observations, in such a case the polar angle will be the difference between the right ascension of the place of the body last observed, and that of the place of the other on its circle of diurnal motion when its altitude was taken. This latter right ascension must manifestly be got by adding the interval in sidereal time to the right ascension of the body itself when observed; since, by the apparent diurnal motion of the celestial concave from east to west, the point it was at before must have been carried so much to the westward.

* See last note on preceding page.

### *Zenith Distances.*

(238.) The observed altitudes are corrected as in Art. 211, and the true altitudes found. A correction is then applied to the T. A. first observed for the run of the ship in the interval of the observations, by the following rule: by which the said T. A. is reduced to what it would have been at the place of the second. Take each T. A. (after this correction of the first) from 90°, the results will be the zenith distances (Z. D.). When both the altitudes are taken at the same instant or nearly so, no correction of this kind is necessary.

### *Correction of First Altitude for Run of Ship, App.* 20.

(239.) RULE. When the first altitude is taken, observe by means of the compass the bearing of the sun, and applying the variation, get its true bearing. Find by working the log. account the true course of the ship and distance run in the interval. Then with the distance run as a *dist.* and the angle between the true bearing of the sun at the first observation, and true course of the ship in the interval as a *course* (supposed less than 8 points), enter the Traverse Table and take out the *diff. lat.*, which add to the first true altitude. When the *course* so deduced is greater than 8 points, enter the Traverse Table with what it wants of 16 points, and subtract the *diff. lat.* taken out from the first true altitude.

When the *course* so deduced is 0, add the whole distance run; when it is 16 points subtract the whole distance run; when it is 8 points there is no correction.

The *tenths* of nautical miles or minutes in the Traverse Table may be turned into seconds by multiplying them by 6.

Having determined as above the polar distances, polar angle, and the zenith distances, arrange them under the heads of greater bearing and less bearing (see examples); and then compute the true latitude by the following rule.

### (240.) RULE *for Double Altitude, App.* 21.

*To find* (1). Add together *log. sines* of both polar distances, and *log. havers.* of polar angle, rejecting the tens in the index of the sum. With result as a *log. havers.* take out the arc in degrees and mark it (*a*), see note.* To *nat. vers.* of (*a*) add *nat. vers.* of difference of polar distances. With sum as *nat. vers.* take out the arc, and mark it (1). See note*.

* When the diff. pol. dist. is *nothing*, as for the *same fixed star*, arc (*a*) itself is arc (1). When the diff. pol. dist. is small, as when the *sun* is observed at each time, or the *moon*, or a *planet*, to find arc (1) add the seconds (if they appear of any consequence) from the following Table to arc (*a*). Should the diff. pol. dist. be greater than 40′, it will be best to proceed by general rule.

| Arc (*a*) | 90° | 70° | 60° | 55° | 50° | 45° | 40° | 35° | 30° | 25° | 20° | 15° | 10° | 8° | 6° | 4° | 2° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diff. Pol. Dist. | ′ | ″ | ″ | ′ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| | 10 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 5 | 6 | 8 | 12 | 24 |
| | 20 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 8 | 10 | 13 | 20 | 25 | 34 | 51 | 97 |
| | 30 | 8 | 8 | 9 | 9 | 10 | 11 | 12 | 14 | 16 | 18 | 23 | 30 | 45 | 57 | 75 | 111 | 222 |
| | 40 | 14 | 15 | 16 | 17 | 18 | 20 | 22 | 24 | 28 | 33 | 41 | 54 | 80 | 101 | 134 | 200 | 399 |
| Arc (*a*) | 90° | 110° | 120° | 125° | 130° | 135° | 140° | 145° | 150° | 155° | 160° | 165° | 170° | 172° | 174° | 176° | 178° |

*To find* (2). Under (1) put polar distance at greater bearing; take the difference, under which put polar distance at less bearing. Take the sum and difference. Add together *log. cosecants* (rejecting 10 from each index) of the two first terms in this form and the *halves** of *log. haversines* of the two last terms. With the sum as *log. havers.* take out the arc in degrees, and mark it (2).

*To find* (3) *and* (4). Again, under (1) put the zenith distance at the greater bearing; take the difference, under which put the zenith distance at the less bearing. Take the sum and difference. Add together *log. cosecants* (rejecting 10 from each index) of the two first terms in this form, and the *halves* of *log. haversines* of two last terms. With the sum as a *log. havers.* take out the arc in degrees, and mark it (3).

*To find* (*b*) *if necessary* †. Subtract the latitude by account from 90°, and under the remainder put the difference of the zenith and polar distances at the greater bearing. Take the sum and the difference. Add together the *second log. cosecants* as used in the two preceding forms, and the *halves* of *log. haversines* of the two last terms in the form. With the sum as a *log. havers.* take out the corresponding arc in degrees and call it (*b*).

Take the difference or the sum ‡ of (2) and (3), according as (*b*) is nearer to their difference or sum; and mark the result (4).

*To find Latitude.* Add together *log. sine* of polar distance at greater bearing, *log. sine* of zenith distance at greater bearing, and *log. havers.* of arc (4), rejecting the tens in the index of sum. With the result as a *log. havers.* take out the arc in degrees. To the *nat. vers.* of this arc add *nat. vers.* of difference of polar and zenith distance at greater bearing. The sum will be the *nat. vers.* of an arc, which take from the table and subtract from 90°: the result will be the required latitude.§

When near the equator the arc may be greater than 90°, in which case the excess above 90° will be the latitude required, of a different name from that of the lat. by account. (See *App.* 22.)

*Ex.* 1. April 2, 1834, the following altitudes of the sun, &c., were observed to determine the latitude.

| Mean Time nearly. | Chronometer. | Obs. Alt. Sun's L. L. | Tr. Bearing. |
|---|---|---|---|
| $6^h\ 30^m$ A.M. | $1^h\ 29^m\ 50^s$ | 9° 30′ 10″ | E. ½ S. |
| 2 0 P.M. | 9 0 55 | 42 29 25 | S. W. b. S. |

The run of the ship in the interval was S.S.E. 18 miles; the index correction was −1′ 40″, and the height of the eye above the sea was 15 feet: required the true latitude at the second observation; the latitude by account being 42° N. and longitude 74° 30′ E. Rate of chronometer 18.2 seconds

* In taking out the *halves* of log. haversines the computer will find the easiest way is to divide by 2 by inspection, following the division with his left hand.

† In all cases whatever take the difference of (2) and (3) for (4), *unless* the distance arc between the places of the body or bodies passes between the zenith and pole (Art. 227), *in which case alone* take their sum. If the seaman can determine this distinctly by tracing the said distance arc with his eye, the computation of arc (b) may be omitted.

‡ If the sum of (2) and (3) be greater than 180°, the supplement to 360° must be considered as the sum.

§ *Log. sin.* pol. dist. at gr. bearing, and its *log. cosec.* may be taken out at the same opening; also *log. cosec.* zen. dist. at gr. bearing, and its *log. sin.* When arc, of which the *log. cosec.* is wanted is greater than 90°, take *log. sec.* of what it is above 90°. Thus for *log. cosec.* of 98° 10′ look out *log. sec.* of 8° 10′

gaining. Sun's decl. on April 1 at Gr. mean noon 4° 27′ 59″ N., on April 2, 4° 51′ 6″ N., corresponding Eq. T. 4ᵐ 1ˢ.06 A. and 3ᵐ 42ˢ.8 A. (see note, Art. 190) semid. 16′ 1″.

The Greenwich dates are got from ship mean time nearly and the longitude as in Art. 185. For each of these dates the sun's decl. is taken from the Nautical Almanac as in Art. 186, also the semid. The declination having the same name (N) as the latitude by account, is taken from 90° for the polar distance in each case. The observed altitudes are corrected as in Art. 211, and the correction for the run of the ship to be applied to the first true altitude is 8′ 30″ +, this being the *diff. lat.* corresponding to a *dist.* 18 miles and a *course* 5½ points between E. ½ S. and S. S. E. The zenith distances are then got by subtracting from 90°. The interval by chronometer is 7ʰ 31ᵐ 5ˢ: to which the amount of rate (gaining) 5.7ˢ being subtracted, the true interval in mean time is 7ʰ 30ᵐ 59ˢ.3. In this interval the change of the equation of time is 5.7ˢ *decreasing*, the equation itself being *additive* to apparent time (see note, Art. 190): consequently 5.7ˢ must be added, which makes the polar angle in time described by the sun to be 7ʰ 31ᵐ 5ˢ.

*At Greater Bearing.* Pol. Dist. 85° 18′ 59″. Zen. Dist. 80° 16′ 9″.
*At Less Bearing.* Pol. Dist. 85 11 45. Zen. Dist. 47 21 0.

Polar Angle 7ʰ 31ᵐ 5ˢ Diff. of Pol. Dist. 0° 7′ 14″. Diff. of Zen. and Pol. Dist. at Greater Bearing 5° 2′ 50″.

| To find (1). | To find (2). | To find (3) and (4). | To find (*b*). | To find Lat. |
|---|---|---|---|---|
| 9.998547 | (1) 112° 10′ 52″ | 112° 10′ 52″ | 90° 0′ 0″ | 9.998547 |
| 9.998471 | 85 18 59 | 80 16 9 | 42 0 0 | 9.993704 |
| 9.841061 | | | | 9.204697 |
| | 26 51 53 | 31 54 43 | 48 0 0 | |
| 9.838079 | 85 11 45 | 47 21 0 | 5 2 50 | 9.196948 |
| (*a*) 112° 10′ 52″ | | | | 46° 44′ 40″ |
| | 112 3 38 | 79 15 43 | 53 2 50 | |
| | 58 19 52 | 15 26 17 | 42 57 10 | |
| No increase of | 0.033392 | 0.033392 | 0.001453 | 0314746 |
| consequence from | 0.001453 | 0.006294 | 0.006294 | 0003869 |
| diff. pol. dist. See | 4.918723 | 4.804714 | 4.649875 | |
| Table, p.106. Con- | 4.687842 | 4.128125 | 4.563634 | 0318615 |
| sequently (*a*) may | | | | 47° 2′ 53″ |
| be considered as | 9.641411 | 8.972525 | 9.221256 | |
| (1). | (2) 82° 52′ 15″ | (3) 35° 40′ 52″ | (*b*) 48° 9′ 15″ | Lat. 42 57 7 N. |
| | | (2) 82 52 15 | | |
| | | (4) 47 11 23. See (*b*) | | |

*Ex.* 2. Nov. 6, 1834, the following altitudes, &c., of the moon were observed in order to find the latitude.

| Mean Time nearly. | Chronometer. | Obs. Alt. | Tr. Bearing. |
|---|---|---|---|
| 4ʰ 45 P.M. | 5ʰ 40ᵐ 30ˢ | 36° 45′ 10″ | S. S. W. ½ W. |
| 9 28 P.M. | 10 23 35 | 5 40 20 | S. W. by W. ½ W. |

The run of the ship in the interval was S. S. E. 10 miles; the index correction was — 3′ 50″, and the height of the eye above the sea was 17 feet: required the true latitude; the latitude by account being 27° N. and longitude 80° 30′ E. Daily rate of chronometer 13ˢ.5 *losing*.

Moon's decl. on Nov. 5, at 23ʰ, 24° 32′ 36″ S., at 24ʰ, 24° 29′ 34″ S., on Nov. 6, at 4ʰ, 24° 16′ 1″ S., at 5ʰ, 24° 12′ 17″ S.; corresponding R. A.

moon $19^{o}\ 37^{m}\ 14^{s}.3$; $19^{o}\ 39^{m}\ 39^{s}.6$; $19^{h}\ 49^{m}\ 17^{s}.4$; $19^{h}\ 51^{m}\ 41^{s}.1$. Moon hor. semid. on Nov. 5, at Gr. mean midn. $15'\ 46''.8$, on Nov. 6, at Gr. mean noon $15'\ 39''.0$, on Nov. 6, at Gr. mean midn. $15'\ 31''.5$. Corresponding hor. par. $57'\ 54''.6$; $57'\ 26''$; $56'\ 58''.2$.

The Greenwich dates, the declinations, hor. semid., and hor. parallax of the moon are got as in Art. 185, and following Arts. The observed altitudes are corrected as in Art. 211. Then to the first true altitude (T. A.) is added $6'\ 42''$, the *diff. lat.* corresponding to 10 miles as a *dist.* and a *course* $4\frac{1}{2}$ points, the difference of bearing between S. S. W. $\frac{1}{2}$ W. and S. S. E. (See Art. 239.) The moon's declinations, which are both S., the latitude by account being N., are added to $90^{o}$ for the polar distances. The true altitudes (the first corrected for the run of the ship) are subtracted from $90^{o}$ for the zenith distances.

The interval by the chronometer is $4^{h}\ 43^{m}\ 5^{s}$; correcting this for the amount of rate $2^{s}.1$ +, the correct interval in mean time is $4^{h}\ 43^{m}\ 7^{s}.1$. The increase of the moon's right ascension in this interval beginning Nov. 5, $23^{h}$ (the hour of the first Greenwich date) is $11^{m}\ 23^{s}$; the corresponding increase of R.A. of mean sun is $46^{s}.5$: their difference is $10^{m}\ 36^{s}.5$, which being subtracted from the interval in mean time, the polar angle is got, namely, $4^{h}\ 42^{m}\ 30^{s}.6$.

*At Greater Bearing.* Pol. Dist. $114^{o}\ 15'\ 39''$. Zen. Dist. $83^{o}\ 23''\ 44'$.
*At Less Bearing.* Pol. Dist. $114\ 31\ 26$. Zen. Dist. $52\ 15\ 33$.

Polar Angle $4^{h}\ 32^{m}\ 30^{s}.6$. Diff. of Pol. Dist. $0^{o}\ 15'\ 47''$. Diff. of Zen. and Pol. Dist. at Gr. Bearing $30^{o}\ 51'\ 55''$.

| To find (1). | To find (2). | To find (3) and (4). | To find (*b*). | To find Lat. |
|---|---|---|---|---|
| 9.959839 | $61^{o}\ 20'\ 33''$ | $61^{o}\ 20'\ 33''$ | $90^{o}\ 0'\ 0''$ | 9.959839 |
| 9.958936 | *114 15 39 | 83 23 44 | 27 0 0 | 9.997109 |
| 9.496550 | | | | 9.336503 |
| | 52 55 6 | 22 3 11 | 63 0 0 | |
| 9.415325 | 114 31 26 | 52 15 33 | 30 51 55 | 9.293451 |
| (*a*) $61^{o}\ 20'\ 30''$ | | | | $52^{o}\ 38'\ 0''$ |
| Tab. p. 106 3+ | 167 26 32 | 74 18 44 | 93 51 55 | |
| | 61 36 20 | 30 12 22 | 32 8 5 | 0393086 |
| (1) 61 20 33 | | | | 0141627 |
| | 0.056755 | 0.056755 | 0.040154 | |
| | 0.040154 | 0.002891 | 0.002891 | 0534713 |
| | 4.997387 | 4.781025 | 4.863655 | $62^{o}\ 16'\ 16''$ |
| | 4.709359 | 4.415903 | 4.442096 | |
| | | | | Lat. 27 43 44 |
| | 9.803655 | 9.256574 | 9.348796 | |
| | (2) $105^{o}\ 49'\ 7''$ | (3) $50^{o}\ 17'\ 15''$ | (*b*) $56^{o}\ 23'\ 30''$ | |
| | | (2) 105 49 7 | | |
| | | (4) 55 31 52 | See (*b*. | |

*Ex.* 3. Nov. 18, 1834, observed the following altitudes, &c., of the planet Mars to determine the latitude.

| Mean Time nearly. | Chronometer. | Obs. Alt. of Cr. of Planet. | True Bearing. |
|---|---|---|---|
| $2^{h}\ 0^{m}$ A. M. | $3^{h}\ 10^{m}\ 40^{s}$ | $54^{o}\ 40'\ 20''$ | S. S. E. |
| 7 15 A. M. | 8 25 30 | 32 50 30 | S. W. |

* For *log. cosec.* of $114^{o}\ 15'\ 39''$, take out *log. sec.* $24^{o}\ 15'\ 39''$, see note §, page 107.

The run of the ship in the interval was North 10 miles: the index correction was $+0'\ 40''$, and the height of the eye above the sea was 14 feet: the latitude by account being 53° N. and longitude 18° W. The distance arc between the places of the planet evidently did *not* pass between the zenith and pole. Rate of chronometer $8^s.5$ *losing*.

Planet's decl. on Nov. 17, at Gr. mean noon 23° 40′ 26″ N. on Nov. 18, 23° 42′ 22″ N. Increase of planet's R. A. in $24^h$ is $22^s$.

The Greenwich dates and declinations are found as in Art. 185, &c. The observed altitudes are corrected as in Art. 211; to the first T. A. the correction for the run of the ship 9′ 12″— is applied, being the *diff. lat.* corresponding to the *dist.* 10 miles, and *course* 2 points, what the diff. of bearing between S.S.E. and North wants of 16 points: the results being taken each from 90°, give the zenith distances. The interval by chronometer is $5^h\ 14^m\ 50^s$, which being corrected for the rate by $1^s.8+$, the interval in mean time is $5^h\ 14^m\ 51^s.8$. The diff. of increase of planet's R.A. and mean sun's R. A. is $47^s.1+$, the latter being the greater. Hence Polar Angle is $5^h\ 15^m\ 39^s$.

*At Greater Bearing.* Pol. Dist. 66° 17′ 55″. Zen. Dist. 50° 13′ 32″.
*At Less Bearing.* Pol. Dist. 66 18 21. Zen. Dist. 35 32 28.

Polar Angle $5^h\ 15^m\ 39^s$. Diff. of Pol Dist. 0° 0′ 26″. Diff. of Zen. and Pol. Dist. at Greater Bearing 16° 4′ 23″.

| To find (1). | To find (2). | To find (3) and (4). | To find Lat. |
|---|---|---|---|
| 9.961735 | 71° 10′ 7″ | 71° 10′ 7″ | 9.961735 |
| 9.961749 | 66 17 55 | 50 13 32 | 9.885679 |
| 9.606216 | | | 9.031587 |
| | 4 52 12 | 20 56 35 | |
| 9.529700 | 66 18 21 | 35 32 28 | 8.879001 |
| (*a*) 71° 10′ 7″ | | | 31° 56′ 10″ |
| | 71 10 33 | 56 29 3 | 0151361 |
| | 61 26 9 | 14 35 53 | 0039091 |
| There being little diff. of pol. dist., (*a*) is also (1). See note p. 106. | 0.023891 | 0.023891 | 0190452 |
| | 0.038268 | 0.114321 | 35° 56′ 53″ |
| | 4.764882 | 4.675004 | |
| | 4.708265 | 4.103959 | Lat. 54 3 7 N. |
| | 9.535306 | 8.917175 | |
| | (2) 71° 42′ 0′ | (3) 33° 24′ 45″ | |
| | | (2) 71 42 0 | |
| | | (4) 38 17 15. | See note †, p. 107. |

*Ex.* 4. Feb. 28, 1834, the observed altitude of $\alpha$ Urs. Maj. was 41° 12 15″ bearing N. 10° W., the index correction being —0′ 50″; and at the same instant the observed altitude of $\alpha$ Scorpio was 14° 17′ 30″ bearing S. 40° E., the index correction being $+2'\ 10''$; the height of the eye in each case above the sea was 18 feet: required the true latitude; the latitude by account being 15° N.

The distance arc between the two stars evidently passed between the zenith and pole. The declination of $\alpha$ Urs. Maj. 62° 38′ 43″ N., R. A. $10^s\ 53^m\ 27^s$. Decl. of $\alpha$ Scorpio 26° 3′ 15″ S., R. A. $16^h\ 19^m\ 14^s$.

*At Greater Bearing.* Pol. Dist. 116° 5′ 15″. Zen. Dist. 75° 48′ 16″.
*At Less Bearing.* Pol. Dist. 27 21 17. Zen. Dist. 48 50 52.

Polar Angle (see Art. 233) $5^h\ 25^m\ 47^s$. Diff. of Pol. Dist. 80° 41′ 58″. Diff. Zen. and Pol. Dist. at Greater Bearing 40° 14′ 59″.

| To find (1). | To find (2). | To find (3) and (4). | To find (*b*). | To find Lat. |
|---|---|---|---|---|
| 9.953460 | 109° 11′ 24″ | 109° 11′ 24″ | 90° 0′ 0″ | 9.953460 |
| 9.662275 | 116 3 15 | 75 48 16 | 15 0 0 | 9.986531 |
| 9.629030 | | | | 9.460185 |
| 9.244765 | 6 51 51 | 33 23 8 | 75 0 0 | 9.400176 |
| (*a*) 49° 33′ 50″ | 27 21 17 | 48 50 52 | 40 14 59 | 60° 10′ 14″ |
| 0351400 | 34 13 8 | 82 14 0 | 115 14 59 | 0502580 |
| 0977303 | 20 29 26 | 15 27 44 | 34 45 1 | 0236765 |
| 1328703 | 0.024833 | 0.024833 | 0.046540 | 0739345 |
| (1) 109° 11′ 24″ | 0.046540 | 0.013469 | 0.013469 | 74° 53′ 28″ |
| | 4.468637 | 4.817958 | 4.926631 | |
| | 4.250107 | 4.128801 | 4.475125 | Lat 15 6 32 N. |
| | 8.790117 | 8.985061 | 9.461765 | |
| | (2) 28 45 34 | (3) 36° 13′ 8″ | (*b*) 65° 6′ 45″ | |
| | | (2) 28 45 34 | | |
| | | (4) 64 58 42 | See *b* and note †, p. 107. | |

*Ex.* 5. Nov 4, 1834, the following altitudes, &c., were observed to determine the latitude.

| Mean Time nearly. | Chronometer. | | Obs. Alt. | True Bearing. |
|---|---|---|---|---|
| $6^h\ 30^m$ P. M. | $6^h\ 20^m\ 15^s$ | $\alpha$ Serpens | 16° 40′ 10″ | W. b. S. |
| 7 30 P. M. | 7 21 45 | $\alpha$ Aquila | 45 15 20 | S. S. W. |

The run of the ship in the interval was S. S. E. 6¼ miles; the index correction was +1′ 50″, and the height of the eye above the sea was 15 feet: required the true latitude, the latitude by account being 47° 20′ N. and longitude 52° 30′ E. The rate of the chronometer was 6 seconds losing.

Decl. of $\alpha$ Serpens 6° 57′ 12″ N.; R. A. $15^h\ 36^m\ 6^s$. Decl. $\alpha$ Aquila 8° 26′ 19″ N., R. A. $19^h\ 42^m\ 42^s$.

The polar distance and zenith distances are found as in the preceding examples. The interval by chronometer is $1^h\ 1^m\ 30^s$. This being corrected for rate + 0.3 *seconds*, the interval in mean time is $1^h\ 1^m\ 30^s.3$. This being corrected for the amount of increase of R. A. of m. sun, namely +10 *sec.*, the interval in sidereal time is $1^h\ 1^m\ 40^s.3$. Adding this to the R. A. of $\alpha$ Serpens (the first observed star) and taking the difference (see Art. 234) between the result and the R.A. of $\alpha$ Aquila, the polar angle is thus found to be $3^h\ 4^m\ 56^s$.

*At Greater Bearing.* Pol. Dist. 83° 2′ 48″. Zen. Dist. 73° 26′ 19″.
*At Less Bearing.* Pol. Dist. 81 33 41. Zen. Dist. 44 47 36.

Polar Angle $3^h\ 4^m\ 56^s$. Diff. of Pol. Dist. 1° 29′ 7″ Diff. of Zen. and Pol. Dist. at Greater Bearing 9° 36′ 29″.

| To find (1). | To find (2). | To find (3) and (4). | To find (b). | To find Lat. |
|---|---|---|---|---|
| 9.996793 | 45° 48′ 57″ | 45° 48′ 57″ | 90° 0′ 0″ | 9.996793 |
| 9.995274 | 83 2 48 | 73 26 19 | 47 20 0 | 9.981596 |
| 9.187911 | | | | 9.128071 |
| | 37 13 51 | 27 37 22 | 42 40 0 | |
| 9.179978 | 81 33 41 | 44 47 36 | 9 36 29 | 9.106460 |
| (a) 45° 27′ 20″ | | | | |
| 0302695 | 118 47 32 | 72 24 58 | 52 16 29 | 41° 53′ 20″ |
| 0000336 | 44 19 50 | 17 10 14 | 33 3 31 | |
| | | | | 0255559 |
| 0303031 | 0.144412 | 0.144412 | 0.003207 | 0014027 |
| (1) 45° 48′ 57″ | 0.003207 | 0.018404 | 0.018404 | |
| | 4.934854 | 4.771384 | 4.643972 | 0269586 |
| | 4.576660 | 4.174006 | 4.454087 | 43° 4′ 44″ |
| | 9.659133 | 9.108206 | 9.119670 | Lat. 46 55 16 N. |
| | (2) 84° 58′ 20″ | (3) 41° 58′ 37″ | (b) 42° 33′ 45″ | |
| | | (2) 84 58 20 | | |
| | | (4) 42 59 43 | | |

*Remarks.*

(241.) The above method of finding the latitude from two altitudes of the same or different heavenly bodies off the meridian will become easy by a little attention and practice; at the same time it has the advantage of being direct and general. The methods of making the computation by correcting the estimated latitude of the ship, and approximating to the true latitude by repeated operations, are omitted as greatly inferior to the rule given above. Several attempts have been made to improve these methods of approximation, but it does not appear possible to render any one of them practically easy, and applicable in all cases, where the latitude may be determined by observations of this kind.

In concluding this subject, it may be proper to make one or two additional remarks thereon for the guidance of the seaman.

(242.) In the first place, the watch, with which the times are taken, should show an interval of three or four hours, without the probability of making an error of more than five or six seconds; and the sextant or quadrant made use of should be one, the accuracy of which may be depended on within 1 or 2 minutes. To diminish the errors of observation, two or three altitudes should be taken each time, and a mean of them and of the corresponding times by the watch should be used in the calculation.

(243.) In fixing the limits, the error to which an observer is liable, in taking the altitude of a heavenly body at sea, has been supposed to be about 2 minutes; so that the error in latitude on this account would never be more than 5 or 6 minutes, and generally not more than 2 or 3 minutes.

Perhaps, in taking the altitude of a star or planet, a much greater error than this may be made, especially when the horizon is imperfectly seen. In such cases the limits must be something modified by increasing the difference between the bearings (see Art. 226 (1), (2), &c.) with respect to the less bearing.

The seaman, however, will be the best judge, by a little practice, what degree of accuracy in the resulting latitude he may expect from double alti-

tudes of fixed stars or planets, particularly if he make trial of these observations, under different circumstances, when he knows the true latitude from other sources. And it is presumed that the general method given above will enable him to make such trials without difficulty. *

(244.) It will be proper to attend to the following cautions:—

1. This method of finding the latitude should not be used when a great circle between the places of the body or bodies passes within two or three degrees of the zenith or pole of the heavens.

2. A heavenly body should not be observed for this purpose, when its altitude is less than 3° or 4°.

3. The distance run by the ship in the interval of the observations should not be more than 12 leagues or 36 miles; the interval itself should not be more than 8 or 9 hours. In determining the true course and distance in the interval, care should be taken to make a proper allowance for any currents or tides by which the place of the ship may have been affected.

The *log. sines*, &c. used in the computation should be taken out to the nearest 15 seconds of a degree or 1 second of time, which may be done at once by inspection. (See Nautical Tables.)

*To find the Longitude of the Ship by Astronomical Observation.*

(245.) The longitude of the ship is the angle which the meridian of the ship makes with the meridian of Greenwich at the pole of the earth, or the angle which the celestial meridian of the ship makes with the celestial meridian of Greenwich at the pole of the heavens. Let PYP′ (see fig. Art. 84) be the celestial meridian of the ship, PBP′ the celestial meridian of Greenwich; then the angle BPY is the longitude of the ship; *west*, because the left side of the figure is considered as west and the right side as east. In like manner BPT is the longitude *east* of another place, of which the celestial meridian is PTP″.

Let the mean sun be on the meridian PXP′; then the angle XPY (expressed in time) is mean time at the ship in *west* longitude, XPT at the ship in *east* longitude, and XPB at Greenwich. Hence it appears if from Greenwich mean time we subtract the same kind of time at the ship (supposed less than Greenwich time), that the remainder will be the *west* longitude of the ship in time; and if from ship mean time we subtract Greenwich mean time (supposed less than ship time), that the remainder will be the longitude in time *east* of the ship.

It follows therefore, that in order to determine the longitude, we must be able to find mean time for the ship and for Greenwich at the same instant. The most common way of finding mean time at the ship is by observing with a sextant the altitude of a heavenly body, when it is rising or falling with considerable rapidity; this observed altitude is corrected and the true zenith distance as ZX (see fig. Art. 95) is deduced; with this and the colatitude and polar distance, as PZ and PX, the hour angle ZPX may be computed (see App. 28), and thence mean time as in Arts. 201, 202. The

* It would be an useful exercise, and at the same time facilitate the method of finding the latitude by double altitudes, if the arcs (1) and (2) were computed annually for different bright stars lying in proper positions. The computation would then require simply the two last operations.

most common way at sea of finding mean time for Greenwich, is by means of a chronometer, the error of which fast or slow on Greenwich mean time is supposed to have been known when the ship sailed, and also its *rate*, that is, its daily gain or loss on mean time; so that by making the proper allowances for this error and rate, Greenwich mean time may be deduced from the chronometer at any subsequent period. At the instant therefore of observing the altitude, the time by the chronometer is noted, and thus we have the means of determining the corresponding mean times at the ship and at Greenwich, and thence the longitude of the ship. The necessary steps in the observation and computation are described in the following rule.

### *To find Longitude by Chronometer.*

(246.) When a heavenly body bears as nearly *east* or *west* as possible (always farther from the meridian than two points of bearing), observe its altitude, twice or thrice with a sextant, and at the same instant let the time shown by a chronometer be noted. Add the altitudes observed together, and also the times noted; divide each sum by the number, and thus get the means.

(247.) **Rule.** Get a Gr. date as in Art. 185 or note thereto. To the time by chronometer apply its error* on Greenwich mean time at the instant of observation; if necessary adding or subtracting $12^h$, so as to bring the result to the proper Greenwich mean time known nearly from the date just got. For the resulting Greenwich date by chronometer, take the necessary elements from the Nautical Almanac as follows:—

(248.) *For the Sun:* he sun's declination as in Art. 186, the sun's semidiameter and equation of time as in Art. 190 (see note Art. 190).

*For the Moon, a Planet, or Fixed Star*: the right ascension of the mean sun (see Art. 191); the right ascension and declination of the body observed as in Art. 186, &c. Correct the observed altitude as in Art. 211, and get the true zenith distance (Z.D.)

(249.) Under the latitude†, marked N. or S., put the declination also marked according to its name N. or S. If the names be *like*, take the dif

---

* Put down the error of the chronometer at the Greenwich mean noon preceding the time of taking a departure from a known longitude, marking it *f* if *fast*; and *s* if *slow*. Under it put the daily rate, marking it *f* if *gaining*; and *s* if *losing*. When the names are *like*, take the sum and affix the common name to it; when the names are *unlike*, take the difference and affix the name of the greater. The result will be the error of the chronometer the next day at Greenwich mean noon, and so on. To a table so formed, ten or twenty days in advance, may be appended the amount of rate gaining *(f)* or losing *(s)* for 1, 2, 3, &c. hours.

| | | | | | |
|---|---|---|---|---|---|
| Ex. | April 5, | $2^m\ 15^s.7\ f$ | $0^m\ 4^s.3\ f$ | $10^m\ 20^s.2\ s$ | $0^m\ 2^s.6\ s$ |
| | | 3 .5 *f* | 6 .6 *s* | 10 .1 *f* | 8 .2 *f* |
| | April 6, | 2 19.2 *f* | 0 2.3 *s* | 10 10.1 *s* | 0 5.6 *f* |

From such a table, the required error of the chronometer at the observation may be easily found.

† The latitude at the time of observation for chronometer is supposed to be known by bringing up the last latitude by observation to this time by means of log account.

ference; if the names be *unlike*, take the sum. Under the result put the true zenith distance (Z. D.); take the sum and difference*. Add together the *log. secants* (rejecting 10 from each index) of the two first terms in the form, and the *halves* of the *log. haversines* of the two last terms (see note *, p. 107). With the sum as a *log. havers.* take out the corresponding angle in time, at the *top of the page* when the body is *west* of the meridian, and at the *bottom of the page* when the body is *east* of the meridian: call this the *hour angle* W. (see App. 28).

*For the Sun:* to the hour angle (which is apparent time) apply the *equation of time* with its proper sign as applied to apparent time (see note, Art. 190). The result will be ship mean time, to which prefix the proper astronomical day of the month.

*For Moon, Planet, or Star:* to the hour angle got as above, add the *right ascension of the body*, and from the sum (increased if necessary by $24^h$) subtract the *right ascension of mean sun*. The remainder (diminished by $24^h$ if greater than $24^h$) will be *ship mean time*, to which put the proper astronomical day of the month.

Under the resulting ship mean time put the Greenwich date in mean time got from chronometer. If the days of the month be different, put the more advanced one day back, and add 24 to the hours. Take the difference of the times, and from table of *log. haversines* take the corresponding arc in degrees. This will be the true longitude by chronometer, E. when ship mean time is the greater, and W. when ship mean time is the less.

*Ex.* 1. Oct. 15, 1835, at $4^h\ 40^m$ P. M. mean time nearly, in latitude 15° 32′ N. and longitude by account 83° E., a chronometer showed $11^h\ 10^m\ 55^s$, and the observed altitude of the sun's L. L. was 15° 12′ 30″; the index correction was +4′ 10″, and the height of the eye above the sea was 15 feet: required the true longitude.

On Oct. 2, at Gr. mean noon the chronometer was *slow* on Gr. mean time $1^m\ 22^s.6$, and its rate was $12^s.5$ gaining.

Sun's Decl. on Oct. 14, at Gr. mean noon 7° 59′ 11″ S., on Oct. 15, 8° 21′ 33″ S.; corresponding Eq. T. $13^m\ 48^s.7$ S. and $-14^m\ 2^s.3$ S. (see note, Art. 190); semid 16′ 4″.

The rough Gr. date in mean time will be found to be Gr. Oct. 14, $23^h\ 8^m$. The amount of rate of chronometer from Oct. 2, mean noon, to Oct. 14, $23^h\ 8^m$, is $2^m\ 41^s.9$ *fast;* its original error was $1^m\ 22^s.6$ *slow*. Consequently, its error at the instant of observation is $1^m\ 19^s.3$ *fast*. The same error may be got by constructing a table of errors (as in note to Art. 24ⁿ).

| | Chronometer. | |
|---|---|---|
| Sh. Oct. 14, $28^h\ 40^m$ | $11^h\ 10^m\ 55^s$ | Decl. 8° 20′ 46″ S. |
| Long. in T. 5 32 E. | 1 19.3 | Semid. 16 4 |
| | | Eq. T. $14^m\ 1^s.8$ S. |
| Gr. Oct. 14, 23 8.....23 | 9 35.7 | Z. D. 74° 34′ 24″ |

* And (if it be thought more convenient than taking the halves of haversines) take half this sum and half this difference. Then add together the *log. secants* of the two first terms in the form, and the *log. sines* of the two last terms in it, rejecting the tens from the index of sum. Take from the table the *arc in time*, corresponding to the result as a *log. haversine*, from the top of table when body is W. of meridian, and from bottom of table when body is E. of meridian. Proceed afterwards as in Rule above.

| | | | | | |
|---|---|---|---|---|---|
| Lat. | 15° 32′ 0″ N. | *sec.* | 0.016160 | | 4ʰ 45ᵐ 22ˢ.5 |
| Decl. | 8 20 46 S. | −10 | 0.004624 | Eq. T. | 14 1.8 S |
| | | | 4.879270 | | |
| | 23 52 46 | | 4.631542 | Sh. Oct. 15, | 4 31 20.7 |
| | 74 34 24 | | | Sh. Oct. 14, | 28 31 20.7 |
| | | | 9.531596 | Gr. Oct. 14, | 23 9 35.7 |
| | 98 27 10 | ½ *havers.* | H. Angle or App. T. | | |
| | 50 41 38 | | 4ʰ 45ᵐ 22ˢ.8 W. | Long. in T. | 5 21 45 |

Long. 80 26 15 E.

*Ex.* 2. May 12, 1835, at 8ʰ 0ᵐ A. M. mean time nearly, in latitude 40° 25′ 10″ N. and longitude by account 95° 30′ W., a chronometer showed 2ʰ 12ᵐ 16ˢ, and the observed altitude of the sun's L. L. was 35° 20′ 42″; the index correction was — 4′ 20″, and the height of the eye above the sea was 20 feet: required the true longitude.

On May 2, 1835, at Gr. mean noon the chronometer was *slow* on Gr. mean time 5ᵐ 16ˢ.4, and its rate was 3ˢ.7 *losing*.

Sun's decl. on May 12, at Gr. mean noon 18° 1′ 26″ N., on May 13, 18° 16′ 32″ N.; corresponding Eq. T. 3ᵐ 53ˢ.5 S. and 3ᵐ 54ˢ.9 S.; semid. 15′ 51″.

The rough Gr. date in mean time is Gr. May 12, 2ʰ 22ᵐ. The amount of the rate of chronometer from May 2, at Gr. mean noon, to May 12, at 2ʰ 22ᵐ, is 37ˢ.3 *slow*: its original error is 5ᵐ 16ˢ.4 *slow*. Consequently, its error at the instant of observation is 5ᵐ 53ˢ.7 *slow*.

| | | Chronometer. | | |
|---|---|---|---|---|
| Sh. May 11, | 20ʰ 0ᵐ | 2ʰ 12ᵐ 16ˢ | Decl. | 18° 2′ 53″ N. |
| Long. in T. | 6 22 W. | 5 53.7+ | Eq. T. | 5ᵐ 53ˢ.7 S. |
| | | | Semid. | 15′ 51″ |
| Gr. May 12, | 2 22 | 2 18 9.7 | Z. D. | 54 33 26 |

| | | | | | |
|---|---|---|---|---|---|
| Lat. | 40° 25′ 10″ N. | *sec.* | 0.118443 | | 20ʰ 6ᵐ 17ˢ.5 |
| Decl. | 18 2 53 N. | −10 | 0.021917 | Eq. T. | 3 53.7 S. |
| | | | 4.793812 | | |
| | 22 22 17 | | 4.442781 | Sh. May 11, | 20 2 23.8 |
| Z. D. | 54 33 26 | | | Gr. May 11, | 26 18 9.7 |
| | | | 9.376953 | | |
| | 76 55 43 | ½ *havers.* | Hour Angle or App. T. | | 6 15 45.9 |
| | 32 11 9 | | 20ʰ 6ᵐ 17ˢ.5 W. | | |

Long. 93° 56′ 28″ W.

*Ex.* 3. Nov. 24, 1834, at 9ʰ 50ᵐ A. M. mean time nearly, in latitude 50° 48′ N., and longitude by account 2° 50′ W. when a chronometer showed 9ʰ 51ᵐ 50ˢ, the observed altitude of the moon's L. L. was 35° 42′ 10″ W. of meridian; the index correction was +3′ 40″, and the height of the eye above the sea was 18 feet: required the true longitude. On Nov. 10, at Gr. mean noon, the chronometer was *fast* on Gr. M. T. 2ᵐ 10ˢ.5, and its daily rate was 4.7ˢ *losing*. Allowing the daily rate of the chronometer, namely, 4.7 *slow*, to the original error 2ᵐ 10ˢ.5 *fast*, and continuing this allowance day by day to Nov. 23, 22ʰ 1ᵐ, the error at the instant of observation is 1ᵐ 5ˢ.2 *fast*. R. A. of mean sun (see note, Art. 191) on Nov. 23, at Gr. mean noon 16ʰ 7ᵐ 54ˢ, on Nov. 24, 16ʰ 11ᵐ 51ˢ. R. A. of moon on

Nov. 23, at $21^h$....$10^h\ 33^m\ 18^s$, at $22^h$.... $10^h\ 35^m\ 31^s$; corresponding declinations 14° 38′ 16″ N. and 14° 26′ 7″ N. Moon's hor. semid. on Nov. 23, at Gr. mean midn. 15′ 50″.2, on Nov. 24, at mean noon, 15′ 55″.9; corresponding hor. par. 58′ 7″.0 and 58′ 28″.0.

| | | Chronometer. | | |
|---|---|---|---|---|
| Sh. Nov. 23, | $21^h\ 50^m$ | $9^h\ 51^m\ 50^s$ | R. A. Mean Sun, | $16^h\ 11^m\ 30^s$ |
| Long. in T. | 0 11 W. | 1 5.2— | R. A. Moon | 10 35 11 |
| | | | Decl. Moon | 14° 28′ 0″N. |
| Gr. Nov. 23, | 22 1 | ....21 50 44.8 | Hor. Semid. | 15 55 |
| | | | Hor. Par. | 58 25 |
| | | | Z. D. | 53 16 19 |

| | | | | | |
|---|---|---|---|---|---|
| Lat. | 50° 48′ 0″ N. | *sec.* | 0.199263 | H. Angle | $3^h\ 14^m\ 32^s.6$ W. |
| Decl. | 14 28 0 N. | —10. | 0.013993 | R. A. Moon | 10 35 11 |
| | | | 4.847987 | | |
| | 36 20 0 | | 4.168135 | Adding $24^h$ | 37 49 43.6 |
| Z. D. | 53 16 19 | | | R. A. M. Sun | 16 11 30 |
| | | | 9.229378 | | |
| | 89 36 19 | ½ *havers.* | Hour Angle | Sh. Nov. 23, | 21 38 13.6 |
| | 16 56 19 | | $3^h\ 14^m\ 32^s.6$ W. | Gr. Nov. 23, | 21 50 44.8 |
| | | | | Long. in T. | 0 12 31.2 |
| | | | | Long. | 3° 7′ 48″ W. |

*Ex.* 4. Nov. 19, 1834, at $7^h\ 20^m$ A. M., mean time nearly, in latitude 54° 2′ N. and longitude by account 45° 10′ W., a chronometer showed $10^h\ 21^m\ 40^s$, and the observed altitude of the planet Mars was 39° 50′ 30″, bearing S. W.; the index correction was — 2′ 10″, and the height of the eye above the sea was 17 feet: required the true longitude. On Nov. 1, at Gr. mean noon the chronometer was *fast* on Gr. M. T. $1^m\ 50^s.6$, and its daily rate was $7^s.9$ *losing*. The error continued, by allowing rate, up to Gr. Nov. 18, $22^h\ 21^m$ (see rough Gr. date) is 31° *slow*. Decl. Mars on Nov. 18 at Gr. mean noon 23° 42′ 22″ N., on Nov. 19, 23° 44′ 27″ N., corresponding R. A. of Mars $7^h\ 33^m\ 38^s$, and $7^h\ 33^m\ 57^s$; corresponding R. A. mean sun $15^h\ 48^m\ 11^s.6$ and $15^h\ 52^m\ 8^s.2$.

| | | | | | |
|---|---|---|---|---|---|
| Sh. Nov. 18, | $19^h\ 20^m$ | | $22^h\ 21^m\ 40^s$ | R. A. Mean Sun, | $15^h\ 51^m\ 52^s$ |
| Long. in T. | 3 1 W. | | 0 31+ | R. A. Mars | 7 33 56 |
| | | | | Decl. Mars | 23° 44′ 18″ N. |
| Gr. Nov. 18, | 22 21 | | ... 22 22 11 | Z. D. | 50 16 46 |

| | | | | | |
|---|---|---|---|---|---|
| Lat. | 54° 2′ 0″ N. | *sec.* | 0.231129 | | $3^h\ 37^m\ 27^s.3$ W. |
| Decl. | 23 44 18 N. | —10. | 0.038389 | | 7 33 56 |
| | | | 4.810651 | | |
| | 30 17 42 | | 4.239312 | Adding $24^h$.. | 35 11 23.3 |
| | 50 16 46 | | | | 15 51 52 |
| | | | 9.319481 | | |
| | 80 34 28 | ½ *havers.* | Hour Angle | Sh. Nov. 18, | 19 19 31.3 |
| | 19 59 4 | | $3^h\ 37^m\ 27^s.3$ W. | Gr. Nov. 18, | 22 22 11 |
| | | | | Long. in T. | 3 2 39.7 |
| | | | | Long | 45 39 55 W. |

### *Remarks.*

(250.) It has already been remarked (246) that the heavenly body, of which the altitude is taken for finding the longitude by chronometer, should not be nearer in bearing to the meridian than two points; if nearer than this, a small mistake in the altitude or in the latitude would produce, perhaps, too great an error in the resulting longitude. The most advantageous bearing of a heavenly body is due East or West.

(251.) Whenever it can be conveniently done, altitudes should be taken not only nearly east or west, but also on *both sides* of the meridian: by which means an error in the longitude from altitudes on one side will be partly or altogether cancelled by an error of an opposite kind on the other side. If the sun is observed in the morning, it should also be observed in the afternoon; if a fixed star is observed east of the meridian, another, if possible, should be observed west of the meridian, as nearly as possible at the same time, and at about an equal bearing. (See App. 29, 30, 31.)

(252.) The longitude determined by chronometer at sea in the morning, is usually carried forward by means of the log account to noon; and if determined in the afternoon, it is usually brought back to noon by means of the log account. The result is then inserted in the log book in the proper space, as longitude by chronometer. A similar remark may be extended to any other astronomical method of finding the longitude, and also the latitude determined by observations off the meridian.

Having explained in the preceding articles the method of finding at sea the longitude by chronometer, supposing its error on Greenwich mean time to have been known at sailing, and also its rate, it is necessary now to explain methods for determining such error and rate.

### *To find the Error of a Chronometer on Mean Time and its Rate by Single Altitudes.*

(253.) By the daily rate of a chronometer is meant what it goes more or less than 24 hours in a mean solar day. If it goes more than 24 hours, its rate is said to be so much *gaining;* if less than 24 hours, its rate is said to be so much *losing.*

This rate is got by determining the error of the chronometer on mean time at the same place on different days. If the error remain unaltered, there is no rate; but if it change, we know from that change and the time elapsed how much it gains or loses in 24 hours.

Let an astronomical observation therefore be taken, from which mean time can be deduced, and at the instant of the observation let the hour, minute, and second shown by the chronometer be noted down. Then the difference between the mean time deduced from the observation, and the time by the chronometer, will be its error on mean time at the place where the observation is taken, fast or slow.

And if mean time at the place be converted into Greenwich mean time, by adding or subtracting the longitude in time, before the difference is taken, the result will be the error of the timekeeper on Greenwich mean time.

If the error be found on successive days at the same hour (which if possible should be done), write them down under each other, and the differences will be the daily rate required If there be an interval of several days between two successive observations, the difference between the errors must be divided by the number of elapsed days.

When the observations are not made at the same hour of the day, a proportion must be made for the rate in the interval thus:—

If the number of hours elapsed require the difference of the errors, what will 24 hours require?

(254.) Mean time at any place may be deduced from the observed altitude of a heavenly body, as in Arts. 246, &c. By repeating such observations, therefore, on different days, and taking the corresponding times by the chronometer, its rate may be found.

Let a ship be supposed to be lying at anchor for a few days, where the horizon can be distinctly seen; then in order to find the rate of the chronometer, the altitude of the sun is taken with a good sextant, when it bears as nearly E. or W. as possible, and the observation is made with the greatest care and accuracy. At the same instant the time is taken by the chronometer.

From the altitude of the sun, the latitude of the ship, and the declination of the sun, compute mean time at the ship (Art. 249.) Take the difference between this and the time by the chronometer, and note it down fast or slow. Repeat the observation on as many days afterwards as possible, and note down the errors of the chronometer, thence deduced as before on ship mean time. From these the rate of the timekeeper is found as explained above.

(1.) *Ex.* May 19, 1834, at $7^h\ 20^m$ A.M. mean time, nearly, in latitude 45° 25′ 10″ N., and longitude 135° 26′ 10″ W., the mean of times by chronometer was $4^h\ 28^m\ 20^s.5$, and the mean of observed altitudes of the sun's L. L. was 28° 32′ 16″; the index correction was + 3′ 20″, and the height of the eye above the sea was 20 feet.

(2.) May 23, at the same place and at the same hour and minute, the mean of times by chronometer was $4^h\ 28^m\ 11^s.5$, the mean of observed altitudes of the sun's L. L. was 29° 2′ 10″: the index correction and height of the eye above the sea were the same as on the 19th. Required the daily rate of the chronometer.

Sun's decl. on May 19, at Gr. mean noon 19° 43′ 35″.6 N.; on May 21, 19° 56′ 21″.9 N.; semid. 15′ 49″; corresponding Eq. T. $3^m\ 51^s.5$ S., and $3^m\ 48^s.9$ S. Sun's decl. on May 23, at Gr. mean noon 20° 32′ 37″ N., on May 24, 20° 44′ 0″ N.; semid. 15′ 48″; corresponding Eq. T. $3^m\ 37^s.8$ S. and $3^m\ 33^s$ S.

From the ship mean time known nearly, and the longitude, a Gr. date is got as in Art. 185: for which the sun's declination, semid., and the Eq. T. are taken out as in Art. 186, &c. The observed altitude is corrected as in Art. 211, and the true zen. dist. got by subtracting the T. A. from 90°.

(1.) Decl. 19° 45′ 55″ N.; semid. 15′ 49″; Eq. T. $3^m\ 51^s$ S. (note Art. 190); Z. D. 61° 14′ 37″.

| | | |
|---|---|---|
| 45° 25′ 10″ N. } sec. | 0.153718 | Hour Angle 19h 25m 17s.8 W. |
| 19 45 55 N. } —10. | 0.026371 | 3 51.0 S. |
| | 4.637408 | |
| 25 39 15 | 4.485181 | Sh. May 18, 19 21 26.8 |
| 61 14 37 | ——— Chron. | adding 12h, 16 28 20.5 |
| | 9.502678 | |
| 86 53 52 } ½ havers. | | Oct. 19h 21m..2 53 6.3 slow |
| 35 35 22 } | | |

(2.) Decl. 20° 46′ 1″ N.; semid. 15′ 48″; Eq. T. 3m 32s.1 S. Z. D 60° 44′ 42″.

| | | |
|---|---|---|
| 45° 25′ 10″ N. } sec. | 0.153718 | Hour Angle 19h 24m 20s W. |
| 20 46 1 N. } —10 | 0.029174 | 3 32.1 S. |
| | 4.831347 | |
| 24 39 9 | 4.491098 | Sh. May 22, 19 20 47.9 |
| 60 44 42 | ——— Chron. | adding 12h, 16 28 11.5 |
| | 9.505337 | |
| 85 23 51 } ½ havers. | | At 19h 21m..2 52 36.4 slow. |
| 36 5 33 } | | |

By taking the difference of these two errors, it appears that in 4 mean solar days the chronometer has gained 29s.9; and consequently that its average *daily rate* has been 7s.5 gaining. By applying the longitude in time (supposed correct) to the ship mean time, on the last day of observation, adding W. and subtracting E., the Gr. mean time is easily got, and then the error of the chronometer on Gr. mean time: with which and the rate thus determined it is usual to go to sea; and then to find the longitude as explained in Art. 246, &c.

(255.) The above method of finding the rate of a timekeeper is liable to some objections; it has also certain advantages. It is objectionable on account of the unavoidable errors, which may be made in the altitude of the sun from observation, reading off, and also from the imperfection of the instrument used. There may also be an error in the latitude. It hence happens that the mean time at the ship deduced from the altitude may be in a small degree wrong, and the error may be greater or smaller at the second observation than at the first, or it may be of a different kind. A very accurate rate therefore cannot be expected from this method.

However, by observing several altitudes near to each other with a good instrument and the corresponding times by the chronometer, of which sets a mean is taken; by determining the latitude of the ship with as great accuracy as possible; and by working to the nearest second in the necessary calculation, the error of the result may be diminished so far as to be of no great consequence in a practical point of view.

The advantages of this mode of proceeding arise from the circumstance of the rate being determined without moving the chronometer from the place in which it is afterwards used. It is there subject to the same changes of temperature in the air, and to similar motions of the ship, to which it is subject at sea. Whereas when a chronometer is taken on shore for the purpose of ascertaining its rate with greater accuracy, it may be placed in a room much more warm or cold than the ship; also the shocks to which it is liable in passing from and to the ship are apt in some mea-

sure to alter the rate. Upon the whole therefore the seaman may have reason to be satisfied with the rate got in the manner pointed out above, by his own observations, better than with a rate found on shore with more exact instruments and by more exact methods.

It may be necessary to add, that in getting the rate in this way, the observations, if possible, should be taken every day, nearly at the same time of the day, and with the same instrument; and that a mean of the rates so deduced should be used on going to sea, with the error last found on Greenwich mean time.

### *To find the Error of a Chronometer on Mean Time, and its Rate, by Equal Altitudes.*

(256.) If the time shown by a chronometer can be ascertained when a heavenly body passes the meridian of the place, the error of the chronometer on M. T. there may be found, the M. T. of the meridian passage being determined as in Arts. 203 and 204. And if errors be thus found on different days, the variation of such errors will be seen, and thence may be easily deduced the daily gain or loss of the chronometer on M. T., that is, its *rate*. Let the time by chronometer be supposed to be noted, when the heavenly body has any particular altitude E. of the meridian, and again when it has the same altitude W. of the meridian. The middle point of time, that is, half the whole time elapsed, added to the time E. of meridian, would evidently be the time by chronometer when the body passes the meridian, provided the body, as a fixed star, had no motion of itself in altitude, and the chronometer (as may be here supposed) went uniformly. This, however, would not be the case for a body, as the sun, which has a motion in declination affecting the altitude. The middle point of time must in this case require a correction for such motion in declination, in order to get the exact time of the meridian passage by the chronometer. Such correction is called the *equation of equal altitudes*, and may be computed by the rule given hereafter (see Art. 258). Before, however, we proceed to give such rule, it may be proper to say a few words on the mode of making the necessary observations with the sextant.

### *Mode of observing Equal Altitudes.*

(257.) If the body observed be the sun, which is usually the case, proceed as follows:—When the sun's motion in altitude is considerable A. M., take the altitude of the lower limb (L. L.). Then set the index forward from 5′ to 10′ to an exact minute, and wait till the sun has risen to this new altitude. At the instant of its having done so, let an assistant note the time by the chronometer, as nearly as he can, to the nearest tenth of a second, and write it down with the altitude. Set the index again forward 5′ or 10′, and proceed as before, and thus take about five or six observations. In the afternoon, at something less than the distance in time from noon of the last morning observation, take the altitude again of the sun's L. L., and when it has come nearly to the last of the morning altitudes, set the index to this altitude exactly, and wait till there is a contact. At that instant let the assistant note the time by chronometer, and write the said time opposite to the corresponding time in the morning. Set the index back as far as it was set forward in the morning, and proceed as before; and thus go on till all the corresponding observations to the morning ones are got, or as many of them as possible.

The above observations have been supposed to be of single altitudes from some stationary place, as a ship at anchor.

In observing double altitudes on shore by means of an artificial horizon, the index may be set first to about twice the altitude taken roughly without the telescope. Then, putting in the telescope (supposed an inverting one), the U. L. of the image from the glasses of the sextant may be made nearly to touch the L. L. of the image from the artificial horizon. Then set the index forward exactly to a division for minutes, and wait for the contact. Let the time by chronometer be noted at the instant such contact takes place. Afterwards put forward the index 10′ or 20′, and proceed as above.

*Rule for finding Equation of Equal Altitudes, &c.* (See App. 32.)

(258.) Take the mean of the chronometer times at the *second* observations, and put it down on the left-hand side of the paper, as in the following examples (adding $12^h$ thereto if necessary). Under this put the mean of the chronometer times at the corresponding *first* observations, and subtract. Mark the remainder *El. T.* or elapsed time. Take half this, and mark it $\frac{1}{2}$ *El. T.*, which add to the mean of times at the first observations. The sum will be the *approximate* chronometer time of the meridian passage of the body observed. Then:

*Either,*

To mean of chronometer times at *first* observations apply the supposed error of chronometer on Gr. M. T.; if necessary (as indicated by the longitude), add or subtract $12^h$ or $24^h$, and affix the proper day of the month at Greenwich. The result will be the *first* Gr. date. To this add the $\frac{1}{2}$ *El. T.* and, if necessary, reject $24^h$, and put the day of the month one forward. The result will be the *second* Gr. date.

*Or,*

From the estimated M. T. at the place, at the *first* observations, and the longitude, get the *first* Gr. date in M. T., as in Art. 185. To this add $\frac{1}{2}$ *El. T.*; reject $24^h$ if necessary, and put the day of month one forward. The result will be the *second* Gr. date.

The sun being supposed to be the body observed*, take from the Naut. Almanac its *decl.* at the *first* Gr. date, and the *eq. of time* at the *second* Gr. date. When the Naut. Tables are opened for the purpose of getting the sun's decl. write down at the same time, under each other, and in a separate place, *prop. log.* of change of decl. in $24^h$, *Gr. date log. for sun* corresponding to El. T. (elapsed time), and 1.47712. Mark the sum of these numbers (*a*), which sum, or (*a*), write down again and mark it (*b*). Under (*a*) put log. *sin.* of $\frac{1}{2}$ El. T., and at the same time under (*b*) the log. *tan.* of $\frac{1}{2}$ El. T. Again under (*a*) put log. *cotan.* of latitude, and under (*b*) log. *cotan.* of declination. Add each set of numbers, rejecting the tens from the indices of sums. Find from Naut. Tables, p. 16 (*qq*), the seconds corresponding to each result to the nearest hundredth as estimated by inspection. Mark the seconds + or −, according to the following directions:—

* When the body observed is a Planet, take out its decl. and R. A. and also the R. A of mean sun.

($a$) When decl. is *increasing*, and of same name with lat., mark seconds under ($a$) . . . . . —
When decl. is *increasing*, and of a different name from lat. . +
When decl. is *decreasing*, and of same name with lat. . . +
When decl. is *decreasing*, and of a different name from lat. . —
($b$) When decl. is *increasing*, and El. T. is less than $12^h$, mark seconds under ($b$) . . . . . +
When decl. is *increasing*, and El. T. is greater than $12^h$ . —
When decl. is *decreasing*, and El. T. is less than $12^h$ . . —
When decl. is *decreasing*, and El. T. is greater than $12^h$ . +

When the two parts under ($a$) and ($b$) have the same signs, take their sum, to which affix the sign of either. When they have different signs, take their difference, to which affix the sign of the greater. The result will be the *equation of equal altitudes*. Apply this equation, according to its sign, to the approximate chronometer time of the meridian passage. The result will be the *correct* time by chronometer of the said passage. The difference between this and M. T. at the place of the same meridian passage computed as in Arts. 203, 204 (adding or subtracting from either $12^h$ or $24^h$, so as to get the least difference), will be the error of the chronometer on M. T. at the place at the instant of the mer. passage.

By adding the long. in time, if W., to the M. T. at the place of the mer. passage, and subtracting it if E. (adding or subtracting $24^h$ if necessary), Gr. M. T. corresponding to the mer. passage at the place will be got; the difference between which, and the correct chronometer time thereof, will be the error of the chronometer on Gr. M. T. at the instant of the mer. passage at the place.

From errors on different days got as above, either on M. T. at the place or on Gr. M. T., the *rate* of the chronometer may be easily deduced, by dividing the whole change of error by the number of intervening days.

*Ex.* 1. Aug. 18, 1842, in lat. 50° 48′ N. and long. 1° 6′ W. equal altitudes of the sun were observed. The mean of the times by chronometer were A. M. $10^h\ 10^m\ 26^s.4$, and P. M. $2^h\ 23^m\ 36^s.4$, the chronometer being supposed *fast* on Gr. M. T. about $9^m\ 5^s$. Required the correct error of the chronometer on M. T. at the place of observation, and also on Gr. M. T. at the instant of the sun's mer. pass. at the place.

| | h. | h. m. s. | Decl. | | | Eq. T. h. m. s. | |
|---|---|---|---|---|---|---|---|
| Mean P. M. | + 12... | 14 23 36.4 | Aug. 17 | ° ′ ″ 13 29 49.7 N. | | 18 3 39.74 | A. |
| Mean A. M. | . . | 10 10 26.4 | 18 | 13 10 32.0 N. | | 19 3 26.44 | A. |
| | | | | | | | 13.30 S. |
| El. T. . . . . | | 4 13 10 | | 19 17.7 S. | | | 0.07 S. |
| | | | | | | Eq. T. | 3 39.67 A. |
| + El. T. . . . | | 2 6 35 | | .96983 . . | .96983 | | 0 0 0 |
| Mean A. M. . . | | 10 10 26.4 | | .03713 | .75496 | | |
| | | | | 1.00696 | 1.47712 | Mer. Pass. | 0 3 39.67 M.T |
| Approx. Chr. Mer. Pass. . . . | | 12 17 1.4 | | | 3.20191 (a) . . . . | | 3.20191 (b.) |
| | | h. m. s. | | ″ ′ 17 42.8 S. | 9.71988 | | 9.78960 |
| Mean A. M. . . | | 10 10 26.4 | | 13 29 49.7 N. | 9.91147 | | 10.62969 |
| Chr. on Gr. M. T. . | | 0 9 5.0 *fast* | | | | s. | |
| | | | Decl. . | 13 12 7 N. | 2.83326 . . | 15.85 + | 3.62140 |
| Gr. Aug. 17 . . | | 23 1 21.4 | *Decreasing.* | | | 2.58 — | 2s.56 — |
| + El. T. . . . | | 2 6 35 | | | | | |
| | | | | | Eq. Eq. Alt. | 13.27 + | |
| Gr. Aug. 18 . . | | 0 7 56.4 | Approx. Chr. Mer. Pass. | | | 0 17 1.40 | |
| | | | Corr. Chr. Mer. Pass. | | | 0 17 14.67 | |
| | | | M. T. of Mer. Pass. | | | 0 3 39.67 | |
| | | | Chr. on Ship M. T. | | | 0 13 35.0 *fast.* | |

By applying the long. in time, namely, $4^m\ 24^s$ W., or + to Sh. M. T., it appears that the chronometer's error on Gr. M. T. is $9^m\ 11^s.0$ *fast*.

*Ex.* 2. Sept. 13, 1842, at the same place as above, mean of chronometer times A. M. was $11^h\ 10^m\ 50^s.5$, and P. M. was $1^h\ 13^m\ 4^s$. The mean time at the place A. M. was about $10^h\ 55^m$. Required the error as above, and also the daily rate of the chronometer.

| | d. h. m. s. |
|---|---|
| Mean P. M. + | 12...13 13 4 |
| Mean A. M. | . . 11 10 50.5 |
| El. T. | . . . . 2 2 13.5 |
| ½ El. T. | . . . 1 1 6.75 |
| Mean A. M. | . . 11 10 50.5 |
| Approx. Chr. Mer. Pass. | 12 11 57.25 |
| Sh. Sept. 12 | . . 22 55 0 |
| Long. | . . . 4 24 W. |
| Gr. Sept. 12 | . . . 22 59 24 |
| ½ El. T. | . . . 1 1 6.7 |
| Gr. Sept. 12 | . . . 0 0 31 |

| | Decl. ° ′ ″ | | |
|---|---|---|---|
| Sept. 12 | 4 14 52.4 N. | | |
| 13 | 3 51 54.6 N. | | |
| | 22 57.8 S. | | |
| | .89449 | . . | .89449 |
| | .01880 | | 1.07124 |
| | | | 1.47712 |
| | .91329 | | |
| | ′ ″ | | 3.44285 (a) . . . . . |
| | 21 59 S. | | 9.42081 |
| | 4 14 52.4 N. | | 9.91147 |
| | | | s. |
| Decl. | 3 52 53.4 N. | | 2.77513 18.13 + |
| *Decreasing.* | | | 0.97 − |
| | | Eq. Eq. Alt... | 17.16 + |
| | Approx. Chr. Mer. Pass. | | 24 11 57.25 |
| | Corr. Chr. Mer. Pass. | | 24 12 14.41 |
| | M. T. of Mer. Pass. | | 23 55 54.64 |
| | Chr. on Ship M. T. | | 0 16 19.77 *fast* |

| | Eq. T. m. s. |
|---|---|
| Sept. 12 | . 4 5.36 S. |
| | 24 0 0 (*Art.* 204) |
| Mer. Pass. | 23 55 54.64 M. T. |
| | 3 44285 (b.) |
| | 9.42644 |
| | 11.16825 |
| | 4.04754 |
| | 0s.97.− |

By applying the long. in time, namely, $4^m\ 24^s$ W. to Sh. M. T. of mer. pass., it appears that the chronometer's error on Gr. M. T. is $12^m\ 55^s.77$ *fast*.

By comparing the errors on Aug. 18 and Sept. 13, it appears that the chronometer has gained $2^m\ 44^s.77$ on M. T. in 26 days, and consequently at the rate of $6^s.3$ per day. The note made therefore respecting the chronometer on going to sea would be this: Sept. 13, 1842, at Gr. mean noon* nearly, chronometer on Gr. M. T. $16^m\ 19^s.8$ *fast;* daily rate $6^s.3$ *gaining.*

*If the body be a fixed star*, the chronometer approximate time got as above will be the *correct* chronometer time of the mer. passage; the difference between which and the M. T. of mer. passage at the place got as in Art. 203, will be the error of chronometer on M. T. at the place, at the instant of the mer. passage of the star.

*If the body be a planet*, proceed as above to get the *equation of equal altitudes*, and find the M. T. of mer. passage according to Art. 203.

(259.) When the error of a chronometer on Gr. M. T. is supposed to be accurately known at the observation of equal altitudes, the correct Gr. M. T. corresponding to the mer. passage may be found by applying that error to the correct chronometer time thereof; and the difference between this and the M. T. at the place of the mer. passage got as above will be the longitude in time.

*Ex.* Let the error of the chronometer on Gr. M. T. at the mer. passage

* When the long. is considerable, the error at mean noon at place must be reduced to Gr. mean noon, by allowing rate for long. in time.

in the first of the above two examples be supposed $9^m\ 5^s.5$ *fast*. Then proceeding as just directed, the long. comes out in time $4^m\ 29^s.5$ W. or in degrees $1°\ 7'\ 22''.5$ W.

### *Inferior Meridian Passage.*

(260.) The error of chronometer may be sometimes found from equal altitudes of a body before and after its *inferior* mer. passage, in which case the *first* observations will be to the west of the meridian and the *second* observations to the east thereof. The rule given in Art. 258 applies also in this case, with the exception that the signs + or − to be affixed to the seconds under (*a*) and (*b*) are then different, being as below (see App. 33); and that the M. T. at the place of the *inferior* mer. passage must be found (see Art. 203), and the *second* Gr. date must correspond to it.

(*a*) When decl. is *increasing* and of same name with lat. mark seconds; under (*a*) . . . . . +

When decl. is *increasing* and of different name from lat. . −

When decl. is *decreasing* and of same name with lat. . . −

When decl. is *decreasing* and of different name from lat. . +

(*b*) When decl. is *increasing* and El. T. greater than $12^h$ mark seconds under (*b*) . . . . . −

When decl. is *increasing* and El. T. less than $12^h$ . . +

When decl. is *decreasing* and El. T. greater than $12^h$ . . +

When decl. is *decreasing* and El. T. is less than $12^h$ . . −

*Ex.* Aug. 2, 1842, in lat. 54° 20′ N. and long. 6° 40′ E., the mean of chronometer times when the sun's altitudes were observed P. M. was $6^h\ 40^m\ 10^s.3$, and the mean of chronometer times of equal altitudes A. M. next day was $4^h\ 36^m\ 17^s.8$. The chronometer was supposed to be *slow* on Gr. M. T. $0^m\ 58^s$. Required the error of the chronometer on M. T. at the place of observation at the instant of the inferior mer. passage.

| | h | h m. s. | | ° ′ ″ | | m s. |
|---|---|---|---|---|---|---|
| | | | | | Eq. T. Aug. 2, | 5 56.73 A. |
| | | | | | .. 3, | 5 52.55 A. |
| Mean A. M. + | 12 | 16 36 17.8 | Decl. Aug. 2, | 17 50 5.1 N. | | |
| Mean P. M. | | 6 40 10.3 | 3, | 17 34 35.0 N. | Eq. T. at Gr. Date.. | 5 54. 7 A. |
| El. T. | . | 9 56 7.5 | | 15 30.1 S. | Infer. Mer. Pass. | ..12h 5 54.7 M.T (Art. 203.) |
| ½ El. T. | . | 4 58 3.75 | | | | |
| Mean P. M. | . | 6 40 10.3 | | 1.06494 | | 1.06494 |
| | | | | .55522 | | 0.38302 |
| Approx. Chr. Inf. Mer. Pass. | . | 11 38 14.05 | | 1.62016 | | 1.47712 |
| | | | | | | 2.92508 (*a*) . . . 2.92508 (*b*) |
| | | | | 4 19 8 | | 9.98394 10.55750 |
| Mean P. M. | . | 6 40 10.3 | | 17 50 5.1 N. | | 9.85594 10.49439 |
| | | 0 58.0 | | | | |
| Decl. | | 17 45 46.1 N. | | *decreasing.* | | 2.76496..18.55− 3.97697 |
| Gr. Aug. 2 | . | 6 41 8.3 | | | | 1.14− 1°.14− |
| ½ El. T. | . | 4 56 3.75 | | | | |
| | | | | | Eq. Eq. Alt. | 19.69− |
| Gr. Aug. 2 | . | 11 39 12 | Approx. Chr. Inf. Mer. Pass.. | | | 11h 38m 14.05 |
| | | | Corr. Chr. Inf. Mer. Pass. .. | | | 11 37 54.36 |
| | | | M. T. of Inf. Mer. Pass. .. | | | 12 5 54.70 |
| | | | Chr. on M. T. at Place .. | | | 0 28 0.34 *slow.* |

The method of finding the rate of a chronometer by observing with a *transit instrument* successive meridian passages of a heavenly body will be explained hereafter in the articles on the use of astronomical instruments.

### *To find the Longitude by Lunar Observation.*

(261.) The moon describes an orbit round the earth from west through south to east, at the distance of about 240 thousand miles from the earth;

this orbit it completes in about 30 days, so that the angle it thus describes round the spectator on the earth in one day or 24 hours is about 12°. The moon seems to traverse the surface of the celestial concave, approaching heavenly bodies as stars, which lie to the east nearly in its track, at the rate of an arc of about 12° in 24 hours, and receding from others to the west lying also nearly in its track at the same rate. By means of a sextant the observer on the earth is enabled to measure the angle between the moon and one of these heavenly bodies, which angle is the same in degrees as the arc of a great circle reaching apparently from the moon to the body, and is therefore called their *apparent distance*.

To an observer supposed to be placed at the earth's centre the distance measured at the same instant would be somewhat different, since the two bodies would from this point be seen lower in their respective circles of altitude on account of refraction, and (with the exception of fixed stars) higher therein on account of parallax. The places of the bodies seen from the earth's centre are called their *true* places, and the distance taken at this point is called their *true distance*. The *apparent distance* is without much difficulty reduced to the *true distance*, provided the altitudes of the bodies are known, either by observation or by computation, at the instant the distance is measured on the earth's surface. Thus at any time when the moon and a proper heavenly body are seen, we have the means of ascertaining their true distance; and thence from the Nautical Almanac, which contains their distances for every third hour at Greenwich, we can deduce a Greenwich date in Greenwich mean time, subject only to the error arising from slight errors of the tables used in computing for the Nautical Almanac, and to others scarcely altogether avoidable by the observer as well as in the instrument used.

(262.) If the *true distance* got from observation be found exactly in the Nautical Almanac, the corresponding Greenwich mean time sought will be seen at once at the head of the column. But if the *true distance* cannot be found exactly, it is necessary to make a proportion for the change of distance from the one immediately preceding it, knowing from the Nautical Almanac the change of distance that takes place in three hours. In making this proportion, it is supposed that the distance changes uniformly, that is, in proportion to the time elapsed,* which in fact it does not exactly (see App. 35).

(263.) In its motion on the celestial concave, the moon approaches or recedes from bright stars lying nearly in its track most rapidly and most uniformly. Such stars therefore are selected for applying this method of getting Greenwich mean time: the distances of the moon from them are put down in the Nautical Almanac within such limits, that whenever the moon may be seen above the horizon, one if not two of these stars may be seen at the same time. The distances put down in the Nautical Almanac are likewise limited by the nature of the instrument used in the observation, and by the particular direction of the moon's motion with respect to the star.

Since the sun is never very far from the moon's track, it is made one of the bodies used in the lunar method. The same may be said of the planets which can be seen with sufficient distinctness for observing the distance of the moon from them.

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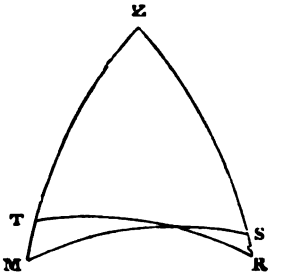
* A correction for the error of this supposition may be taken from the Nautical Almanac, p. 556.

(264.) The Greenwich date in mean time being supposed to be known from an observed distance and necessary reductions by calculation, it is manifest that the error of a chronometer may be found on Greenwich mean time, supposing the hour, minute, and second to have been noted by it at the instant of the observation; which error may be used in getting the longitude by chronometer and the observed altitude of any heavenly body in a proper position, that is, bearing as nearly due east or west as possible: which longitude so found may be called the longitude by lunar observation carried *on* by chronometer; or if necessary carried *back* by chronometer, if the altitude for chronometer has been observed previous to the lunar distance.

And such perhaps is the most simple way of considering the subject, when there is a chronometer on board to be so used.

(265.) But the longitude may be found independently of the chronometer, by computing ship mean time from one of the altitudes supposed to be observed at the same instant with the distance, and taking the difference between this and the Greenwich mean time got from the distance as pointed out above. For this method we shall first give a rule after the principle for computing the true distance from the apparent distance, or as it is commonly termed *clearing the distance*, has been explained.




Let T be the true place of the moon's centre as seen from the centre of the earth, and R that of the sun; then TR is the true distance of the centres, which corresponds to the distances put down in the Nautical Almanac, and from which Greenwich mean time is determined. The arc MT is part of a vertical circle ZT, and is the excess of parallax in altitude above refraction, by which the centre of the moon is raised when viewed from the centre of the earth. The arc SR is also part of a vertical circle ZS, and is the excess of refraction above parallax, by which the centre of the sun is depressed when viewed from the centre of the earth (see Art. 131). The point Z is the zenith. Supposing the altitudes of the sun and moon to be observed at the same instant the distance is taken, we know ZM and ZS the apparent zenith distance of the centres, by applying the index correction, semidiameter, and the dip. Hence in the triangle ZMS all the sides are given to find the angle Z. Again, applying to ZM and ZS the corrections MT and SR for refraction and parallax, we know ZT and ZR, which, with the included angle Z, enable us to compute the true distance TR. In this way by the common rules of trigonometry the true distance may be deduced from the apparent. But as such a method would be tedious and liable to error, several easier and more exact rules have been invented for doing the same, one of which, perhaps the best adapted for use at sea, will be given here.

*Rule for finding the Longitude by Lunar Observation, when the Distance and both Altitudes are observed at the same instant, and Ship mean time is computed from one of the Altitudes.* (See App. 34.)

(266.) *Observations made for Sun and Moon.* When the sun and moon are both seen above the horizon, and *within* distance (that is, when the distance is put down in the Nautical Almanac), bring with the sextant the darkened image of the sun to the moon without using a telescope. When

this is done, so that the nearest edges or limbs of the two bodies appear nearly to touch one another, clamp the index plate; put in and adjust the telescope; then by means of the tangent screw make an exact contact of the nearest points of the said limbs, taking care not to make the limbs overlap. At the same instant, let two assistant observers take the altitudes,* one of the sun's L. L., and the other of the moon's L.L. or U. L., as may be practicable. Read off and note down the arcs. When this is done, unclamp the index plate, and by the hand move it till the limbs a little overlap, and then again clamping by the tangent screw make a contact, taking care not to make the limbs open from each other; at the same instant let the altitudes be again observed. Repeat these operations once or twice, if possible. Take a mean of the readings off on each instrument. Determine the index correction, if any, of each instrument, supposing it to be unknown. If possible, take sets of observations as above for a body both east and west of the moon. (See Use of Sextant, Art. 334, &c.)

(267.) *Observations for Star or Planet and Moon.* Bring the image of the moon, a little darkened if necessary, up to the star or planet, by the hand and without the telescope, so that the enlightened limb may nearly touch the star or planet. Clamp the index plate: put in the telescope and adjust it; then, by the tangent screw, make the limb exactly touch or rather seem to pass through the middle of the star or planet.† Let assistant observers at the same time take the altitudes. Read off and note down the arcs. Unclamp, and by hand bring the limb so as to overlap the star and planet; again clamp, and by the tangent screw make a contact as before; let the altitudes be also again taken. Repeat these observations, if possible, two or three times. Take a mean of the readings off on each instrument. Determine the index correction of each instrument (see Art. 349, &c.).

If possible, get observations both east and west of the moon, as a slight error of observation, or in the index correction, may be thus corrected.

(268.) *Ship Time Altitude.* Select that one of the two bodies observed, which seems to have been the most advantageously situated, or to be on the whole the best for finding, from its altitude, ship mean time. This will depend on the true bearing, which should be as nearly as possible east or west: it will also depend on the clearness of the body and the horizon under it; and possibly it may be necessary to prefer that body whose altitude has been taken with a superior instrument, other circum-

* When it is inconvenient to observe the altitudes at the same instant with the distance, they may be observed a little before and a little after, at equal intervals of time measured by a watch or chronometer from the observation of distance: a mean, that is, *half the sum of two altitudes* of either body thus observed will then be the altitude required. If it be inconvenient to observe altitudes at equal short intervals on each side of distance, they may be taken at unequal short intervals. Let the interval between first altitude and distance be A, between the altitudes themselves be B; let the difference of the observed altitudes be D. Then add *prop. log.* of D to *prop. log.* of A, and from sum subtract *prop. log.* B; the remainder will be *prop. log.* of an arc, which take out, and when the body is rising add it to the first altitude, if the body be falling subtract it from first altitude; the result will be the observed altitude corresponding to distance. The body is supposed not to pass meridian in interval.

| | | |
|---|---|---|
| Time $3^h\ 10^m\ 15^s$ | $3^h\ 11^m\ 50^s$ | $3^h\ 13^m\ 42^s$ |
| Obs. Alt. $26°\ 40'\ 20''$ | Dist. $90°\ 25'\ 30'$ | Alt. $26°\ 15'\ 30''$ |
| $A = 1^m\ 35^s$ | $B. = 3^m\ 27^s$ | $D = 24'\ 50''$ |

Proceeding as in above rule arc required $= 11'\ 24''$, and subtracting this from $26°\ 40'\ 20''$, the obs. alt. corresponding to distance is $26°\ 2s'\ 56''$.

† It seems sufficiently exact to make the moon's limb pass through the middle of the visible disk of a planet without attempting to make a contact with the enlightened limb.

stances being sufficiently favourable. The body thus selected by way of distinction may be called the *ship time body.*

When bodies both *east* and *west* of the moon are observed, one body east of meridian should be used in one calculation, and one west of meridian in the other.

(269.) *Computation.* Get a Gr. date, as in Art. 185, or as in note thereto. For this date take from the Nautical Almanac the following quantities.

(270.) *Sun and Moon observed.* The semidiameter of the sun, the horizontal semidiameter (to which at once apply augmentation) and horizontal parallax* of the moon. *If the sun be the ship time body*, the sun's declination and the equation of time (Art. 186, &c.). *If the moon be the ship time body*, the right ascension of the mean sun, and the right ascension and declination of the moon (Art. 191, &c.).

(271.) *Star and Moon observed.* The horizontal semidiameter (adding thereto augmentation) and horizontal parallax of the moon. *If star be the ship time body*, the right ascension of the mean sun, the right ascension and declination of the star. *If moon be the ship time body*, the right ascension of the mean sun, and the right ascension and declination of the moon (Art. 191).

(272.) *Planet and Moon observed.* The same as for star and moon, with the addition of the horizontal parallax of the planet (Art. 189, &c.).

(273.) *Correction of Altitudes.* Having noted down distinctly the quantities taken from the Nautical Almanac, write down in a line from left to right the observed altitude of the ship time body, that of the other body, and the observed distance. To each of these apply the proper index correction: then apply to the altitudes successively, the dip, the semidiameter (if any), adding if L. L. and subtracting if U. L.; mark the results A. A. Correct these for refraction and parallax as follows: *for sun*, subtract this correction in altitude (table *m*): *for the moon*, add this correction in altitude (see table *w*), and at the same time take from the same table the auxiliary angle A†: *for a star*, subtract this correction in altitude (table *n*): *for a planet*, subtract refraction, that is, correct as for a star, and then add parallax in altitude (Table *b*). Subtract each result from 90°, marking each remainder Z. D. (true zenith distance).

To the distance already corrected for index correction apply semidiameters as follows. *When sun and moon observed*, add the semidiameter of the sun, and also the semidiameter of the moon augmented. *When a star or planet and moon observed*, add the moon's augmented semidiameter if N. L. (nearest limb) is observed, and subtract the moon's augmented semidiameter when F. L. (farthest limb) is observed. Call the result in any case A. D. (apparent distance of centres.)

(274.) *Computation of True Distance* (see *App.* 34). Add together the two true zenith distances (Z. D.), and mark the sum *vers.*; add together

* The *hor. par.* taken from Naut. Almanac should in strictness be diminished by reduction taken from table (*k*). (See Naut. Tables.)

† The angle A is taken out first for degrees and minutes of moon's app. altitude and for *minutes* of moon's hor. par. Two additions are then made, one for seconds of hor. par. and the other for the altitude of sun or star found in a small table at the bottom of page of table. For a planet the latter addition or correction must be taken from table (*c*), entering with correction in planet's altitude for parallax at the top, and apparent altitude of planet at the side.

the two apparent altitudes (A. A.), under the sum put the correct auxiliary angle A., take the sum and difference, each of which mark *vers.*; under the apparent distance (A. D.) put the correct auxiliary angle A, take the sum and difference, each of which mark *vers.* From the proper table (*v*) take the last five figures of the *nat. versine* of the degrees and minutes of each arc* marked *vers.*, and put them under each other, at the same time taking from the right-hand page of the table the parts for the seconds of each arc, and writing them under each other at the side. Add each set of numbers and then add the sums, taking care to reject the tens in the fifth place to the left. The resulting five figures, or the next less to them, will be found in the column of *nat. versines* either immediately under the degree of the apparent distance, or in the column preceding that, or in the column following that. Write down the corresponding degrees and minutes, and then the seconds taken as usual from the opposite page. The result will be the true distance required.

(275.) *Computation of Greenwich Mean Time.* Find in the Nautical Almanac, on the given day, two distances of the moon and sun, or moon and star or planet, between which the true distance lies; that is, two distances, one of which is greater, and the other less, than the true distance. Under the true distance put the one which is placed first in the Nautical Almanac, and under this again the one that is the next in the Nautical Almanac. Take the difference between the first and second as they stand, and also the difference between the second and third. From the *prop. log.* of the 1st difference subtract the *prop. log.* of the 2nd difference. Find the hours, minutes, and seconds, answering to the remainder as a *prop. log.*, add them to the hour corresponding to the 1st distance taken from the Nautical Almanac, and to the sum put the day of the month as in the Nautical Almanac: the result will be Greenwich mean time expressed astronomically; which may be corrected, if thought material, by seconds from the Nautical Almanac p. 556 (see *App.* 35).

(276.) *Computation of Ship Mean Time.* From the true zenith distance (Z. D.) of the *ship time body* (supposed to be written down at the left-hand side of the paper) compute a correct date in ship mean time as in working a chronometer (see Art. 249).

*To find the Longitude.* Take the difference between Greenwich mean time and ship mean time, got as above, taking care first, if necessary, to reduce them to the same day of the month, by adding 24 to the least time and rejecting a day. This difference will be the longitude in time to be turned into degrees, by means of the table of *log. haversines.* The result will be the longitude W., when ship mean time is *less* than Greenwich mean time, and E. when ship mean time is *greater* than Greenwich mean time.

*Ex.* 1. March 13, 1834, at $3^h\ 15^m$ P. M. mean time nearly, in latitude 29° 50′ N. and longitude by account 40° W. the following lunar observation was taken.

| Obs. Alt. Sun's L. L. | Moon's L. L. | Obs. Dist. N. L. |
|---|---|---|
| 34° 10′ 40″ | 57° 2′ 11″ | 35° 15′ 40″ |
| Ind. Corr. — 1 10 | — 1 40 | + 0 40 |

The sun was sufficiently distant in bearing from the meridian for finding ship mean time from its observed altitude. The height of the eye above the sea was 17 feet: required the true longitude.

* If any of the arcs marked (*vers.*) be greater than 180°, it must be subtracted from 360°, and the remainder used instead of it.

Sun's decl. on March 13, at Gr. mean noon 2° 59′ 42″.1 S., on March 14, 2° 36′ 3″ .6 S.; corresponding Eq. T. 9ᵐ 45ˢ.4 A. and 9ᵐ 28ˢ .6 A: sun's semid. 16′ 6″. Moon's hor. semid. on March 13 at Gr. mean noon 14′ 45″.4, on March 13 at Gr. mean midn. 14′ 47″ .4; corresp. hor. par. 54′ 9″ .1 and 54′ 16″ .6.

Sh. March 13, 3ʰ 15ᵐ Sun's Decl. 2° 53′ 52.4 S. Moon's sem. aug. 14′ 58″.4
Long. in T. 2 40 W. Eq. T. 9ᵐ 41ˢ.2 A. Hor. Par. 54 12 .8
Sun's semid. 16′ 6″
Gr. March 13, 5 55

| | Sun's L. L. | Moon's L. L. | Dist. N. L. | | |
|---|---|---|---|---|---|
| | 34° 10′ 40″ | 57° 2′ 11″ | 35° 15′ 40″ | | |
| Ind. Corr. | 1 10 − | 1 40 − | 0 40 + | | |
| | 34 9 30 | 57 0 31 | 35 16 20 | | |
| Dip. | 4 4 − | 4 4 − | Sun's Semid. 16 6 | | |
| | 34 5 26 | 56 56 27 | Moon's Semid. 14 58.4 Augᵈ. | | |
| Semid. | 16 6 + | 14 58 + | Ap. Dist. 35 47 24.4 | | |
| A. A. | 34 21 32 | A. A. 57 11 25 | 60 25 7 | | |
| Cor. in Alt. | 1 18 − | 28 38 + | 6 + | | |
| | | 7 + | 3 + | | |
| | 34 20 14 | 57 40 10 | A. 60 25 16 | | |
| Z. D. | 55 39 46 | | | | |
| | | Z. D. 32 19 50 | 64810 | | 174 |
| Lat. | 29° 50′ 0″ N. | Z. D. 55 39 46 | 82674 | | 030 |
| Decl. | 2 53 52 S. | | 43883 | | 102 |
| | | 87 59 36 *Vers.* | 07999 | | 195 |
| | 32 43 52 | | 90885 | | 104 |
| Z. D. | 55 39 46 | A. A. 57 11 25 | | | |
| | | A. A. 34 21 32 | 90251 | | 605 |
| | 88 23 38 | | 605 | | |
| | 22 55 54 | 91 32 57 | | | |
| | | A. 60 25 16 | 90856 | | |
| | 0.061742 | | 35 59 16 T. Dist. | | |
| | 0.000555 | 151 58 13 *Vers.* | 35 56 58 VI. | | |
| | 4.843311 | 31 7 41 *Vers.* | 37 18 0 | | |
| | 4.298380 | | | | |
| | | 35 47 24.4 | 2 18 | | 1.89354 |
| | 9.203988 | 60 25 16 | 1 21 2 | | 34661 |
| H. Angle | 3ʰ 8ᵐ 35.5 | | | | |
| Eq. T. | 9 41.2 A. | 96 12 40.4 *Vers.* | 5 6.5 | | 1.54693 |
| | | 24 37 51.6 *Vers.* | 6 | | |
| Sh. Mar. 13, | 3 18 16.7 | | | | |

Gr. March 13, 6 5 6.5*
Sh. March 13, 3 18 16.7
Long. in T. 2 46 50
Long. 41° 42′ 30″ W.

*Ex.* 2. Oct. 9, 1834, at 6ʰ 15ᵐ P. M. mean time nearly, in latitude 40° 10′ S. and longitude by account 43° 45′ W. the following lunar observation was taken.

| Obs. Alt. α Pisc. Aust. (Fomalhaut) E. of mer. | Moon's L. L. | Obs. Dist. F. L. |
|---|---|---|
| 48° 5′ 30″ | 65° 2′ 35″ | 46° 2′ 50″ |
| Ind. corr — 1 20 | + 1 10 | − 0 40 |

* Supposing a chronometer the instant of the observation to have shown 6ʰ 1ᵐ 20ˢ, its error on Gr. mean time would be found from this result to be 3ᵐ 46ˢ.5 *slow*, using which error the longitude by chronometer might afterwards be found as in Art. 246, &c.

The star was sufficiently distant in bearing from the meridian for the purpose of computing ship time from its observed altitude. The height of the eye above the sea was 19 feet: required the true longitude.

R. A. mean sun on Oct. 9, at Gr. mean noon $13^h\ 10^m\ 29^s.5$, on Oct. 10, $13^h\ 14^m\ 26^s.0$. R. A. $\alpha$ Piscis Aust. $22^h\ 48^m\ 30^s.2$. Decl. $\alpha$ Piscis Aust. 30° 29′ 50″ S. Hor. semid. moon on Oct. 9, at Gr. mean noon 15′ 35″.4, on Oct. 9. at Gr. mean midn. 15′ 28″.6; corresponding hor. par. 57′ 12″.8 and 56′ 47″.6.

Sh. Oct. 9, $6^h\ 15^m$ — R. A. mean sun $13^h\ 12^m\ 0^s$ — Aug. sem. moon 15′ 44″.4
Long. in T. 2 55 W. — R. A. star 22 48 30.2 — Hor. par. moon 56 53 .6
Dec. star 30° 29′ 50″ S.
Gr. Oct. 9, 9 10

| | Star. | Moon's L. L. | Dist. F. L. | |
|---|---|---|---|---|
| | 48° 5′ 30″ | 65° 2′ 35″ | 46° 2′ 50″ | |
| Index Corr. | 1 20 − | 1 10 + | 0 40 − | |
| | 48 4 10 | 65 3 45 | 46 2 10 | |
| Dip. | 4 17 − | 4 17 − | 15 44.4 − | |
| A.A. | 47 59 53 | 64 59 28 | 45 46 25.6 | |
| | 52 − | 15 44 + | | |
| | 47 59 1 | A. A. 65 15 12 | 60 28 14 | |
| | | 23 0 + | 27.5 + | |
| Z. D. | 42 0 59 | 23 + | 0 | |
| | | | A. 60 28 41.5 | |
| Lat. | 40° 10′ 0″ S. | 65 38 35 | | |
| Decl. | 30 29 50 S. | | | |
| | 9 40 10 | Z. D. 24 21 25 | | |
| | 42 0 59 | Z. D. 42 0 59 | | |
| | 51 41 9 | 66 22 24 *Vers.* | 99118 | 107 |
| | 32 20 49 | | 93993 | 025 |
| | 0.116809 | A. A. 65 15 12 | 94938 | 090 |
| | 0.064670 | A. A. 47 59 53 | 79829 | 033 |
| | 4.639390 | 113 15 5 | 32732 | 019 |
| | 4.444898 | A. 60 28 41.5 | 00610 | 274 |
| | 9.265767 | 173 43 46.5 *Vers.* | 274 | |
| | | 52 46 23.5 *Vers.* | 00884 | |
| Hour Ang. | $20^h\ 36^m\ 33^s$ W. | | 45° 38′ 38″ *T. Dist.* | |
| R. A. Star | 22 48 30.2 | 45 46 25.6 | 45 45 50 IX. | |
| | | 60 28 41.5 | 44 16 23 | |
| | 43 25 3.2 | | 0 7 12 | 1.39794 |
| R.A.M. Sun | 13 12 0 | 106 15 7 *Vers.* | 1 29 27 | .30023 |
| | | 14 42 16 *Vers.* | | |
| Sh. Oct. 9, | 6 13 3.2 | | 0 14 22.5 | 1.09771 |
| | | | 9 | |
| | | | 9 14 22.5 | |
| | | Corr from Naut. Alm. p. 556, | − 3.5 | |
| | | Gr. Oct. 9 . . | 9 14 19 | |
| | | Sh. Oct. 9 . . | 6 13 3.2 | |
| | | | 3 1 15.8 | |
| | | Long. . . . . | 45 18 57 W. | |

* Supposing a chronometer at the instant of the observation to have shown $9^h\ 20^m\ 22^s.5$, its error on Gr. mean time would be found from this result to be $6^m\ 3^s.5$ *fast*; using which error the longitude by chronometer might afterwards be found as in Art. 246, &c.

*Ex.* 3. Sept. 22, 1834, at $2^h\ 15^m$ A. M. mean time nearly, in latitude $24°\ 50'$ N. and longitude by account $37°\ 30'$ E. the following lunar observation was taken:

| | Obs. Alt. Mars. E. of Mer. | Moon's L. L. | Dist. N. L. |
|---|---|---|---|
| | $32°\ 10'\ 40''$ | $70°\ 10'\ 40''$ | $49°\ 42'\ 10''$ |
| Ind. Corr. | $-\ 1\ 10$ | $-\ 2\ 40$ | $+\ 1\ 10$ |

Mars was in a proper position for finding ship mean time from its observed altitude. The height of the eye above the sea was 18 feet: required the true longitude.

R. A. mean sun on Sept. 21, at Gr. mean noon $11^h\ 59^m\ 32^s$, on Sept. 22, $12^h\ 3^m\ 28^s$; corresponding R. A. of Mars $6^h\ 7^m\ 19^s$ and $6^h\ 9^m\ 35^s$; corresponding decl. of Mars $23°\ 28'\ 59''$ N. and $23°\ 29'\ 55''$ N; hor. par. of Mars $7''.5$; moon's hor. par. on Sept. 21 at Gr. mean noon $14'\ 43''.6$, at Gr. mean midn. $14'\ 45''$; corresponding hor. par. $54'\ 2''$ and $54'\ 7''$.

| | | | | | |
|---|---|---|---|---|---|
| Sh. Sept. 21, | $14^h\ 15^m$ | R. A. mean sun | $12^h\ 1^m\ 27^s$ | Hor. Par. Mars. | $0'\ 7'.5$ |
| Long. in T. | $2\ 30$ E. | R. A. Mars | $6\ 8\ 25$ | Aug$^d$. Sem$^r$. Moon | $14\ 58$ |
| | | Decl. Mars | $23°\ 29'\ 26''$ N. | Hor. Par. Moon | $54\ 7$ |

Gr. Sept. 21, 11 45

| | Mars. | Moon's L. L. | Obs. Dist. N. L. | |
|---|---|---|---|---|
| | $32°\ 10'\ 40''$ | $70°\ 10'\ 40''$ | $49°\ 42'\ 10''$ | |
| | $1\ 10\ -$ | $2\ 40\ -$ | $1\ 10\ +$ | |
| | $32\ 9\ 30$ | $70\ 8\ 0$ | $49\ 43\ 20$ | |
| | $4\ 11\ -$ | $4\ 11\ -$ | $14\ 58\ +$ | |
| A. A. | $32\ 5\ 19$ | $70\ 3\ 49$ | Ap. Dist. $49\ 58\ 18$ | |
| Refr. | $1\ 33\ -$ | $14\ 58\ +$ | | |
| | $32\ 3\ 46$ | $60\ 28\ 13$ | | |
| | | A. A. $70\ 18\ 47$ | $4$ | |
| Par. | $7\ +$ | $17\ 52\ +$ | $3$ | |
| | | $2\ +$ | | |
| | $32\ 3\ 53$ | | A. $60\ 28\ 20$ | |
| | | $70\ 36\ 41$ | | |
| Z. D. | $57\ 56\ 7$ | | $80438$ | $123$ |
| | | Z. D. $19\ 23\ 19$ | $55622$ | $038$ |
| Lat. | $24°\ 50'\ 0''$ N. | Z. D. $57\ 56\ 7$ | $55883$ | $148$ |
| Decl. | $23\ 29\ 26$ N. | | $49117$ | $173$ |
| | | $77\ 19\ 26$ *Vers.* | $16745$ | $002$ |
| | $1\ 20\ 34$ | | | |
| | $57\ 56\ 7$ | A. A. $70\ 18\ 47$ | $57805$ | $484$ |
| | | A. A. $32\ 5\ 19$ | $484$ | |
| | $59\ 16\ 41$ | | | |
| | $56\ 35\ 33$ | $102\ 24\ 6$ | $58289$ | |
| | | $60\ 28\ 20$ | T. Dist. $50°\ 4'\ 50''$ | |
| | $0.042137$ | | $51\ 1\ 53$ | IX. |
| | $0.037575$ | $162\ 52\ 26$ *Vers.* | $49\ 36\ 54$ | |
| | $4.694194$ | $41\ 55\ 46$ *Vers.* | | |
| | $4.675804$ | | $0\ 57\ 3$ | $.49902$ |
| | | $49\ 58\ 18$ | $1\ 24\ 59$ | $.32594$ |
| | $9.449710$ | $60\ 28\ 20$ | | |
| H. Angle, | $19^h\ 43^m\ 34^s.5$ W. | | $2\ 0\ 50$ | $.17308$ |
| | $6\ 8\ 25$ | $110\ 26\ 38$ *Vers.* | $9$ | |
| | | $10\ 30\ 2$ *Vers.* | | |
| | $25\ 51\ 59.5$ | Gr. Sept. 21, | $11\ 0\ 50$* | |
| | $12\ 1\ 27$ | Sh. Sept. 21, | $13\ 50\ 32.5$ | |
| Sh. Sept. 21 | $13\ 50\ 32.5$ | | $2\ 49\ 42.5$ | |
| | | | Long. $42\ 25\ 37$ E. | |

* Supposing a chronometer to have shown $11^h\ 1^m\ 55^s$ at the instant of the observation, its error on Gr. mean time would then have been $1^m\ 5^s$ *fast*.

*Ex.* 4. March 11, 1835, at $6^h\ 10^m$ P.M. in latitude 10° 15 S. and longitude by account 3° 30′ E. the following lunar observation was taken.

| Obs. Alt. Moon's L. L. | Mars. | Dist. N. L. |
|---|---|---|
| Bearing S. E. b. E. | S. b. E. | |
| 32° 20′ 10″ | 47° 15′ 40″ | 31° 16′ 50″ |
| − 1 15 | + 1 10 | + 0 30 |

The height of the eye above the sea was 16 feet: required the true longitude.

R. A. mean sun March 11, at Gr. mean noon $23^h\ 13^m\ 42^s.5$, on March 12, $23^h\ 17^m\ 39^s.1$; R. A. moon, on March 11, at Gr. $5^h$, $8^h\ 45^m\ 20^s.3$, on March 11, at Gr. $6^h$, $8^h\ 47^m\ 33^s.5$, corresponding decl. moon 22° 20′ 57″.6 N. and 22° 13′ 34″.8 N. hor. semid. moon on March 11, at Gr. noon 15′ 43″.8, on March 11, at Gr. midn. 15′ 51″.1, corresponding hor. par. 57′ 43″.5 and 58′ 10″.4, hor. par. Mars on March 11, 10″.6.

Sh. March 11, $6^h\ 10^m$ — R. A. mean Sun, $23^h\ 14^m\ 41^s$ — Aug$^d$. Semid. Moon 15′ 56″
Long. in T. 0 14 E. — R. A. Moon 8 47 34 — Hor. Par. Moon 57 57
Decl. Moon 22° 14′ 4″ N. — Hor. Par. Mars 10 6
Gr. March 11, 5 56

| | Moon's L. L. | | Mars. | | Dist. N. L. | |
|---|---|---|---|---|---|---|
| | 32° 20′ 10″ | | 47° 15′ 40″ | | 31° 16′ 50″ | |
| | 1 15 − | | 1 10 | | 0 30 + | |
| | 32 18 55 | | 47 16 50 | | 31 17 20 | |
| | 3 56 − | | 3 56 − | | 15 56 + | |
| | 32 14 59 | A. A. | 47 12 54 | Ap. Dist. | 31 33 16 | |
| | 15 56 + | | 0 53 − | | | |
| | | | | | 60° 16′ 44″ | |
| A. A. | 32 30 55 | | 47 12 1 | | 18 + | |
| | 46 34 + | | 5 + | | 2 + | |
| | 48 + | | | | | |
| | | | 47 12 6 | A. | 60 17 4 | |
| | 33 18 17 | | | | | |
| | | Z. D. | 42 47 54 | | 64761 | 177 |
| Z. D. | 56 41 43 | Z. D. | 56 41 43 | | 66044 | 165 |
| | | | | | 56971 | 073 |
| Lat. | 10° 15′ 0″ S. | | 99 29 37 *Vers.* | | 31992 | 097 |
| Dec. | 22 14 4 N. | | | | 22994 | 111 |
| | | A. A. | 32 30 55 | | | |
| | 32 29 4 | A. A. | 47 12 54 | | 42762 | 623 |
| | 56 41 43 | | | | 623 | |
| | | | 79 43 49 | | | |
| | 89 10 47 | | 60 17 4 | | 43385 | |
| | 24 12 39 | | | T. Dist. | 31° 3′ 41″ | |
| | | | 140 0 53 *Vers.* | | 30 48 33 VI | |
| | 0.006987 | | 19 26 45 *Vers.* | | 32 28 28 | |
| | 0.033533 | | | | | |
| | 4.846353 | | 31 33 16 | | 0 15 8 | 1.07534 |
| | 4.321621 | | 60 17 4 | | 1 39 55 | .25563 |
| | 9.208494 | | 91 50 20 *Vers.* | | 0 27 16 | .81971 |
| H. Angle | $20^h\ 50^m\ 22^s$ W. | | 28 43 48 *Vers.* | | 6 | |
| | 8 47 34 | | | | 6 27 16 | |
| | | | Corr. from Naut. Alm. | p. 6 | + 2.7 | |
| | 29 37 56 | | | Gr. March 11, | 6 27 18.7* | |
| | 23 14 41 | | | Sh. March 11, | 6 23 15 | |
| | | | | | 4 3.7 | |
| Sh Mar. 11, | 6 23 15 | | | Long. | 1° 0′ 55″.5 W. | |

* Supposing a chronometer to have shown $6^h\ 20^m\ 15^s$. at the instant of the observation, its error on Gr. mean time would have been then $7^m\ 3.7^s$ *slow*.

*To find the Longitude by Lunar Observation, when the Altitudes are determined by Calculation.* (See *App.* 36.)

(277.) From the observed altitude of any heavenly body advantageously situated (see Art. 246, &c.) find the ship mean time, and take the difference between this and the time shown by the chronometer. The result will be the error of the chronometer on ship mean time. Let this be done either before the lunar distance is observed or after it, as near thereto as circumstances allow.

When the lunar distance is observed, note the time by chronometer.

Get a Greenwich date in mean time, and for it take from the Nautical Almanac the moon's horizontal semidiameter and horizontal parallax; (except for the sun) the right ascension and declination of each body, and the right ascension of the mean sun. *For the sun*, only its declination and the equation of time.

(278.) Apply the error* of the chronometer to the time shown by it at the instant of the observation of the lunar distance, *adding* what it may be slow, and *subtracting* what it may be fast. The result will be the correct ship mean time corresponding to the observation of the distance. Express this astronomically, and add it (except for the sun) to the *right ascension of mean sun*. From the sum (increased if necessary by 24 hours) subtract the *right ascension of the body*: the remainder (diminished by 24 hours if greater than 24 hours) will be the *hour angle of the body* reckoned W. from the meridian. *For the Sun*: to the ship mean time apply the *equation of time* with a *contrary* sign (see note, Art. 190): the result will be the *hour angle* reckoned W. from the meridian.

Under the latitude† put the declination of the body, marking each with its proper name N. or S. When the names are *like*, take the *difference*; when the names are *unlike*, take the *sum*: mark the result M.Z. (meridian zenith distance).

(279.) For each body, add together *log. cos.* of lat., *log. cos.* of decl., and *log. havers.* of hour angle, rejecting the *tens* in the index of sum. The result will be the *log. havers.* of an arc, which take from the table in degrees. To the *nat. versine* of this arc add *nat. versine* of M. Z. The result will be *nat. versine* of the body's true zenith distance (Z. D.). It will be sufficient to take it out to the nearest minute. Subtract each Z. D. from 90°,

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* If the ship has run any distance *in longitude* in the interval between the observations, the error of chronometer on ship mean time must be corrected by that run turned into time: *add*, if the place of the ship at the observation of the distance be E. of its place at observation of time altitude; *subtract*, if W. Also if the chronometer has been supposed to gain or lose in the interval, correct also for amount of gain or loss, adding when the chronometer is slower at distance observation than at altitude observations, and subtracting when faster. The result will be the error at distance observation.

† The latitude at the observations should be determined with as great accuracy as possible, by astronomical observations brought either up to the time or back to the time (if necessary) by the log account.

the remainder will be the true altitude (T. A.), which correct for parallax and refraction as follows. First, enter the proper table with each altitude, and take out the corresponding correction roughly to nearest minute, which correction suppose to be applied with a contrary sign (adding where it should be subtracted and subtracting where it should be added). Enter the table again with each result, and take out the corrections accurately, which actually apply in the same manner to the true altitude (T. A.); then each result will be accurately the apparent altitude, which mark A. A. At the time the correction in altitude for the moon is found in the table, take out also the auxiliary angle A (see note, Art. 273).

Proceed then as in Art. 274 to compute the true distance and get a correct Greenwich date in mean time, under which put the correct ship date in mean time got from the chronometer: the difference will be the longitude in time, which turn into degrees by means of table of *log. haversines;* marking the result E. when ship mean time is the greater, and W. when ship mean time is the less.

Or, find the error of the chronometer on Greenwich mean time, which is the difference between the time shown by chronometer and the Greenwich mean time got from distance; and then using this error find the longitude by chronometer, whenever a favourable opportunity of taking an altitude occurs, calling the resulting longitude the longitude by lunar observation carried on by chronometer.

*Ex.* Feb. 10, 1835, at $11^h\ 15^m$ P. M. mean time nearly, in lat. 45° 28′ N. and longitude by account 169° 30′ E. when a chronometer showed $0^h\ 12^m\ 30^s$ the observed distance of the moon's F. L. from α Leo (Regulus) was 44° 0′ 10″, the index correction being — 0′ 40″. On the same day at $11^h\ 58^m$ P. M., when the chronometer showed $0^h\ 53^m\ 16^s$ the observed altitude of α Taurus (Aldebaran) was 21° 9′ 40″ bearing about W., the index correction being — 0′ 40″ and the height of the eye above the sea 14 feet. The run of the ship in the interval of the two observations was 15′ W. in longitude, and the daily rate of the chronometer was 12 seconds losing. Required the true longitude at the time of the observation of the distance, and also the error of the chronometer on Greenwich mean time at that instant.

It is first necessary to find from the observed altitude of α Taurus (Aldebaran) the error of the chronometer on ship mean time, which will be found to be $11^h\ 18^m\ 31^s.7$ *slow*. Adding this to the time shown by it when the distance was observed, namely, $0^h\ 12^m\ 30^s$, the result is $11^h\ 31^m\ 1^s.7$ ship mean time (at the instant the distance was taken) for the place of the altitude observation. Adding 1 *min.* for 15′ of longitude which the distance was observed *eastward* of the altitudes, and subtracting 0.4 *sec.* for the rate of the chronometer in the interval, the result is $11^h\ 32^m\ 1^s.3$ ship mean time corresponding to the distance.

For this ship mean time the altitudes are then computed by Art. 278, &c., and the true distance computed, from which Gr. mean time is got, the difference between which and the ship mean time is the longitude in time, &c. (See principal parts of computation on the next page.)

## *For Ship Mean Time by Altitude.*

Sh Feb. 10, 11h 58m
Long. in T. 11 17 R.

Gr. Feb. 10, 0 41

R. A. Mean Sun, 21h 19m 29s.2
R. A. α Taurus, 4 26 27 .3
Decl. α Taurus, 16° 10′ 17″ N.
Z. D. 68 57 11

| | | |
|---|---|---|
| Lat. | 45° 28′ 0″ N. | 0.154081 |
| Decl. | 16 10 17 N. | 0.017632 |
| | | 4.878602 |
| | 29 17 43 | 4.530477 |
| | 68 57 11 | |
| | | 9.580692 |
| | 98 14 54 | Hour Angle |
| | 39 39 28 | 5h 4m 49s.6 |

5h 4m 49s.6 W.
4 26 27 .3

33 31 16.9
21 19 29.2

Sh. Feb. 10, 12 11 47.7
Chr. 0 53 16

Error, 11 18 31.7 *slow.*

## *The Greenwich Mean Time by Distance.*

Chr. . . 0h 12m 30s
Slow . . 11 18 31.7

11 31 1.7
Run. . 1 0 +
Rate . . 0.4−

Sh. Feb. 10, 11 32 1.3
Long. in T. 11 18 0 E.

Gr. Feb. 10, 0 14 1.3

R. A. M. Sun, 21h 19m 24s.8
R. A. α Leo. . 9 59 35.5
Decl. α Leo. 12° 46′ 14″ N.
R. A. Moon . 7h 2m 0s.3
Decl. Moon . 25° 8′ 37″ N.
Hor. Sem. 15 27.2
Hor. Par. . 56 42.5

H. Ang. α Leo. . 22 52 0.6

11h 32m 1s.3
21 19 24.8

32 51 36.1
9 59 35.5

32 51 36.1
7 2 0.3

H. Ang. Moon 1 49 35.8

| | α Leo. | Moon. |
|---|---|---|
| Lat. | 45° 28′ 0″ N. | 45° 28′ 0″ N. |
| Decl. | 12 46 14 N. | 25 8 37 N. |
| M. Z. | 32 41 46 | 20 19 23 |
| | 9.845919 | 9.845919 |
| | 9.999121 | 9.956773 |
| | 8.339298 | 8.748907 |
| | 8.174338 | 8.551599 |
| | 14° 2′ 30″ | 21° 45′ 37′ |
| | 0029880 | 0071256 |
| | 0158450 | 0062253 |
| | 0188330 | 0133509 |
| Z. D. | 35° 44′ 0″ | 29° 57′ 0′ |
| T. A. | 54 16 0 | 60 3 0 |
| | 41+ | 28 9− |
| A. A. | 54 16 41 | 59 34 51 |
| Obs. Dist. | 44 0 10 | 60 26 47 |
| | 40− | 21 |
| | 43 59 30 | A. 60 27 8 |
| | 15 40− | |
| A. Dist. | 43 43 50 | |

Z. D. 29° 57′ 0″
Z. D. 35 44 0

65 41 0 *Vers.*

A. A. 59 34 51
A. A. 54 16 41

113 51 32
60 27 8

174 18 40 *Vers.*
53 24 24 *Vers.*

App. D. 43 43 50
60 27 8

104 10 58 *Vers.*
16 43 18 *Vers.*

T. Dist. 43 29 12
43 40 44..0h
42 3 22

0 11 32
1 37 22

0 21 19.5

| | | |
|---|---|---|
| | | 88220 |
| | | 000 |
| | | 95056 |
| | | 019 |
| | | 03775 |
| | | 094 |
| | | 44743 |
| | | 273 |
| | | 42261 |
| | | 025 |
| | | 74466 |
| | | 1.19392 |
| | | .26686 |
| | | .92646 |

Gr. Feb. 10, 0h 21m 19s.5
Sh. Feb. 10, 11 32 1.3

Long. in T. 11 10 41.8

Long. 167 40 27 E.

Error of Chr. on Gr. M. T. 8m 49s.5 *slow.*

(280.) Brief directions have been given in the rules just laid down, to take, if possible, altitudes for ship time of bodies bearing as nearly east or west, and both east and west of the meridian: it is equally important to observe distances from the moon, of bodies both east and west of it, in order to get Gr. time more exactly. The reasons of the former recommendation have been already given in Art. 251: the reasons for the latter are these:— Should the distance observed from a body east of the moon be too little, either through a bad habit of observing in the person who takes the distance, or from some unknown error in the instrument (from which none is altogether free), similar errors may be expected to be introduced into the distance observed from a body west of the moon, that is, this distance will be also too little. Now the error *east* of moon in defect will make the Greenwich time too far advanced, as it makes the moon too far advanced in its course from west to east towards the other body, and a similar error *west* of the moon must have just the contrary effect. One error, therefore, will correct the other. Similar remarks may be applied to the amount of errors in excess, that is, which make the distance too great.

*To find both the Latitude and Longitude from a Lunar Observation, both the Altitudes and the Distance being supposed to be observed*.* (See *App.* 37.)

(281.) From ship mean time supposed to be known nearly, and the longitude by account, or from the chronometer, get a Greenwich date, for which take from the Nautical Almanac all the quantities specified in Art. 270, &c., and also the declination of that body which is *not* the ship time body. Correct the observed altitudes, &c., and compute the true distance as by Art. 274. With this true distance as arc (1) proceed as in the rule for working a double altitude, beginning with the computation of arc (2); for which part of the work the true zenith distances, and polar distances known from the declinations, will be sufficient; the polar angle is not required.

When the latitude is thus determined, use it in computing, from the true zenith distance (Z. D.) of the ship time body, the correct ship date in mean time, and under this put the correct date in Greenwich mean time got from the true distance. The difference will be the longitude in time, which turn into degrees by means of the table of *log. haversines;* and mark the resulting longitude E. when ship mean time is the greater, and W. when ship mean time is the less.

*Ex.* Feb. 4, 1835, in N. latitude, A. A. sun's cr. 20° 2′ 46″ bearing S. W. b. S.; A. A. moon's cr. 30° 13′ 34″ bearing S. E. ½ E.; *app. dist.* 76° 48′ 10″; sun's decl. 16° 19′ 24″ S.; moon's declination 8° 45′ 21″ N., equation of time 14′ 14″.1 A., hor. par. 54′ 11″.9. Tr. dist. from Naut. Almanac at $0^h$, 75° 48′ 3″, at III, 77° 8′ 56″: required the latitude and longitude. By proceeding as in the foregoing examples the true distance will be found to be 76° 37′ 12″, and Greenwich mean time $1^h\ 49^m\ 22^s.5$;

* The true bearings of the bodies must be conformable to the limits given in Art. 226.

considering 76° 37′ 12″ as arc (1) in the application of rule for double altitude, the following part of the process will give the latitude and ship mean time, &c.

| To find arc (2). | To find arcs (3) and (4). | To find Lat. | To find Sh. M. T. |
|---|---|---|---|
| 76° 37′ 12″ | 76° 37′ 12″ | | 50° 48′ 9″ N. |
| 81 14 39 | 59 1 16 | 9.994904 | 16 19 24 S. |
| | | 9.933160 | |
| 4 37 27 | 17 35 56 | 8.949214 | 67 7 33 |
| 106 19 24 | 69 59 44 | | 69 59 44 |
| | | 8.877278 | |
| 110 56 51 | 87 35 40 | 51° 52′ 18″ | 137 7 17 |
| 101 41 57 | 52 23 48 | 0150767 | 2 52 11 |
| | | 0074263 | |
| 0.011950 | 0.011950 | | 0.199302 |
| 0.005096 | 0.066840 | 0225030 | 0.017872 |
| 4.915856 | 4.840175 | 39° 11′ 51″ | 9.968858 |
| 4.889577 | 4.644911 | Lat. 50 48 9 N. | 8.398641 |
| 9.822479 | 9.563876 | | 8.584673 |
| 2) 109° 12′ 18″ | (3) 74° 29′ 52″ | | Hour Ang. 1h 30m 26s.5 W. |
| | (2) 109 12 18 | | Eq. T. 14 14.1 A. |
| | (4) 34 42 26 | | Sh. Feb. 4, 1 44 40.6 |
| | | | Gr. Feb. 4, 1 49 22.5 |
| | | | 4 42 |
| | | | Long. 1° 10′ 30″ W. |

*To find the Longitude by Lunar Observation, taking into the Account the Spheroidal Figure of the Earth.* (See *App.* 38, 39.)

(282.) In the foregoing rules for finding the longitude by lunar observation, both refraction and parallax have been supposed to affect the places of the bodies in their respective circles of altitude, elevating or depressing them towards or from the *true* zenith. This supposition is quite correct for refraction (Art. 124), but for parallax it is not strictly correct (Art. 118, &c.). Parallax actually affects a heavenly body's place in a circle, which passes through the straight line drawn to it (independently of refraction) and the radius of the earth (Art. 118): the apparent and true places of the body, parallax only considered, must therefore be in a great circle on the celestial concave, which passes through the earth's radius produced, that is, through the *reduced* zenith, and not through the *true* zenith. Hence it appears, that to compute the true distance from the observed distance, we ought first to correct the latter for refraction, and then the distance resulting from this operation for parallax. Also, if the earth be considered as a spheroid, the hor. par. of the moon will be somewhat less in any considerable latitude than it is at the equator as put down in the Nautical Almanac, inasmuch as the earth's radius in such latitude is less than the equatorial radius. The moon's hor. par. as taken from the Nautical Almanac will require correcting: see Naut. Table (*h*).

(283.) Rule. Get a Greenwich date in mean time, and take every quantity required from the Nautical Almanac as pointed out in Art. 270, &c. Diminish the hor. par. of moon by reduction (see Table *h*), and at the same time take from that table the reduction of latitude. Get app. alti-

tudes, and taking each to nearest 15″ mark it A. A.; get also app. distance A. D., correct each A. A. for refraction only, as if each body were a fixed star; mark each result T. A. Take the difference of the arcs marked A. A., and also of those marked T. A.; under the difference of the A. A.'s put the apparent distance taken to the nearest 15″ (reserving the seconds added or subtracted); take the sum (S.) and difference (D.)

Add together numbers taken from table, Naut. Tables, p. 12* (*o* 4) for the A. A. of each body as a star, the *halves* of *log. haversines* of (S.) and (D.), rejecting the tens in the index of sum. Take out the arc to the nearest second corresponding to the result as a *log. haversine*, and to the *nat. versine* of this arc add the *nat. versine* of difference of T. A.: the sum will be the *nat. versine* of an arc, which take out, and *add* the reserved seconds in the apparent distance when they have been previously *subtracted*, or *subtract* them when previously *added*. The result will be the first corrected distance, which mark T. D.

Correct the first true altitudes (T. A.) for reduction by rule in note *. Take the results to the nearest 15″ and mark each A′. A′.; correct each for hor. parallax alone by rule in note †, and mark each result T′. A′. Take the difference of the A′. A′.'s and also that of T′. A′.'s. Under the difference of A′. A′.'s put the first corrected distance taken to the nearest 15″ (reserving the seconds added or subtracted); take the sum (S.) or difference (D.)

Add together *log. secants* ‡ A′. A′.'s and *log. cosines* of T′. A′.'s, the *halves* of the *log. haversines* of (S.) and (D.), rejecting the *tens* in the index of sum. Take out the arc to the nearest second corresponding to the result as a *log. haversine*, and to the *nat. versine* of this arc add the *nat. versine* of the difference of T′. A′.'s. The sum will be the *nat. versine* of an arc, which take from the table, and *add* thereto the reserved seconds when they have been previously *subtracted* from first corrected distance, and subtract them if previously *added*. The result will be the second corrected distance, or true distance required (T′. D′.).

*Ex.* Feb. 4, 1835, at $1^h\ 44^m\ 40^s.6$ Sh. Mean Time found from following altitude of sun (see *Ex.* p. 139) in latitude 50° 48′ 9″ N. and longitude by account 1° 6′ W., A. A. sun's cr. 20° 2′ 46″ bearing S. W. b. S.; A. A. moon's cr. 30° 13′ 34″ bearing S. E. ½ S.; *app. dist.* of *crs.* 76° 48′ 10″, equatorial hor. par. of moon 54′ 11″.9; reduction of eq. hor. par. −6″.1; reduction of latitude − 10′ 34″; tr. dist. from Naut. Almanac at $0^h$, 75° 48′ 3″, at III. 77° 8′ 56″: required the true longitude.

---

* With the true bearing of the body (reckoned from S. in north latitude, and from N. in south latitude) as a *course*, and the *reduction* of latitude to sphere (see Table *h*) as a *distance*, enter a traverse table: the corresponding difference of latitude will be the reduction of altitude required. When the said bearing is less than 8 points or 90°, this reduction must be *added*; when it is greater than 8 points or 90°, what it wants of 16 points or 180° must be used, and the reduction in that case *subtracted*. In this operation it must be remembered, that seconds may be turned into tenths of minutes by dividing by 6, and tenths of minutes reduced to seconds by multiplying by 6.

† The correction in parallax is found.—*For the Moon*, by adding refraction as for a fixed star to the correction in altitude taken from Table (*w*). Or it may be computed by adding *log. secant* of A.′ A.′ to *prop. log.* hor. parallax, rejecting 10 in the index. The result will be the *prop. log* of parallax as required. *For Sun*, parallax may be taken from Table (*cc*). *For a Planet*, parallax may be taken from Table (*c*). *For a fixed Star*, there is no parallax.

‡ When one of the bodies is a fixed star, the A.′ A.′ and T.′ A.′ will be the same, and no notice need be taken of *log. secant* A.′ A.′ and *log. cos.* T.′ A.′.

| For Refraction. | | | For Parallax. | | |
|---|---|---|---|---|---|
| | Moon's A. A. | 30° 13′ 30″ | Sun's A. | A. 20° 8′ 45″ | Moon's A. | A. 30° 20 0″ |
| Sun's A. A. | 20° 2′ 45″ | 1 39− | Par. | 8+ | | 46 42+ |
| Refr. | 2 39− | | | | | |
| | T. A. | 30 11 51 | T. A. | 20 8 53 | T. A. | 31. 6 42 |
| T. A. | 20 0 6 | Reduction .8 6+ | | | | |
| Reduction | 8 42+ | | | 20° 8′ 45″ | | 0.027417 |
| | | 30 19 57 | | 30 28 0 | | 9.972576 |
| | 20 8 48 | | | | | 0.063937 |
| | | 119 | | 10 11 15 | | 9.932556 |
| | | 120 | | 76 49 45 (−6″) | | 4.837879 |
| | 20° 2′ 45″ | 4.8377746 | | | | 4.739831 |
| | 30 13 30 | 4.739735 | (S.) | 87 1 0 | | |
| | | | (D.) | 66 38 30 | | 9.574196 |
| | 10 10 45 | 9·577720 | | | | 75° 32′ 21″ |
| | 76 48 15 (−5″) | 75° 54′ 3″ | Diff. T. A′. | 10° 57′ 49″ | | 0750183 |
| | | 0756385 | | | | 99 |
| (S.) | 86 59 0 | 14 | | 76 37 0 | | 0018207 |
| (D.) | 66 37 30 | 0015753 | | +6 | | 45 |
| | | 43 | | | | |
| Diff. T. A. | 10 11 45 | | T′. D′. | 76 37 6 | | 0768538 |
| | | 0772195 | Corr. Gr. Feb. 4, | 1h 49m 9s.5 | | |
| | 76 49 56 | | Sh. Feb. 4, | 1 44 40.6 | | |
| | 5− | | | | | |
| | | | | 4 28.9 | | |
| T. D. | 76 49 51 | | | | | |
| | | | Long. | 1° 7′ 13″ W. | | |

*To find the Longitude from the Occultation of a Fixed Star by the Moon.*

(284.) The moon in its monthly revolutions round the earth, at the distance of about 240 thousand miles, frequently passes between the earth and a fixed star, so as to intercept the spectator's view of the latter. This is called an *occultation* of a fixed star by the moon. From the observation of this, the longitude may be found with greater exactness than by a lunar distance, because the instant of the disappearance or reappearance of the star can be ascertained without the use of any instrument liable to error. The observation itself is easy, and at the same time interesting; the principal difficulty has been supposed to lie in the necessary calculations, which therefore we shall endeavour to make as direct and simple as possible. A single example or two in practice at sea will, beyond doubt, render the method perfectly plain and easy.

Let a star be supposed to appear a little to the east of the moon in the track which the latter body is describing round the earth. Then the moon, as it moves from west to east, will be seen to approach the star, and at length will touch it with the eastern edge or limb. The next moment the star will disappear; which disappearance will be distinct and instantaneous, when the eastern limb of the moon is dark; if it be enlightened, the observation will not be quite so exact, though sufficiently so in general for the purpose of finding the longitude. After a certain interval the moon having passed over the star, the spectator will see the star apparently emerging from the western limb. The observation of this also will be more or less exact, according as the western limb is dark or bright.

The observation may be made frequently with precision at sea by means of a common spy-glass.

In some instances of occultation the centre of the moon will pass over the star, in which case the duration will be the longest; in others a much

larger segment of the moon will pass on one side of the star than on the other, when the duration will be less.

When the observation is made of the disappearance or reappearance of a fixed star, it is necessary at the same instant to determine ship mean time. This may be done by a good common pocket watch with a second hand, the error of which on mean time may be found by taking the altitude of a star bearing nearly east or west, or more accurately the altitudes of two stars, one bearing nearly east and the other nearly west. If the interval between the time altitude and the occultation be considerable, a chronometer should be used, the amount of the rate of which should also be considered, and likewise the run in longitude in the interval, as in the lunar observation. When the altitude of the sun or a bright star cannot be got for this purpose, the altitude of the moon or a planet may be taken, supposing them to be sufficiently far from the meridian.

(285.) The steps in taking the observation are therefore sufficiently obvious. The next thing required is to give a rule for the necessary computation. The principle of such rule is as follows. At the instant of disappearance or reappearance of the star, the apparent right ascension and declination of the point of the moon's limb in contact with the star is the same as the right ascension and declination of the star, which latter we can with great facility and precision take from the Nautical Almanac. Correcting the *apparent* right ascension and declination of the point in question for parallax, we get its true right ascension and declination. Then, considering that the distance of this point from the moon's centre is the semidiameter of the moon, and that we can get from the Tables the declination of the centre for the assumed Greenwich date, we are enabled to compute from these data the true right ascension of the moon's centre. Lastly, as the true right ascension of the moon's centre is put down in the Nautical Almanac for every Greenwich mean hour, we can from this last result easily compute Greenwich mean time, subject to a small error, which may be removed by repetition, should the assumed Greenwich date be found essentially incorrect.

The ship mean time is known as explained above. Hence therefore we know the longitude.

### *Occultation of a Fixed Star.* (See *App.* 40.)

(286) RULE. Get a Gr. date as in Art. 185, or as in note thereto.* For this date take from the Nautical Almanac the R. A. mean sun, the R. A. of star (which call *apparent R. A.*), the decl. of star (which call *app. decl.*), the R. A. of moon at hour of Gr. date, the change of R. A. of moon in seconds from that hour to the next hour; the decl. of moon at Gr. date, the hor. semid. in seconds, the hor. par. in seconds, which reduce to latitude (Naut. Tab. (*h*) p. 4), and correct the latitude itself for reduction (Table *h*).

Add together ship mean time expressed astronomically, and the R. A. of mean sun; and from the sum (increased if necessary by 24 hours) sub-

* This date is best got by applying to time shown by chronometer at observation its known error on Gr. mean time. The result of the computation will determine probably a more correct error, which may be used afterwards in finding the longitude by chronometer. From observations of this kind at an interval of several days the rate of chronometer may also be determined.

tract the R. A. of star, and from the remainder (if greater than 24 hours) reject 24 hours. The result, if less than 12 hours, will be the *apparent* hour angle W.; if greater than 12 hours, subtract the result from 24 hours, and the remainder will be the *apparent* hour angle E.

Write down *log.* of reduced hor. parallax separately under heads marked (1), (2), (3):

Under (1) put *log. cos.* red. lat. and 8.522879.
Under (3) . *log. cos.* red. lat.
Under (2) . *log. sin.* red. lat.
Under (1) . *log. sin.* app. hour angle.

Add together the four logarithms under (1), rejecting the *tens* in the index of sum; and mark the sum (*a*),

Under (*a*) . *log. sec.* app. decl.
Under (2) . *log. cos.* app. decl.
Under (3) . *log. sin.* app. decl.

Add together the two last logarithms under (1), rejecting *tens* from index of sum. The result will be the *log.* of a number of seconds, which take from the table and subtract (turned into minutes and seconds) from the app. hour angle.

Under (3) write *log. cos.* corrected hour angle. Add together *logarithms* under (2) and (3), rejecting *tens* in index of each sum. The result under (2) will be *log.* of first part of parallax in declination in seconds, to which (taken from table) give the same name as that of apparent declination when latitude and apparent declination have the *same* name, and a *different* name from that of the apparent declination when the latitude and apparent declination have *different* names. The result under (3) will be the second part of the parallax in declination in seconds, to which (taken from table) give the *same* name as that of the apparent declination when the corrected hour angle is *greater* than $6^h$, and a *different* name from that of the apparent declination when the corrected hour angle is *less* than $6^h$. When the names of the two parts are *like*, their sum with the *same* name will be the parallax in declination; when the names of the two parts are *unlike*, their *difference* with the name of the greater will be the parallax in declination. Put the parallax in declination under the apparent declination; when the names are *like*, their sum with the *same* name will be the corrected declination; when the names are *unlike*, their *difference* with the name of the greater will be the corrected declination. *

Under a head marked (4) put (*a*); 0.301030; and *log. sec.* of corrected declination. Add these together, rejecting the tens in the index of sum. The result will be *log.* of parallax in R. A. in seconds of time, which take from the table to the nearest hundredth of seconds. Add it to the apparent R. A. when the observation has been W. of meridian, and subtract it from the apparent R. A. (adding $24^h$ to the latter, if necessary) when the

* Observe here whether, if the resulting corrected declination were substituted for that used under (1), any material change would be produced in the corrected hour angle, and thereby in the *log. cos.* of this angle under (3). If there should, alter the said *log. cos.*, and then the 2nd part of parallax in decl. and the corrected declination itself.

observation has been to the E. of meridian. The result will be the corrected R. A.

Under the corrected declination put the declination of moon taken from Naut. Alm. for Greenwich date. When the names are *like*, take their *difference*; when their names are *unlike*, take their *sum*. Turn the result into seconds, and under it put the moon's hor. semid. in seconds. Take the sum and difference. Add together the *logarithms* of this sum and difference, the *log. secants* of the two declinations just used, and 7.647818, rejecting tens in index of sum. Take half the result, which will be the *log.* of moon's semid. in R. A. in seconds of time (see *App.* 41), which take from the table to the nearest hundredth of second, and *add* the result (turned into minutes and seconds) to the corrected R. A. when a *reappearance* has been observed, and *subtract* it from the corrected R. A. (adding if necessary $24^h$ to the latter), when a *disappearance* has been observed. The result will be the R. A. of moon's centre by observation; under which put the moon's R. A. taken from Naut. Alm. for the *hour* of Greenwich date. Take the difference, which turn into seconds. To the *log.* of these seconds add 3.556302, and then subtract *log.* of change of moon's R.A. from hour of Greenwich date to next hour (see App. 41). The result will be a number of seconds of time, which take from the table to the nearest hundredth; and add them* (turned into minutes and seconds) to the hour of assumed Greenwich date. The result will be a Greenwich date computed from the observation. If this agree with the one assumed, it is correct; if not, assume this computed date as a new Greenwich date, and repeat such parts of the work as may be necessary, till this exact agreement with the *last assumed date* is produced.

In repeating the work, it should be first observed, whether the alteration in the Greenwich date will make any material alteration in R. A. of mean sun, in hour angle, in hor. semid, and in hor. parallax. If it does, the work should be entirely gone through again; but if not, which generally will be the case, it will be sufficient to correct the declination of moon's centre from Naut. Alm. for the change of date, and to repeat the computation of moon's semid. in R. A.; proceeding afterwards as before to get a new Greenwich date; and repeating the same part of computation, till there is an agreement of the resulting date with the assumed, as nearly as may be wished.

The difference between the last resulting Greenwich date and the ship date in mean time will be the longitude in time.

If the time has been taken by chronometer at the instant of the observation, the difference between this and the last resulting Greenwich date will be the error by occultation of the chronometer on Greenwich mean time; which error may be used afterwards in finding longitude by chronometer.

*Ex.* Feb. 12, 1835, in lat. 50° 49′ 5″ N. and longitude by account 1° 4′ 52″ W. the beginning of an occultation of $\gamma$ Cancer at the moon's limb took place (W. of Mer.) at $2^h\ 29^m\ 40^s.5$ A. M. ship mean time· required the true longitude.

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* If the computed R. A. of moon's centre should be less than the R. A. at hour of Greenwich date, this resulting time must be subtracted from the hour.

| | | | |
|---|---|---|---|
| Gr. Feb. 11, | $14^h\ 34^m\ 0^s$ | R. A. Moon at $14^h$ | $8^h\ 33^m\ 24^s.27$ |
| R. A. Mean Sun | 21 25 42.61 | Change in $1^h$, | $145^s.04$ |
| Apparent R. A. | 8 33 44.21 | Hor. Semid. | $946''.6$ |
| Apparent Decl. | $22°\ 3'\ 25''.8$ N. | Red. Hor. Par. | $3467\ .6$ |
| Apparent Hour Angle | $3^h\ 21^m\ 38^s.9$ W. | Decl. Moon at Gr. date | $22°\ 42'\ 59''\ .1$ N |
| | | Red. Lat. Ship | 50 38 30 N |

| (1.) | (2.) | (3.) | (4) |
|---|---|---|---|
| 3.540029 | 3.540029 | 3.540029 | 1.751971 (a) |
| 9.802205 | 9.888289 | 9.802205 | 0.301030 |
| 8.522879 | 9.966091 | 9.574655 | 10.034700 |
| 9.886858 | 3.395309 | 9.806633 | 2.087701 |
| 1.751971 (a) | 2484".9 N. | 2.723522 | 122s.38 |
| 10.033009 | 529.1 S. | | $2^m\ 2^s.38+$ |
| 1.784980 | 1955.8 N. | | 8 33 44.21 |
| $1^m\ 0^s.9-$ | $32'\ 35''.8$ N. | | 8 35 46.59 |
| 3 21 38.9 | 22 3 25 .8 N. | | 1 1.37— |
| Corr. H. Ang. 3 20 38 | 22 36 1.6 N. | | 8 34 45.22 |
| | 22 42 59.1 N. | | 8 33 24.27 |
| | | *3.134846 | |
| | 6 57.5 | 2.723538 | 80.95 |
| | | 10.034700 | 1.908217 |
| | 417.5 | 10.035069 | 3.556302 |
| | 946.6 | 7.647818 | 5.464519 |
| | 1364.1* | 3.575971 | 2.161487 |
| | 529.1 | 1.787985 | 3.303032 |
| | | | 2006s.24 |

61".37 Gr. Fb. 11, $14^h\ 33^m\ 29^s.24$

(287.) After computing the corrected declination 22° 36′ 1″.6 N. as above, it may be easily seen, that by using this in getting the second sum under (1), there would not be occasioned any material alteration in the corrected hour angle, and consequently none in the second part of parallax in declination. It appears that the resulting Greenwich date $14^h\ 33^m\ 29^s.24$ is less than the first assumed one by $30^s.76$: the corresponding declination of moon's centre will therefore, at the rate 66″.22 in $10^m$ (see Nautical Almanac), be less* than for the first assumed date by 3″.4, or it is 22° 42′ 55″.7 N., and the difference of declination becomes 6′ 54″.1 or 414″.1. Proceeding with this exactly as before in the above computations, the moon's semid. in R. A. instead of $1^m\ 1^s.37$ comes out $1^m\ 1^s.49$, the corrected R. A. of moon's centre is $8^h\ 34^m\ 45^s.10$, and the difference of this from R. A. at $14^h$ is $80^s.83$, which gives an interval of time from $14^h$ of $2006^s.26$ or $33^m\ 26^s.26$. The new Greenwich date is therefore $14^h\ 33^m\ 26^s.26$. Assuming this as a third Greenwich date, the change of declination of moon's centre is 0″.3, new declination 22° 42′ 55″.4 N., and difference of declination is 413″.8. The moon's semidiameter in R. A. becomes $1^m\ 1^s.50$, and the corrected R. A. of moon's centre $8^h\ 33^m\ 45^s.09$. This is greater than the moon's R. A. at $14^h$ by $80^s.82$, which gives in interval $34^m\ 26^s.01$. The new Greenwich date is therefore $14^h\ 33^m\ 26^s.01$, which, being so near the last, may be considered as the correct Greenwich date. Taking the difference between this and the ship mean time $14^h\ 29^m\ 40^s.5$, the true longitude comes out 0° 56′ 22″.6 W.

288.) The foregoing rule for computing the longitude from an occultation of a fixed star by the moon is perhaps as easy and direct as the nature

* The author has not observed that in Feb. 1835, the declination of the moon is diminishing. This error does not affect the problem as an example. But that the results may be correct, for "less" read "greater:" whence it follows that

| | |
|---|---|
| Declin. of moon's centre is | 22° 43′ 2″.5 N. |
| Diff. declin. . . . . | 7′ 0″. 9 |
| Moon's semid in R.A. . . | $1^m\ 1^s.25$ |
| New Greenwich date | $14^h\ 33^m\ 32^s.2$.—Ed. |

of the subject allows of; and is certainly quite within the reach of seamen who are accustomed to the use of logarithms. In order to be prepared for the occultation of a fixed star, the seaman may consult the tables given for the purpose in the Nautical Almanac, especially the one headed "Elements for facilitating the Computation of Occultations," &c. He will find it both interesting and useful also, from time to time, to examine with his spy-glass that part of the celestial concave which lies immediately to the eastward of the moon; and when he sees any star there likely to be occultated by the moon, to find from the table in the Nautical Almanac already referred to the name of the star, and the further probability of an occultation's really taking place.

(289.) After the disappearance of the star (should it be really occultated), it may be of consequence to be able to fix on the point nearly on the western limb of the moon, where it will reappear, in order that the observer may direct his glass to that point, and see the star at the instant of its appearance from behind the moon. This may be done in general as follows: estimate by the eye the point on the moon's limb, where a diameter drawn tending to the elevated pole of the heavens cuts it, and call this the north or south point; and having sketched a circle and the diameter for a representation, draw a chord on the circle from the estimated point of disappearance perpendicular to the said diameter. From the further extremity of this chord draw a perpendicular to the chord opposite to the direction of moon's motion in declination, and having ascertained from the Nautical Almanac the proportion of the change of moon's declination in $10^m$ (as $d$) to that of the moon's R. A. (turned into arc) in $10^m$ (as $a$), take the perpendicular in the same proportion to the chord that $d$ has to $a$, that is, as nearly as can be estimated by the eye. From the point of disappearance draw a line to the extremity of perpendicular. This line (produced if necessary) will indicate on the circumference of circle, and thereby on moon's limb, the point of reappearance nearly.

*To find the Longitude from an Eclipse of the Sun.* (See *App.* 42.)

(290.) The cause of an eclipse of the sun is the same as that of an occultation of a fixed star. The moon, in passing between the earth and the sun, intercepts the solar light, and to a spectator on the earth the sun appears darkened on its surface. The observation of the beginning or end of the eclipse is noted without any difficulty, the point where the observation begins being supposed to be nearly known. The rule for finding the longitude is similar to the one just given for the occultation of a fixed star. Suppose the semidiameter of the moon passing through the point where the sun and moon are apparently in contact to be produced visibly to the centre of the sun as seen by the observer, and let this centre be first supposed at the distance of a fixed star so as to have no parallax. Then it is manifest that the rule given for an occultation must apply here, substituting for the moon's semidiameter the sun and moon's semidiameters, the former being considered as at the distance of the moon seen from the earth's centre, that is, the augmentation of this semidiameter, as if it were the moon's, being subtracted from the sun's semidiameter taken out of the Nautical Almanac (see App. 42). The sun's centre has been supposed to have no parallax; but in fact it has a horizontal parallax of about $8''.7$. Hence in finding the apparent place as seen by the observer, we cannot proceed

exactly as for a fixed star, whose place as seen from the earth's centre is the same as when seen from the surface, and therefore may be taken at once from the tables. We must take the sun's right ascension and declination from the Nautical Almanac; and, to get the apparent right ascension and declination, we should correct for parallax; which being done, we should have reduced the question to a perfect similarity, as above explained, with the case of an occultation. The next step therefore would be to re-correct the apparent right ascension and declination of the sun's centre, using the horizontal parallax of the moon in this computation. This would evidently give the same true place as if, taking the right ascension and declination of the sun's centre from the Nautical Almanac, we consider these elements as apparent, and correct them for parallax; using, instead of the moon's horizontal parallax, the difference between the horizontal parallax of the sun and moon (see App. 42).

Thus we get the true right ascension of the point answering the sun's centre, and thence, as in the rule (Art. 286), the true right ascension of the moon's centre, from which Greenwich mean time is deduced.

Mean time at the ship is found by means of a chronometer, whose error has been determined from the altitudes of heavenly bodies, taken if possible both east and west of the meridian.

### *Longitude by Solar Eclipse.*

(291.) RULE.—From ship mean time and the longitude by account, or from the chronometer, get a Greenwich date. For this date take from the Nautical Almanac the R. A. and decl. of the sun, which call *app.* R. A. and *app. decl.* Take out also R. A. of mean sun, sun's semid. (which diminish by augmentation as if it were the moon's semid.), the sun's hor. par., the moon's hor. par. (which diminish by reduction), the moon's R. A. at hour of Greenwich date, the change of moon's R. A. in $1^h$. Proceed then as in rule for occultation of fixed star, using for semid. the sum of semidiameters (the sun's being diminished by augm.), the difference of reduced hor. par. of moon and hor. par. of sun for hor. par. of moon, and the R. A. and decl. of sun for those of star.

*Ex.* May 15, 1836, in latitude 53° 22′ 38″ N. and longitude by account 6° 40′ 22″ W. the end of a solar eclipse was observed at $4^h\ 7^m\ 23^s.5$ P. M. mean time, the altitude* of the sun being about 37°: required the true longitude. A chronometer at the instant of the observation showed $4^h\ 30^m\ 25^s.5$; required its error on Greenwich mean time.

| | | | |
|---|---|---|---|
| Gr. May 15, | $4^h\ 34^m\ 5^s$ | R. A. Moon at $4^h$, | $3^h\ 32^m\ 43^s.62$ |
| R. A. Mean Sun | 3 33 43.00 | Change in $1^h$, | $120^s.98$ |
| R. A. True Sun or app. R. A. | 3 29 47.11 | Moon's Hor. Semid. +(Sun Semid.—Augm.) | 1829″.1 |
| Decl. True Sun or App. Decl. | 18° 59′ 15″ N. | Moon's Red. Hor. Par. − Sun's Hor. Par. | 3247″.6 |
| Hour Angle | $4^h\ 11^m\ 19^s.39$ | Moon's Decl. at Gr. date | 19° 47′ 0″.2 N. |
| | | Red Latitude | 53 12 15 N. |

* The altitude of the sun may be observed with a sextant, or it may be ascertained nearly by adjusting a celestial globe to the time. It should be known nearly for the purpose of finding supposed augmentation from Naut. Tab. (*g*), p. 4.

| (1.) | (2.) | (3.) | (4.) |
|---|---|---|---|
| 3.511562 | 3.511562 | 3.511562 | 1.761068 (c) |
| 9.777402 | 9.903510 | 9.777402 | 0.301030 |
| 8.522879 | 9.975703 | 9.512367 | 10.025895 |
| 9.949225 | | 9.663336 | |
| | 3.390775 | | 2.087993 |
| 1.761068 (a) | 2459".09 N. | 2.464667 | 122'.46 |
| 10.024297 | 291.52 S. | | |
| | | | +2m 2s.46 |
| 1.785365 | 2167.57 N. | | 3 29 47 .11 |
| | 36' 7".6 N. | | |
| 1m 1s | 18 59 15 .0 N. | | 3 31 49.57 |
| 4 11 19.4 | | | +1 59.72 |
| | 19 35 22 .6 N. | | |
| Cor. H. Angle 4 10 18.4 | 19 47 0 .2 N. | | 3 33 49.29 |
| | | *3.402553 | 3.32 43.62 |
| | 11 37 .6 | 3.053654 | |
| | or 697".6 | 10.025895 | 1 5.67 |
| | 1829 .1 | 10.026420 | |
| | | 7.647818 | 65.67 |
| | 2526.7* | | |
| | 1131.5 | 4.156340 | 1.817367 |
| | | | 3.556302 |
| | | 2.078170 | |
| | | | 5.373669 |
| | | 119s.72 | 2.082714 |
| | | 1m 59s.72 | 3.290955 |
| | | | 1954s.14 |
| | | | Gr. May 15, 4h 32m 34s.14 |

Taking Gr. May 15, $4^h\ 32^m\ 34^s.14$ as a new Greenwich date, the moon's decl. is 19° 46′ 45″.4 N. the R. A. sun or app. R. A. is $3^h\ 29^m\ 46^s.86$, and decl. of sun or app. decl. is 18° 59′ 14″.1 N.; no material change will be made in the hor. par., semid. and hour angle, or in the correction of declination. Hence the corrected declination will be 18° 59′ 14″.1 + 36′ 7″.6 or 19° 35′ 21″.7 N.

| | | h m s | |
|---|---|---|---|
| 19° 35′ 21″.7 N. | *3.400158 | 3 29 46.86 | 1.818358 |
| 19 46 45 .4 N. | 3.058957 | + 2 2.46 | 3.556302 |
| | 10.025895 | | |
| 11 23 .7 | 10.026409 | 3 31 49.32 | 5.374660 |
| | 7.647818 | 2 0.12 | 2.082714 |
| 683.7 | | | |
| 1829.1 | 4.159237 | 3 33 49.44 | 3.291946 |
| | | 3 32 43.62 | 1958s.6 |
| 2512".8* | 2.079618 | | Gr. May 15, $4^h\ 32^m\ 38^s.6$ |
| 1145 .4 | 120s.12 | 65".85 | |

By the above repetition of part of the work the computed Greenwich date comes out $4^h\ 32^m\ 38^s.6$, and by a second repetition in a similar manner it comes out $4^h\ 32^m\ 38^s.3$, which may be considered as correct. The true longitude is therefore 6° 18′ 42″ W., and the error of the chronometer (which showed $4^h\ 30^m\ 25^s.5$ at observation) on Greenwich mean time is $2^m\ 12^s.8$ *slow*.

*To find the Longitude from the Occultation of a Planet by the Moon.* (See *App.* 42.)

(292.) An occultation of a planet by the moon is in appearance similar to that of a fixed star, with the exception that a planet having a semidiameter of sensible length, does not (like a star) pass wholly behind the moon's limb or emerge from it wholly, in an instant. In this respect such an occultation partakes of the nature of a solar eclipse, in which, by the interposition of the moon, the sun's disk is gradually darkened or lost sight of. In a planetary occultation it is necessary therefore to take into account the semidiameter of the planet, by making the observation at the moment of an external contact of the moon and planet, or at the moment of their internal contact. It is more convenient in general to do the latter (if possible) since at an immersion the planet then wholly disappears, and at an emersion it is first seen. When the observer is furnished with a telescope of sufficient power, he may often take the times of both the external and internal contacts of the bodies.

At the instant of the total disappearance or first appearance of the planet the distance of its centre from the moon must be the *difference* between the apparent semidiameters of the moon and planet; seen from the centre of the earth it would be the difference between the hor. semidiameters of the two bodies, on the supposition that the planet is at the same distance from the earth as the moon; supposing also that the whole disk of a planet is enlightened, which may be considered as true in every case except for Venus. This difference therefore may be substituted in the application of the rule, Art. 286, instead of the moon's hor. semidiameter alone. The same substitution may be also made at the total disappearance of Venus, when the moon is approaching the sun, and at its first reappearance when the moon is receding from the sun. When an external contact is observed, the *sum* of the semidiameters must be used. When both the external and internal contacts are observed the mean of the times will be the time of the contact of the planet's centre, in which case there will be no occasion to take into the account the planet's semidiameter.

The augmentation of the planet's semidiameter seen at the moon's distance, being very small, may be neglected. It is the same part of the augmentation of the moon's semidiameter that the planet's semidiameter is of the moon's.

The difference of the moon's reduced hor. parallax and that of a planet must be used for the moon's alone. The planet's R. A. and declination, semidiameters and horizontal parallax, may be taken from the Nautical Almanac.

*To find the Longitude by the Transit of the Moon's enlightened Limb over the Meridian.* (See *App.* 43.)

(293.) When a transit telescope (see articles on instruments) is placed in the meridian, the longitude may be found by noting the time shown by a chronometer, when the enlightened limb of the moon passes the middle or meridian wire, the error of the chronometer on mean time at the place being supposed known.

By applying the error of the chronometer to the time shown by it at observation mean time at the place is known. From this and the longitude by account get a Greenwich date, and for this date take from the Nautical Almanac the R. A. of mean sun, the hor. semidiameter of the moon,

and its declination: take out also the moon's R. A. for hour of Greenwich date, and the change of R. A. from that hour to the next.

To the *logarithm* of the moon's semidiameter in seconds add the *log. secant* of the moon's declination, and the number 8.823909, rejecting the tens from the index in the sum. The result will be the *logarithm* of the moon's semidiameter in R. A. in time, which take out to the nearest hundredth of second, and express in minutes and seconds. Add together the mean time at place and the R. A. of mean sun; the sum diminished by $24^h$ if greater than $24^h$, will be sidereal time (or R. A. of moon's enlightened limb). To this, when the *western* limb is observed, *add* the semidiameter in R. A., rejecting $24^h$ if the sum be greater than $24^h$; and when the *eastern* limb is observed, *subtract* from the sidereal time (adding $24^h$ if necessary) the moon's semidiameter in R. A. The result will be the R. A. of the moon's centre from observation.

Under this put the moon's R. A. for hour of Greenwich date, and take the difference. To the *logarithm* of this difference in seconds add number 3.556302, and from the sum subtract *logarithm* of change of moon's R. A. in one hour. The result will be the logarithm of a number of seconds, which take out to nearest hundredth of second, and, expressing it in minutes and seconds, add* the result to the hour of the Greenwich date. The result will be the Greenwich date from observation. If this agree exactly with the assumed Greenwich date, it is correct: if not, assume it as a new Greenwich date and repeat the computation till as exact an agreement between the result and the last assumed Greenwich date takes place as is required. From this result and M. T. at place find the longitude.

*Ex.* April. 10, 1835, in latitude 50° 48′ N., and longitude by account 8° 45′ 54″ W., the enlightened western limb of the moon passed the meridian at $10^h\ 6^m\ 44^s$ mean time: required the true longitude.

| | | | | | Repeated. |
|---|---|---|---|---|---|
| Sh. April 10, | $10^h\ 6^m\ 44^s$ | 2.991115 | R. A. M. Sun | $1^h\ 13^m\ 44^s.60$ | |
| Long. in T. | 0 35 3.6 W. | 10.006210 | Mean T. | 10 6 44 | |
| | | 8.823909 | | | |
| Gr. April 10, | 10 41 47.6 | | Sid. Time | 11 20 28.60 | |
| | | 1.821234 | As before | 1 6.26 | |
| Moon's Hor. Sem. | 979″.75 | $1^m\ 6^s.26$ | | | |
| Decl. | 9° 39′ 55.′ N. | 11 20 28 .57 | | 11 21 34.86 | |
| R. A. Mean Sun | $1^h\ 13^m\ 44^s.57$ | | | 11 20 0.55 | |
| Mean Time | 10 6 44 | 11 21 34 .83 | | | |
| | | 11 20 0 .55 | | | $94^s.31$ |
| Sid. Time | 11 20 28.57 | | | | |
| Moon's R. A. at $10^h$ | 11 20 0.55 | $94^s$ .28 | | | |
| Change in $1^h$ | $134^s.72$ | | | | |
| | | 1.974420 | | 1.974558 | |
| | | 3.556302 | | 3.556302 | |
| | | 5.530722 | | 5.530860 | |
| | | 2.129433 | | 2.129433 | |
| | | 3.401289 | | 3.401427 | |
| | | 2519.35 secd$^s$. | | 2520.16 secd$^s$. | |
| | Gr. April 10, | $10^h\ 41^m\ 59^s.35$ | . . . | $10^h\ 42^m\ 0^s.16$ | |

* Subtract if R. A. from observation be less than that at hour of Gr. date.

From a second repetition results $10^h\ 42^m\ 0^s.1$, which may be considered as the correct Greenwich date. Taking the difference between this and the Sh. mean time, the true longitude is got, namely, 8° 49′ 1″.5 W.

(294.) When the error of the chronometer on *sidereal time* is known, in that case sidereal time used in the computation is known without taking from the Nautical Almanac the R. A. of mean sun. The other elements, however, must be taken out for a Gr. date in mean time got as nearly as possible. It is best to determine the error of chronometer on sidereal time by observing transits of stars near the moon having nearly the same declination, which may be found in the Nautical Almanac under the name of *moon culminating stars*. By this means any small error in the position of the transit telescope will be corrected. (See *App.* 44.)

(295.) In closing the subject of finding the longitude by the four methods above, it may be observed that perfect exactness cannot be arrived at, on account of slight errors in the observation, and also on account of the errors in the tables of the moon's place. Those last, however, are now very small, and can be of no consequence in a practical point of view.

If the same occultation, eclipse, or transit of the moon should be observed at two different places, the errors of the tables would produce the same error in the longitude of each place, and the difference of longitude would on this account have no error. If one of the places be Greenwich, or a place whose longitude has been exactly ascertained, we should thus get the longitude of the other place so far correctly. If the observations were made with similar telescopes and equal care, it might be expected that the slight unavoidable errors of observation would also in a great degree correct one another in the result. This last remark may be extended to the method of determining the longitude by the eclipses of Jupiter's satellites, of which we shall now give a short explanation.

*To find the Longitude by an Immersion or Emersion of Jupiter's Satellites.*

(296.) The satellites of Jupiter describe orbits round that body in the same manner as the moon does round the earth, and they are occasionally deprived of the solar light. An eclipse of the moon is caused by the interposition of the earth between it and the sun; and the eclipse of a satellite of Jupiter is caused by being in a similar manner carried, with respect to the sun, behind the planet. This deprivation of light may frequently be seen from the earth; and as it occurs at the same instant on every part of the earth, the observation furnishes a very ready and exact method of finding the difference of longitude between two places, by simply taking the difference of times at the places when the observation is made. Moreover, the Greenwich mean times of the eclipses of the satellites, which can be seen, are computed and put down in the Nautical Almanac; whereby the observer is enabled to determine his longitude at once, by taking the difference between the Greenwich time and the time at the place.

(297.) Before the earth, by its annual motion from west to east, is brought between the sun and Jupiter, the shadow of the planet being thrown behind the planet and opposite to the sun, must be seen from the earth to the west of Jupiter. And hence all eclipses of the satellites, which happen then, must be seen to the west of the planet. For a similar reason after

the earth has passed between the sun and planet the shadow must lie apparently on the east of Jupiter, and the eclipses of its satellites must also be seen to the east. When a satellite, in moving round Jupiter from west to east, passes into the shadow, it is called an *immersion*; after this the satellite is for some time invisible, and then passes out of the shadow, which is called an *emersion*. Both the immersions and emersions of the satellites farthest from Jupiter (the 3rd and 4th) are frequently visible, and sometimes those of the next (the 2nd). Both these are never seen of the nearest to Jupiter the (1st); since one side of the shadow which lies near the planet is, with respect to the earth, behind the body of the planet.

When an eclipse of one of the satellites is expected, the first thing is, from the Greenwich time of the immersion or emersion put down in the Nautical Almanac and the estimated longitude, to get a date in M. T. at the place, adding east longitude and subtracting west. This will be the time very nearly when the observation must be taken. The observer should therefore be fixed at his telescope a minute or two before his watch or chronometer indicates this time; with the axis of the telescope pointed precisely to the satellite, if an immersion is about to take place, and precisely to the point where the satellite will appear, when an emersion is about to take place. This point of immersion or emersion may be known from the Nautical Almanac.

When the observer is seated at his telescope, and has fixed his eye on the proper point, he must keep that point carefully in the middle of the field of view, till the observation is complete. At an immersion, he watches the satellite till it disappears, at which instant the time is taken by a chronometer, whose error is known on mean time at the place. At an emersion, he watches the point of appearance, till he thinks he perceives the satellite, at which instant the time is taken; still, however, he keeps his eye on the spot till either assured that he has not been deceived, or till he again thinks he sees the satellite. The difference between mean time at the place so determined and Greenwich mean time taken from the Nautical Almanac is the longitude in time.

(298.) The observer must attend to the following directions. His telescope must have the sufficient magnifying power, and yet not so much as to cause too great a loss of light. The most convenient kind of telescope is an achromatic one of about 46 inches in length, and 2¾ inches aperture. He must seat himself at the telescope in the most easy and steady position; the stand of the telescope must be quite immoveable by any slight cause, and his assistant must be placed near with the chronometer, to note the second and portion of a second. Before the observation he must abstain from using the eye much, especially in looking through the telescope, or where there is much light.

### *The Longitude by an Eclipse of the Moon.*

(299.) The moon in describing its orbit round the earth is sometimes deprived of the solar light by the interposition of the earth. The moon is then, with respect to the sun, behind the earth, and is seen from the earth in the opposite point of the celestial concave with a full orb. The beginning and end of the eclipse really happen at the same instant everywhere on the earth, where the moon is visible; and so far would furnish a very easy method of determining the longitude. This method, however, is

of very little practical use, on account of the great difficulty there is in ascertaining at what instant the beginning and end take place, since the moon in passing behind the earth is deprived of the solar light gradually in the former case and is restored to it in like manner in the other. The uncertainty may amount to several minutes.

The longitude therefore, which is hence deduced by taking the difference between the ship time and Greenwich time (as given in the Nautical Almanac) cannot be depended on; and it is unnecessary to give here any any particular rule or example.

### *Variation of the Compass.*

(300.) The needle, when it has been touched by the magnet, does not in general point to the true north, but to east or west of the true north. This deviation is called the *Variation of the Compass.*

The amount of this variation is found by taking the compass bearing of an object, whose true bearing is either known, or can be computed. The difference of the two bearings is the variation required. Thus let the true bearing of a place A be N. E., and its compass bearing E. N. E.; then the variation is 2 points. Again, let the true bearing of an object B be N. 45° 10′ W., and its compass bearing N. 37° 50′ W.; then the variation of the compass is 7° 20′. When the north end of the needle is turned to the east of the true north, the variation is called *east;* and when it is turned to the west thereof, the variation is *west.* Let the variation be two points east; then the north end of the needle must point to the true N.N.E.; that is, if the compass bearing of an object be N., its true bearing is N.N.E., or the true bearing is two points to the right of the compass bearing. This will manifestly be the case with any other object round the compass. Hence therefore if, of two bearings, the true one is to the right of the other, the observer being supposed to face these points, the variation must be east; and in a similar manner it appears that the variation is west, when the true bearing is to the left of the compass bearing.*

### *Examples.*

| Bearing by Compass. | True Bearing. | Variation. |
|---|---|---|
| N. E. b. E. | E. b. N. | 2 pts. E. |
| S. S. W. ½ W. | S. ¼ W. | 2½ pts. W. |
| N. ¾ W. | N. b. E. ¼ E. | 2 pts. E. |
| N. 50° 20′ W. | N. 60° 32′ W. | 10° 12′ W. |
| S. 110° 30′ E. | S. 92° 16′ E. | 18° 14′ E. |
| W. 10° 15′ N. | W. 20° 40′ N. | 10° 25′ E. |
| W. 5° 20′ S. | W. 17° 36′ N. | 22° 56′ E. |

(301.) When the compass bearing and true bearing are reckoned from different points of the compass, it is necessary to reduce them to the same, before the variation can be found. This is done by subtracting the compass bearing from 90° or 180°, or by adding thereto 90°, according to circumstances.

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* This rule may be recollected by considering, that *east* variation, in correcting compass courses, is allowed to the right, and *west* variation to the left. (See Art. 31.

*Examples.*

| Compass Bearing. | True Bearing. | Variation. |
|---|---|---|
| E. 10° 16′ N. | N. 72° 25′ E. | 7° 19′ W. |
| S. 50° 45′ W. | N. 130° 16′ W. | 1° 1′ W. |
| E. 17° 51′ N. | S. 98° 36′ E. | 9° 15′ E. |

(302.) The objects, which are usually observed at sea for the purpose of finding the variation of the compass are the heavenly bodies, of which the true bearing can always be computed from the altitude, supposed to be observed at the same time with the bearing. The declination of the body is known from the Nautical Almanac; and the latitude of the ship is known by bringing up the last latitude by observation to the time when the bearing is taken, by means of the log account.

*Method of Observing the Compass Bearing at Sea.*

(303.) For the purpose of taking the magnetic bearing with accuracy mariner's compasses are constructed with a view to this particular observation. The box, in which the card is placed, is constructed so as to turn horizontally on a central axis, and to carry with it an index fixed to the side, which index may at any time be brought close to the card, and the distance from the north or south point read off. It is fixed in jimbols, in such a manner as to keep the top of the box nearly horizontal, and to ease the violence of any shock. A bar of brass is fitted diametrically over the box, supporting at each end a thin slip of brass; one of these vertical slips is slit lengthwise, and in the other an open space is left in the middle, which is bisected by a fine thread passing from the top to the bottom. The thread and the slit opposite are so adjusted, that a plane passing through them passes also through the centre of the compass and through the edge of the card 90° from the index. A compass so constructed is called an azimuth-compass.

In making an observation with this instrument the eye is placed at the slit, and the box is turned round till the thread is seen to bisect the object; the index is then pushed close to the card and the bearing is read off, allowing for the 90° which the index is to the right.

In taking the compass bearing of the sun, a piece of dark glass is used before the eye; but, in this case, the observation may be made with greater accuracy and expedition, by throwing the shadow of the thread on the diametrical bar of brass, so as to coincide with a groove running along the middle of it. To render the shadow more distinct, the upper surface of this bar may be whitened, or a piece of white paper pasted on part of it. After taking one bearing in this manner, the compass may be turned half round, and the streak of light passing through the slit thrown on the groove in the bar; in which case the opposite point to that shown by the index should be read off.

An observation of this kind for finding the variation is made at sea in the most complete manner by three persons, one of whom turns the box, and throws the shadow on the middle groove; a second keeps his eye fixed at the same time on the index, so as to be always prepared to read off the bearing; and the third takes the sun's altitude with Hadley's sextant. A single person, in observing both the sun's altitude and bearing, should take

the former both before and after the latter, at times as nearly as he can equidistant from it. A mean of the altitudes so taken will then be nearly the altitude corresponding to the bearing. It would add to the accuracy of the result, if five or six observations were taken in succession; especially when it can be done without stopping the card in order to read off. The less the altitude of the sun, when the above observation is made, the better, since any error that may be produced by the uncertainty of refraction near the horizon is small, compared with the errors arising from the imperfection of the instrument and the motion of the ship at a greater altitude. The altitude should never be greater than 15°.

The reading off on the azimuth-compass, in taking the bearing of the sun, should be always reckoned from, or reduced to, the N. or S., according as the latitude is N. or S.

*Rule for finding the Variation of the Compass from the Compass Bearing of a Heavenly Body, and its Observed Altitude.* (See *Apps.* 45, 46, 47.)

(304.) Get a Gr. date as in Art. 185, or as in note thereto. For this date take from the Nautical Almanac the declination of the heavenly body, get the polar distance* (P. D.), and whatever is necessary for correcting the observed altitude and finding the true altitude (see Art. 211). Correct the observed altitude and get the true altitude (T. A).

Under the true altitude put the latitude and take the difference, under which put the polar distance (P. D.), and take the sum and difference. To the *log. secants* of the two first terms in this form (rejecting ten from each index) add the *halves* of the *log. haversines* of the two last. The sum will be *log. haversine* of the true bearing or azimuth reckoned *from* the N. in north latitude, and *from* the S. in south latitude, and *towards* the W. or E. according as the body is west or east of the meridian.

If necessary reduce the compass bearing to the same names N. or S., and W. or E., as the true, by subtracting it from 90° or 180°, or by adding 90°; and thus reduced (if necessary) put it under the true bearing. Take the difference, which will be the variation, W. when the true bearing is to the *left* of compass bearing, and E. when the true bearing is to the *right* of compass bearing.

*Ex.* 1. Oct. 10, 1835, at $4^h\ 10^m$ P.M. mean time nearly, in latitude 48° 20′ N., and longitude 72° 16′ W., the compass bearing of the sun was S. 50° 25′ W., and the observed altitude of the L. L. was 15° 40′ 30″; the index correction was +2′ 10″, and the height of the eye above the sea was 20 feet: required the variation of the compass.

*Ex.* 2. Oct. 20, 1835, at $8^h\ 40^m$ A.M. mean time nearly, in latitude 30° 17′ S., and longitude 155° 20′ W., the compass bearing of the sun was N. 82° 25′ E., and the observed altitude of the L. L. was 18° 30′ 55″; the index correction was + 5′ 20″, and the height of the eye above the sea was 25 feet: required the variation of the compass.

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* When lat. and decl. have the *same* name, *subtract* the decl. from 90°; when lat and decl. have different names, *add* the decl. to 90°.

| (1.) Sh. October 10, | $4^h\ 10^m$ | (2.) Sh. Oct. 19, | $20^h\ 40^m$ |
|---|---|---|---|
| Long. in T. | 4 49 W. | Long. in T. | 10 21 W. |
| Gr. October 10, | 8 59 | Gr. Oct. 20, | 7 1 |
| Sun's P. D. | 96° 37′ 12″ | Sun's P. D. | 79° 42′ 11″ |
| T. A. | 15 51 6 | T. A. | 18 44 44 |
| Compass Bearing N. | 129 35 0 W. | Semid. | 16 6 |
| Semid. | 16 3 | | |

| Lat 45° 20′ 0″ N. | | 0.177312 | Lat. 30° 17′ 0″ S. | | 0.063714 |
|---|---|---|---|---|---|
| T. A | 15 51 6 | 0.016838 | T. A. | 18 44 44 | 0.023668 |
| | | 4.955695 | | | 4.854140 |
| | 32 28 54 | 4.725042 | | 11 32 16 | 4.748496 |
| P. D. | 96 37 12 | | P. D. | 79 42 11 | |
| | | 9.874887 | | | 9.690018 |
| | 129 6 6 | N. 119° 57′ 30″ W. | | 91 14 27 | S. 88° 50′ E. |
| | 64 8 18 | N. 129 35 0 W. | | 68 9 55 | S. 97 35 E. |
| | | Var. 9 37 30 E. | | | Var. 8 45 E. |

(305.) When the sun is rising or setting, and its true altitude is nothing, its L. L. appears about a semidiameter of the sun above the horizon through the effect of refraction. When this is the case, the compass bearing of the sun may be taken, and the same rule applied for calculating the true bearing; putting the true altitude 0° 0′ 0″: or a more easy rule may be given as follows:—

*Rule for finding the Amplitude of a Heavenly Body at Rising or Setting.* (See *App.* 48.)

(306.) From ship mean time and the longitude find a Greenwich date, for which take from the Nautical Almanac the declination of the heavenly body, to the *log. sin.* of which declination add the *log. sec.* of the latitude, rejecting the tens in the index of sum. The result will be the *log. sin.* of the amplitude of the body, reckoned *from* the E. when it is rising, and *from* the W. when it is setting, and towards the N. or S. according as the declination is N. or S. Under this put the compass amplitude* of the body. When the names are like take the difference, when unlike take the sum. The result will be the variation, W. when the true bearing is to the *left* of the compass bearing, and E. when the true bearing is to the *right* of the compass bearing (see note, Art. 300).

*Ex.* 1. Oct. 13, 1835, at $5^h\ 30^m$ P.M. mean time nearly, in latitude 49° 10′ N., and longitude 50° 20′ W., the sun's amplitude at setting was *by compass* W. 32° 16′ S: required the variation.

*Ex.* 2. Aug. 24, 1835, at $5^h\ 30^m$ A. M. mean time nearly, in latitude 50° 48′ N., and longitude 150° 36′ E., the sun's amplitude at rising was *by compass* E. 12° 40′ S: required the variation.

| (1.) | | (2.) | |
|---|---|---|---|
| Sh. Oct. 13 . . | $5^h\ 30^m$ | Sh. Aug. 23 . . | $17^h\ 30^m$ |
| Long. in T. . . | 3 21 W. | Long. in T. . . | 10 2 E. |
| Gr. Oct. 13 . . | 8 51 | Gr. Aug. 23 . | 7 28 |
| Sun's Decl. . | 7° 45′ 0″ S. | Sun's Decl. . . | 11° 31′ 17″ N. |

* The compass bearing is supposed to have been read off from the W. or E.

| | | | | |
|---|---|---|---|---|
| 9.129854 | | | 9.300431 | |
| 10.184515 | | | 10.199263 | |
| 9.314369 | | | 9.499694 | |
| W 11° 54′ 0″ | S. | | E 18° 25′ 15″ | N. |
| W 32 16 0 | S. | | E 12 40 0 | S. |
| Var. 20 22 | E. | | Var. 31 5 15 | W. |

In the above rule, the true altitude of the sun's centre is supposed to be 0, or its true zenith distance 90°. When this is the case, the apparent altitude of the sun's centre must be nearly 0° 34′; since it is raised so much by the effect of refraction, while parallax, which on the other hand depresses it, is inconsiderable.

The proper time therefore for taking the amplitude of the sun by the compass at sea is when its centre appears to be raised above the horizon about 34′, that is, a space equal to the diameter of the sun; or, what may be a better direction, when its lower edge appears to be half way between the horizon and centre.

If a fixed star or a planet be observed, its bearing must be taken when it appears about 34′, or half a degree above the horizon, or an app. diameter of the sun.

With respect to the moon, the effect of horizontal parallax is to depress it about two of its diameters, whilst refraction raises it only one. This body therefore cannot be seen, when it is truly 90° from the zenith, or its true altitude 0. In this case the bearing should be taken, as soon as sufficient of the moon's disk is perceptible to allow of its being bisected by the thread of the azimuth-compass. This will be quite correct enough for all the purposes for which the variation is wanted at sea.

The amplitude of the sun at rising and setting, and also the time at which it rises or sets, may be taken by inspection from a table constructed for that purpose (see Nautical Tables, p. 373). It is entered with the declination at the top, and the latitude at the side. Under the declination are two columns; one of which contains the amplitude, which is to be reckoned from the W. or E.: the other contains the hours and minutes which the sun rises before or after six o'clock *apparent* time; before, when the latitude and declination have like names, and after, when they have different names: those hours and minutes are also the time, which the sun sets after or before six in the evening; after, when the declination and latitude have like names, and before, when they have different names.

*Ex.* Let it be required to find from the table at what time the sun rises on Oct. 11, 1835, in latitude 50° N. and longitude 60° W. and its amplitude at rising.

The sun's declination at the nearest Greenwich noon is 6° 51′ S. Entering the table with a declination 7° and latitude 50°, we have the time $0^h\ 34^m$, and the amplitude 10° 56′: that is, the sun rises nearly at $34^m$ after 6, or at $6^h\ 34^m$ A. M., and its amplitude is nearly E. 10° 56′ S. If the time of rising and amplitude be wanted with greater exactness, the declination must be taken out for a Greenwich date got from the approximate ship time and the longitude; and a proportion must be made for the minutes of latitude and declination.

*To determine the Bearing of an object by observing the Distance of a Heavenly Body from it.* (See *App.* 49.)

(307.) Suppose an object to be well defined and on a level with the eye. With a sextant bring the image of the heavenly body up to the object; *for the sun*, make the nearest limb touch the object; *for the moon*, make the enlightened limb touch the object; *for a star or planet*, make the image pass through the object. At the same instant let the altitude of the body be observed. By applying the index correction and semidiameter of the body, if it be the sun or moon, to the observed distance as in a lunar observation, get the *apparent distance*, and by correcting the observed altitude for index correction, dip, semidiameter (for sun or moon), get the apparent altitude of centre (A. A.). Under the apparent distance (A. D.) put the apparent altitude (A. A.), and take the sum and difference. To the *log. secant* of app. altitude (A. A.), rejecting ten from the index, add the *halves* of the *log. haversines* of the sum and difference. The sum will be the *log. haversine* of the difference of bearing between the object and the heavenly body. Then compute the true bearing or azimuth of the heavenly body as usual (Art. 304). When this and the bearing of the object from the heavenly body are in the same direction, the sum will be the bearing of object: when the bearing of the object from the heavenly body is reckoned in the contrary direction, the difference will be the bearing of object.

*Ex.* July 10, 1835, at $7^h\ 0^m$ A. M. mean time nearly, in latitude $7°\ 51'$ S., and longitude $153°\ 10'$ E., the observed altitude of the sun's L. L. was $10°\ 30'\ 0''$, and the observed distance of the sun's N. L. from a well-defined point of land on the same level with the eye and to the left of the sun was $95°\ 16'\ 0''$. The index correction of the altitude sextant was $-0'\ 50''$, and that of the latter was $+\ 1'\ 10''$; the height of the eye in taking the sun's altitude was 14 feet: required the true bearing of the point of land.

The compass bearing of the point was N. $5°\ 10'$ W.: required the variation of the compass.

| | | | |
|---|---|---|---|
| Sh. July 9, | $19^h\ 0^m$ | App. Alt. | $10°\ 41'\ 14''$ |
| Long. in T. | 10 13 E. | Tr. Alt. | 10 36 24 |
| | | App. Dist. | 95 32 55 |
| Gr. July 9, | 8 47 | Sun's Semid. | 15 45 |
| Sun's P. D. | $112°\ 23'\ 54''$ | | |

| | | Diff. of Bearing. | | Sun's Bearing. | |
|---|---|---|---|---|---|
| A. D. | $95°\ 32'\ 55''$ | 0.007600 | Lat. | $7°\ 51'\ 0''$ | 0.004089 |
| A. A. | 10 41 14 | 4.903025 | T. A. | 10 36 24 | 0.007485 |
| | | 4.829114 | | | 4.926401 |
| | 106 14 9 | | | 2 45 24 | 4.912410 |
| | 84 51 41 | 9.739739 | | 112 23 54 | |
| | | To left of Sun $95°\ 39'\ 0''$ | | | 9.850385 |
| | | Sun S 114 39 15 E. | | 115 9 18 | S 114° 39 15" E. |
| | | | | 109 38 30 | |
| | | Point of land S 210 18 15 E. | | | |
| | | or N 30 18 15 W. | | | |
| | | Comp. Bearing N 5 10 0 W | | | |
| | | Var. 25 8 15 W. | | | |

By this method the true bearing of objects in different points of the horizon may be found, and thus the variation determined with great accu-

racy. If the ship should change her position, by swinging round, it may be also seen immediately by means of any one of these objects, whether or not the variation alters. (See following remarks on the effects of local attraction.)

To determine the true bearing of an object on the same level with the eye as above, with as much exactness as may be required, it is necessary to attend to the following rules:

(1.) The heavenly body should be rising or falling fast at the time, and never more than 60° high.

(2.) The object should be nearly abreast of the sun, that is, nearly 90° from the point of the horizon to which the sun is vertical.

(3.) When rule (2) is not possible, care should be taken in choosing an object, so that the angle which the distance observed makes with the horizon (as estimated by the eye) may not be more than 45°.

If these rules be attended to, the true bearing may be determined within 3′ or 4′. When the object is elevated above the level of the eye, it is necessary to observe its altitude or elevation. (See *App.* 50, 51, 52, &c.)

### *Remarks concerning the Variation of the Compass, and Cautions to be observed in the Use of this Instrument.*

(308.) If a bar of steel of uniform thickness be supported at the middle point, it will be exactly balanced and at rest in a horizontal position, to whatever point in the horizon it is directed. If the bar or needle so placed be touched with magnets, it will immediately turn on its centre (supposed to be supported and yet to afford a free rotation), till it rests nearly in the plane of the meridian; at the same time one end will sink down and the other will be elevated. On the whole the needle will now lie in an inclined position to the horizon, having one end a little to the east or west of the plane of the meridian, and the other as far to the west or east thereof. This, generally speaking, is the natural position of a magnetised needle.

Let the elevated end be now made to descend into a horizontal position, a weight to be afterwards attached thereto, to keep it so, and the whole to be supported on a central pin. This is the position in which the needle is used in navigation. The angle which the needle, in its natural position, makes with the horizon at any place is called the *dip* *. The angle it makes with the meridian, that is, with a true north and south line, when kept horizontal by a depressing weight, is called the *variation*; west or east, according as the north end lies to the west or east of the meridian.

Since the dip changes as the place is changed, it must be necessary, in order to keep the needle horizontal, to shift the weight attached to one of the arms. In the northern hemisphere, generally speaking, the north end dips under the horizon; and in the southern hemisphere the south end, and this inclination increases as we approach the poles of the earth. Hence in the northern hemisphere generally the balancing weight must be put on

* An instrument called a *dipping needle* is used to measure this dip. It consists of a graduated circle having a needle supported at the middle on a transverse horizontal axis. The needle having been touched, the circle is placed in the magnetic meridian, that is, so as to pass through the horizontal needle in its position east or west of meridian. The dip is taken with the face of the circle both east and west. A mean of the readings off is the correct dip.

the south end of the needle, and pushed nearer the extremity as we sail farther to the north; in the southern hemisphere it must be put on the northern arm, nearer and nearer the extremity, as we get farther and farther to the south.

The needle thus brought into a horizontal position, points generally something to the east or west of the true north: this deviation or *variation* is different in different places, and varies in process of time at the same place. Hence arises the necessity of determining its amount at sea every day.

Besides the general tendency, by which the needle is disposed to deviate through a certain arc from the north, it is sometimes affected by local attraction, as by masses of iron that happen to be near it. Thus the variation may be altered. And moreover, should the position of the body, which so disturbs the needle, be changed, as from the east side to the west, the alteration in the variation is also changed, and even becomes of the opposite kind to what it was before. Now in a ship there is iron at no very great distance on every side of the needle, which may easily be supposed therefore to be affected thereby. If the effects of these disturbing forces be balanced, no deviation will be produced on the whole; but if not, then the variation, which the compass has, independently of such local attraction, will be altered; and as, in working the ship and bringing it on different courses, the iron must be carried round into different positions with respect to the needle, this alteration of the variation must itself undergo continual changes. If westerly variation be increased or easterly variation diminished, when the ship's head is in any one direction, the contrary effect will be produced on the variation, when the ship's head is brought round to the opposite point, that is, westerly variation will be diminished and easterly increased.

It appears necessary therefore in the application of the needle to the purposes of navigation, to determine the variation, when the ship's head is different ways. The simplest method is actually to find the variation by observation (Art. 304, 306, 307); when the ship lies on different points of the compass, at a time when this can be done most conveniently and correctly. The results may be inserted in a small table, such as the following, from which the proper variation, to be allowed according to the course steered, may be taken by inspection. The mean of all the variations put down will be the true variation.

*First Table of Variations.*

| Ship's Head by Compass. | Variation. | Ship's Head by Compass. | Variation. |
|---|---|---|---|
| | ° ′ | | ° ′ |
| North | 24 30 W. | South | 24 30 W. |
| N.N.E. | 23 29 W. | S.S.W. | 25 31 W. |
| N.E. | 22 37 W. | S.W. | 26 23 W. |
| E.N.E. | 22 2 W. | W.S.W. | 26 57 W. |
| East. | 21 50 W. | West | 27 10 W. |
| E.S.E. | 22 2 W. | W.N.W. | 26 57 W. |
| S.E. | 22 37 W. | N.W. | 26 23 W. |
| S.S.E. | 23 29 W. | N.N.W. | 25 32 W. |

*Second Table of Variations.*

| Ship's Head by Compass. | Variation. | Ship's Head by Compass. | Variation. |
|---|---|---|---|
| | ° ′ | | ° ′ |
| North | 32 30 W. | South | 32 30 W. |
| N.N.E. | 30 54 W. | S.S.W. | 34 16 W. |
| E.N.E. | 29 14 W. | S.W. | 35 46 W. |
| N.E. | 28 14 W. | W.S.W | 36 46 W. |
| East | 28 0 W. | West | 37 0 W. |
| E.S E. | 28 14 W. | W.N.W. | 36 46 W. |
| S.E. | 29 14 W. | N W. | 35 46 W |
| S.S.E. | 30 44 W. | N.N.W. | 34 16 W |

From the above table it appears that the true variation, or mean of the whole, is 24° 30′ W. But in correcting courses (Art. 43), or in shaping courses, that variation must be allowed which is opposite the course. Thus, if the compass course be east, the variation to be allowed is 21° 50′, or about two points; if the compass course be west, the variation to be allowed is about 27° 10′, or about 2½ points.

When a table, such as the above, has been once formed by good observations taken on every second point of the compass, it will be often unnecessary afterwards to find the variation with the ship's head on more than two points, namely, those on which there is the greatest and least variation. In the above case the ship's head should be brought east and west, when the sun's azimuth is observed. The mean of the resulting variations will be the true variation, and half their difference will be the greatest error. Thus let the variations, when the ship's head is E. and W., be now 28° W. and 37° W.; then the true variation is 32° 30′ W., and the greatest error is 4° 30′. From these results a new table is easily formed as follows. Considering the degrees and minutes of the greatest error as minutes and seconds, find its *prop. logarithm* and write it down three times; underneath put the *log. secants* respectively of 22° 30′, of 45°, and 67° 30′, and add: the sums, rejecting 10 from each index, will be the *prop. logarithms* of three arcs, which take out as minutes and seconds, but consider as degrees and minutes. These three arcs will be respectively the deviations from the true variation at the distance of two, four, and six points from the points of greatest and least variation. The deviation at the distance of eight points is 0′. The following is the computation in the supposed case (see App. 60):

| | 22° 30′ | 45° | 67° 30′ | 90° |
|---|---|---|---|---|
| *Prop. Log.* ..... | 1.59094 | 1.59094 | 1.59094 | |
| Log. *secants* ..... | 10.03438 | 10.15051 | 10.41716 | |
| | 1.62532 | 1.74145 | 2.00810 | |
| Errors ..... | 4° 16 | 3° 16′ | 1° 46′ | 0° 0′ |
| Tr. Var. ... ..... | 32 30 | 32 30 | 32 30 | 32 30 |
| Adding..... | 36 46 | 35 46 | 34 16 | 32 30 |
| Subtracting ..... | 28 14 | 29 14 | 30 44 | 32 30 |

Diminishing the variations from the greatest by these steps, and increasing them from the least, we have a second table of variations similar to Table p. 160.

In the above method of proceeding, we suppose the greatest and least variations always to take place when the ship's head is in the same direction as in the first set of observations. But owing to a change in the stowage or equipment of the ship, or otherwise, this may not continue to be the case. It is necessary therefore, from time to time, to find the variation by observation, not only when the ship's head is on the supposed points of greater or least error, but also on the points contiguous thereto, and whenever a good opportunity occurs, as in the first case, on every second point. (See App. 61.)

By proceeding in this manner, the effect of the ship, in disturbing the position of the needle, will always be properly corrected.

It must be remarked, before we conclude this subject, that the variation is usually determined on board a ship by an azimuth compass, and applied, in working the log account or shaping a course, to the compass by which the ship is steered. It is obviously necessary therefore in making the proper observations, to see that there is an exact agreement between the two instruments; the steering compass being in the binnacle. And this must be done at every distinct observation, when the direction of the ship's head is changed.

## *Tides.*

(309.) Suppose a spectator to be placed at the centre of the moon and to view from thence the earth, which may be considered as a perfect globe covered with water. Suppose also a straight line to be drawn from the spectator to the centre of the earth, and when produced to cut the earth's surface at two opposite points, that nearest to the spectator being denoted by A and the opposite one by A′. Then, since every particle of the earth is attracted or drawn towards the moon with a force varying inversely as the square of its distance, it is manifest that the most powerful attraction will be on the particles of water near A, and the least powerful on the particles near A′. A mean or average attraction will take place on the particles equidistant from these two points, that is, near a circle on the earth's surface perpendicular to the diameter AA″. The consequence must be, that the equilibrium of the water will be destroyed, and to restore it there must be an accumulation of fluid near A, or the point immediately before the lunar spectator, where the attraction towards the moon is the greatest: there must also be a similar accumulation at the opposite point A′, since the defect of attraction there must, as to the effect in question, be equivalent to an excess in the opposite direction. Upon the whole, therefore, the water will rise near A and A′, and consequently will fall near the circumference of a circle perpendicular to AA′; or in other words, the water will rise towards the middle of the earth's disk or face as seen from the moon, and also near the point opposite to this; and will fall near the edge or limb of the disk.

The appearance then of the earth, to the lunar spectator, will be that of a spheroid with its longest diameter pointed to him. Let us now suppose the earth to have a whirling motion round its own axis from west to east. The question is, will the greatest accumulation of water, or the sharpest end of the spheroid, continue exactly under the moon? As each point in a particular circle of the earth, by its revolution, comes into this situation, the water will rise more and more at it; and when it passes under the moon, the greatest effort will take place in raising the water. Afterwards this effort will diminish; still however the water will continue to rise by its own momentum; till this momentum being overcome by the tenacity of the fluid and its natural tendency now to fall, it will for a moment rest at the greatest elevation, when a few degrees east of the moon.

Taking into account therefore the rotation of the earth, the supposed spectator at the moon will see the highest accumulation of water, that is, the sharpest end of the spheroid, a little to the east of the middle of the earth's disk represented by A, as at A″; and the other sharp end will be to

the east of the point on the earth's surface opposite to A. The circle at low water will also take a position a little to the east of its former one.

If the moon be in the equator, or have no declination, each point of the terrestrial equator in revolving from west to east will have the high tide in succession. If the moon be north of the equator or have north declination, the high tide under the moon will lie continually in a northern parallel of latitude, and the opposite high tide in a southern parallel of latitude.

(310.) In the above observations we have supposed the earth to be a fluid globe. But in fact the surface is covered with water very partially. The South Pacific Ocean extends round a great part of the sphere; but the Atlantic does not stretch from east to west a fourth part of the circumference of the earth; while the other seas are of comparatively small extent; as the Mediterranean, the Caspian Sea, &c. We will inquire, for a moment, what difference this will cause in the appearance of the tides as seen from the moon. In the great Pacific Ocean we may suppose that the elevation of the water will be agreeable to the theory. But in smaller seas they can never reach their proper height. Thus in the Atlantic, when a place on the eastern side, as Teneriffe, in moving from west to east, is under the moon, a point on the western side, as Bermuda, will have passed the circle of low water. Hence it appears that there is not sufficient space for the full operation of the moon's influence in affecting the sea. Consequently neither the elevation nor the depression of the water will be so great as in the Pacific. In still smaller seas, as the Mediterranean, the Caspian Sea, &c. for reasons similar to those given above, the tides must be almost insensible.

(311.) A spectator, situated as we have supposed, will moreover see a great deviation from the theory in the hours of high water at different points, and in the direction in which the high wave reaches him.

In the Pacific the wave will swell from east to west, but in many seas, creeks, rivers, &c. the accumulation of water will flow from south to north, from north to south, or in any other direction, where the water is below its level; and when the external open sea comes to the position for a depression of water, this stream will be reversed, and soon there will be low water at the mouth of the passage in question, and then higher and higher up. In the mean time a second tide wave might be formed on the outside, and thus a second wave would enter the strait. So that we might have three or four high tides, and three or four points of low water at the same instant in a river or narrow sea.

If such a sea grew narrower as the tide wave proceeded up it, the water would then rise higher and higher by its own momentum, greatly above the level to which it would be brought independently of this circumstance.

(312.) The appearance, therefore, which the surface of the earth exhibits will be as follows. In the open sea, as the Pacific, an immense wave will be formed at every point as it comes to a position a little east of the moon, and the opposite point to the moon. This high tide will appear to supply ramifications of the ocean, as narrow seas, bays, rivers, &c. with waves flowing up them in various directions and various heights, according to the form of these inlets. In many cases there will be seen several waves or tides in such seas at once, and several intermediate low waters.

So that we may compare the tide accumulation of waters in the great

open seas to the overflowing of a vast reservoir, which supplies numberless pipes and streamlets attached thereto with successive influxes; returning again individually, as the reservoir presents a lowered state of the fluid.

(313.) It may be of use now to consider for a moment by what rule we should find the time of high water at any place, supposing the moon to act in raising the water.

In the great open sea, high water would take place about 80 minutes after the transit of the moon over the meridian, and also at the same time after the transit of the opposite point in the heavens. All we should have to do therefore, in order to find the time of high water, would be to add 80 minutes to the time of the moon's meridian passage as put down in the Nautical Almanac for the given day (correcting it for the longitude of the place). If the sum came out in the half day (A. M. or P. M.), on which we want the time of high water, the result would be correct. If it came out beyond that half day, we should in that case take the preceding transit of the opposite point in the heavens.

(314.) We will now consider the effect of the sun's attraction in raising the tides, or rather the combined effect of the sun and moon.

The effect of the sun must singly be of a similar kind to that of the moon; although from its greater distance the disturbing force of the sun is much less than for the moon. When the two bodies are in conjunction, and have the same declination, the high tide raised by each must be at the same place on the sea, a little to the east of them. And another joint high tide must be a little to the east of the point opposite to them.

When the moon, by its superior proper motion from west to east, is got to the eastward of the sun, the lunar and solar tides will no longer coincide. The highest point of the wave, considering the combined efforts of both bodies, will lie between the points where each singly would produce the highest wave. Hence two variations from the conjunction or change tide will take place; the tide will be less high, and will come sooner to a given place than before. This will be the case in a greater and greater degree till the moon gets into quadrature, or during the first quarter.*

In the second quarter the tide raised by the moon will be influenced, as to height and time, by the inferior solar tide, that is, by the tide on the opposite point of the earth to that under the sun. To this the lunar wave will come nearer and nearer as the moon goes through the second quarter, so that the height will increase and the time will be later than if the sun did not act.

When the moon comes into opposition, or is at full, the two tides will again coincide, and cause a great tide.

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* The sun is at the distance of about 94 millions of miles from the earth, the moon describes an orbit round the earth at the distance of about 240 thousand miles; when the moon passes between the earth and sun it is said to be in *conjunction*, two or three days after which it is seen a little eastward of the sun like a crescent or letter C, with its back towards the sun. The enlightened disk afterwards increases, and when it has got a quarter of its orbit round the earth, reckoning from conjunction, it is said to be in *quadrature*: this is the the end of the first quarter or the beginning of the second, the appearance of the moon being that of a luminous semicircle. When the moon has got a second quarter round the earth, or is on the opposite side of the earth to the sun, it is said to be in *opposition*, and is that time a full orb. After a third quarter the moon is brought again within one quarter of conjunction, and is again in quadrature, being reduced in appearance to a luminous semicircle. In the fourth quarter the moon is brought into conjunction again.

From full moon, through the third and fourth quarters to change again, similar variations will take place on account of the solar action, as from change to full.

(315.) By attending to the above general observations on this subject, the seaman will have little difficulty, it is presumed, in accounting for the principal phenomena of the tides. It is particularly necessary, however, to notice the following apparent deviation from the result of theory. The changes of the tides are found to be about a day and half later than theory would give. Thus the highest tides each month do not take place on the day when the moon changes or is at full, but generally the third tides after change and full are the greatest. Thus also the greatest excess of a spring tide does not happen when the moon is exactly in its perigee (the nearest point of its orbit to the earth), but about three tides after; and so of the other effects produced by any particular position of the sun and moon. These apparent anomalies are owing to the inertia of the fluid to be raised, and its inertia or momentum when it is raised. Hence when the amount of the acting force or the mode of its application is altered, it requires some time before the corresponding effect is perceptible; and when an effect is produced, it continues to be perceptible, although the cause shall have ceased, or undergone some new modification.

The principal phenomena of the tides, which fall under our observation, are as follows:—

(316.) It is observed that we have high water when the moon is nearly on some particular point of the compass, and also about $12^h\ 25^m$ (or half a lunar day) after this time. Generally the third tides after new and full moon are the highest. These are called *Spring Tides*. Generally the third tides after the commencement of the second and fourth quarters of the moon are the lowest tides. These are called *Neap Tides*.

If the moon at change or full happens to be in perigee, or its semidiameter about $16'\ 30''$, the spring tides are higher than usual. If this happens when the sun is also in perigee, or in January, the tides are still higher. At Brest the excess above the average spring tides from these causes is nearly three feet. When the moon, at change or full, is in apogee, or its semidiameter is about $14'\ 30''$, the spring tides are lower than usual.

The higher the tide rises on any day, the lower it falls at low water. The total height is the difference between low water and high water.

(317.) When the latitude of the place is of the same kind (N. or S.) with the moon's declination, the superior tide, that is, the tide which takes place when the moon is above the horizon, is greater than the inferior tide or the tide when the moon is below the horizon. This appears from the consideration that the high wave near the moon (309) will be formed in north latitude, but the opposite high wave will be in south latitude. Consequently the place of the spectator, as it revolves with the earth, in passing the moon itself, will have the tide higher than it will have in passing the opposite point of the circle of diurnal motion.

(318.) If the latitude of the place be of a different name (N. or S.) from the moon's declination, in that case the reverse of the above is expe-

rienced; the inferior tide is greater than the superior. For the tide wave near the moon itself will be formed on a different side of the equator from that of the spectator; the tide wave near the opposite point will be formed on the same side. From the effects of local situation these circumstances do not always occur.

(319.) When the declination of the moon is equal to the polar distance of the place, the water will rise twelve hours and fall twelve hours. For in this case the low water circle will touch the opposite point of the parallel of latitude described by the place of the spectator as the earth revolves. After high water, therefore, the tide will ebb or fall till the spectator has reached the opposite point, or for about twelve hours.

(320.) The phenomena above described are supposed to take place in the open sea. In confined seas, rivers, &c. several of them will be considerably modified and even altered. For instance, at the Nore the inferior tide is higher than the superior tide, when the moon has north declination; which is owing to local situation, whence it happens that when an inferior tide is formed at the Orkney Islands in the open sea, a superior tide, ranging down the eastern coasts of Scotland, arrives at the Nore.

It has been found also by observation that the difference between the superior and inferior tide is much less than what theory indicates. This may be owing to the following circumstance:—The greater undulation in retiring from any part of the coast causes an accumulation of water in the smaller succeeding one, and thus makes the next tide greater on the shore than it would be independently of this.

(321.) One of the most remarkable anomalies in the tides is their greater elevation on different points of a shore to what they have attained in the open sea at a distance therefrom. This is supposed to be owing to the following circumstances:—First, a tide undulation or wave breaking on points of the shore is thrown as it were into heaps, and thus running up the different inlets which narrow gradually, is carried to a considerable height above the level a little outside. Secondly, it may sometimes happen that a tide vibrates between one part of the shore and another, and that the repeated influence of the sun and moon in raising the water may act altogether or partly in unison with these vibrations. Thus again the tides may be raised beyond the natural height.

In some places, instead of two tides in a lunar day, which theory would give, there is but one. This also is found to be owing to peculiarity of local situation. Whilst one tide is ebbing, another by a different channel is flowing; so that the height to which the water rises is the elevation of the greater tide above the depression of the less, and the lowest point to which it falls is the elevation of the smaller tide above the depression of the greater.

In fact there are few places where the phenomena of the tides are not more or less modified by the shape of the coast, or other peculiarities in the approaches to them. However, in one particular, theory and observation agree with great exactness, namely, in the successive intervals of high water; and we are thus enabled to compute the hour of high water very easily and correctly, provided we know it at change or full. For we have only to find the time of its theoretic accomplishment, and correct this by

the difference between the time of the observed change tide and the time given by the theory.

(322.) It is necessary here to remark, that the change tide, upon which we make the rest depend, is that tide which takes place (P. M.) on the day the moon changes; particularly on that day when the moon happens to change at noon. As the time of high water is considerably affected by the weather, it is usual to take the mean of a considerable number of observations for the average apparent time of change tide.

*Rule for finding the Mean Time of High Water* A. M. *and* P. M. *on any given Day, the Apparent Time of Change Tide* being given and Longitude of Ship.*

(323.) Mark one heading (1) towards the left hand side of the paper; a second heading a little farther to the right (2); and a third still farther (3). Under (1) put time of moon's Greenwich meridian passage on proposed day from Nautical Almanac: under (3) put time of Greenwich moon's meridian passage on preceding day; under (2) put a mean of the two passages already written down. Correct each of these by Nautical Tables (*k*), p. 5, entering with longitude of ship and difference of numbers under (1) and (3), and thus reduce the meridian passage to ship. Correct by Naut. Tables (*l*), p. 5 † the ship meridian passage under (1), and then add the given apparent time of change tide.

*If the result under* (1) *be less than* $12^h$, it is the mean time of High Water P. M. for the proposed day.

*If the result under* (1) *be greater than* $12^h$ *and less than* $24^h$, then work as described above with ship meridian passage under (2). Then if the result be greater than $12^h$, reject $12^h$, and you will have the mean time of High Water P. M. on the proposed day. But if the result of the second operation be less than $12^h$, it will be the mean time of High Water A. M. on the proposed day.

*If the result under* (1) *be greater than* $24^h$, work as described above with ship meridian passage under (3). Then, if the result be greater than $24^h$, reject $24^h$, and you will have the mean time of High Water P. M. on the proposed day. But if the result be less than $24^h$, and greater than $12^h$. reject $12^h$, and you will have the mean time of High Water A. M. on the proposed day.

When the mean time of High Water has been found as above P. M., subtract therefrom the difference between meridian passages under (1) and (2); the remainder will be the mean time of High Water A. M. on the proposed day.

When the mean time of High Water has been found A. M., add thereto the difference between meridian passages under (1) and (2); and

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* The *change tide* is here supposed to be the first tide P. M. on the day the moon changes or is at full (322). If the tide be given A. M. on that day as the *change tide*, it should be reduced to P. M. by adding 18 minutes, which may be considered as an average difference on that day.

† This Table is to be entered at side with ship mer. passage, corrected by Equation of Time to nearest minute applying it as to *mean time*, and at top with moon's semidiameter taken roughly from Naut. Almanac.

the sum will be the mean time of High Water P. M. on the proposed day.

It may be necessary to add $12^h$, before this difference is subtracted, in which case the remainder will be the mean time of High Water P. M. on the preceding day: there will be no High Water A. M. on the proposed day. And if in adding the difference the sum be greater than $12^h$, this sum (rejecting $12^h$) will be the mean time of High Water A. M. on the following day: there will be no High Water P. M. on the proposed day.

*Ex.* 1. Required the mean time of high water on Aug. 29, 1835, A.M. and P. M., the change tide being at $4^h\ 10^m$ app. time, and longitude 100° W. Moon's semid. 16′ 11″ and Eq. of time $1^m$ subtractive from mean time.

| | (1.) | (2.) | (3.) |
|---|---|---|---|
| Gr. Moon's Mer. Pass. | $4^h\ 34^m$ | $4^h\ 8^m$ | $3^h\ 43^m$ |
| Table (*k*) . . . | 14+ | 14+ | 14+ |
| Sh. Mer. Pass. . . | 4 48 | 4 22 | 3 57 |
| Tide Table (*l*) . . | 1 15— | | |
| | 3 33 | | |
| Change Tide . . . | 4 10 | | |
| H. W. . . . . | 7 43 P. M. | | |
| | 26— | | |
| H. W. . . . | 7 17 A. M. | | |

*Ex.* 2. Required the mean time of high water on Aug. 6, 1835, A. M. and P.M., the change tide being at $2^h\ 58^m$, app. time, and longitude 20° E. Moon's semid. 15′ 48″; Eq. time $6^m$ subtractive from mean time.

| | (1.) | (2.) | (3.) |
|---|---|---|---|
| Gr. Moon's Mer. Pass. | $10^h\ 36^m$ | $10^h\ 5^m$ | $9^h\ 35^m$ |
| Table (*k*) . . . | 3— | 3— | 3— |
| Sh. Mer. Pass. . | 10 33 | 10 2 | 9 32 |
| Tide Table (*l*) . . | 21+ | 25+ | |
| | 10 54 | 10 27 | |
| Change Tide . | 2 58 | 2 58 | |
| Gr. than $12^h$ | 13 52 | H. W. 1 25 P. M. | |
| | | 31— | |
| | | H. W. 0 54 A. M. | |

*Ex.* 3. Required the mean time of high water on Aug. 20, 1835, A. M. and P. M., the change tide being at $6^h\ 20^m$ app. time, and longitude 56° W. Moon's semid. 15′ 7″. Eq. time $3^m$ subtractive from mean time.

| | (1.) | (2.) | (3.) |
|---|---|---|---|
| Gr. Moon's Mer. Pass. | 21h 48m | 21h 21m | 20h 55m |
| Table (*k*) . . . | 8+ | 8+ | 8+ |
| Sh. Mer. Pass . . | 21 56 | 21 29 | 21 3 |
| Tide Table (*l*) . . | 20+ | | 19+ |
| | 22 16 | | 21 22 |
| Change Tide . . | 6 20+ | | 6 20+ |
| Gr. than 24h . . | 28 36 | | H. W. 3 42 P. M. |
| | | | 27− |
| | | | H. W. 3 15 |

*Ex.* 4. Required the mean time of high water on May 10, 1835, A. M. and P. M., the change tide being at 1h 40m app. time, and longitude 110° E. Moon's semid. 16′ 35″. Eq. time 4m additive to mean time.

| | (1.) | (2.) | (3.) |
|---|---|---|---|
| Gr. Moon's Mer. Pass. | 10h 27m | 10h 1m | 9h 35m |
| Table (*k*) . . . | 16 | 16− | 16− |
| Sh. Mer. Pass. . | 10 11 | 9 45 | 9 19 |
| Tide Table (*l*) . | 31+ | 34+ | |
| | 10 42 | 10 19 | |
| Change Tide . . | 1 40+ | 1 40 | |
| Gr. than 12h . . | 12 20 | H. W. 11 59 A. M. | |
| | | 26+ | |
| | | 12 25 | No Tide May 10, P. M. |
| | H. W. May 11, | 0 25 A.M. | |

*Ex.* 5. Required the mean time of high water on April 23, 1835, A. M. and P. M., the change tide being 2h 0m app. time, and longitude 90° W. Moon's semid. 15′ 0″. Eq. time 2m additive to mean time.

| | (1.) | (2.) | (3.) |
|---|---|---|---|
| Gr. Mer. Pass | 21h 44 | 21h 23m | 21h 1 |
| Table (*k*) | 11+ | 11+ | 11+ |
| Sh. Mer. Pass. | 21 55 | 21 34 | 21 12 |
| | 19+ | | 18+ |
| | 22 14 | | 21 30 |
| Change Tide | 2 0 | | 2 0+ |
| Gr. than 24h | 24 14 | | 23 30 |
| | | | H. W. 11 30 A. M. |
| | | | 21+ |
| | | | H. W. 11 51 P. M. |

## *Winds.*

(324.) Air is an elastic fluid, which surrounds the earth, and reaches to the height of about 80 miles above it. The equilibrium of this fluid is frequently disturbed by partial rarefactions and condensations; in consequence whereof it moves, in a current, from the denser to the rarer parts. These currents are called winds.

The earth, together with the atmosphere or air which rests on it, revolves once in twenty-four hours from west to east. In consequence of this rotation, the parts of the atmosphere towards the equator move faster than those to the north or south. Suppose a portion of air to be suddenly transferred from a high northern or southern latitude to the equator. Then this transferred portion, having a less velocity eastward than the spot on which it is placed, must have a relative westerly motion; that is, a spectator must feel it apparently blowing from the east.

Now such a transfer is in fact constantly taking place; for the equatorial parts of the earth being the hottest, the particles of air are there expanded and rise upwards, and the cooler air to the north and south flows in. The air to a certain distance on the north of the equator thus in reality moves southward, while at the same time the effect of the earth's rotation is to give it an apparently westerly direction. Upon the whole therefore a N. E. * wind is produced.

For similar reasons to a certain distance south of the equator a S. E. wind is constantly blowing.

These N. E. and S. E. winds are called Trade Winds. They extend to about 30° of latitude on each side of the equator, more or less according to the season of the year, as well as to local circumstances.

As the currents of wind in blowing from the N. E. and S. E. approach the equator, they become more easterly. At the equator, or rather from about 2° to 5° north latitude †, they blow due east. For here the northerly and southerly currents destroy each other, and nothing remains but the apparent westerly motion arising from the earth's rotation. Frequently squalls and rains are found to prevail in this zone or track of the sea.

(325.) To the east of Africa, in our summer months, or from April to October, the air over the continent of Asia is very greatly heated and rarefied; in consequence whereof the S. E. trade winds pass the equator, and move considerably to the north. But having acquired, in passing the equatorial parts, the greatest rotatory motion of the earth, when they have got further northward, they have a greater easterly motion than the points arrived at. Over the Arabian Sea and Bay of Bengal these winds therefore at this season of the year blow from S. W.; at the equator nearly south.

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* Two other reasons are assigned for this westerly motion of the current: the diurnal motion of the sun, and therefore of the hottest point of the earth, westward; and the effect of the sun and moon in raising a tide in the atmosphere (see Articles on the Tides), by which the accumulation of air is made to move from east to west, and thus causes a current in that direction.

† The sun being perpendicular to the equator twice in the year, and never farther from it than 23½°, the average heat here is the greatest. Taking also into account the superior length of the summer in the northern hemisphere (about 16 days), arising from the elliptic form of the earth's orbit, the circle of greatest heat is carried a little north of the equator, namely, to the zone between 2° and 5° north latitude; variable a little with the place of the sun.

Between Madagascar and Africa they blow directly through the channel, or about S. S. W.

In our winter months, that is, from October to April, the sun having south declination, the continent of Asia becomes cold, and the winds on the north side of the equator blow from the N. E.; they extend even over the equator, as far as about 3° S. To the south of the line the S. E. trade winds stop at about 10° south latitude. From 10° to about 3° the winds blow from the N. W.

At this season between Madagascar and Africa the winds blow N. N. E. directly through the channel, in the opposite direction to the winds there in our summer months.

(326.) The winds which in the Arabian Sea and Bay of Bengal blow six months in one direction and six months in the other, are called *monsoons*, from a Malay word signifying season.

(326.) To the eastward of Sumatra and Malacca, along the coasts of Cambodia and China, similar monsoons prevail and change at the same time, namely about the equinoxes. These however are more northerly and southerly than the ones just described. They extend as far as the Philippine Islands and Japan, and immediately to the south of the line as far as New Guinea. For about a month near the changing of the monsoons very great storms of wind are usually experienced.

Over the Pacific Ocean, out at sea, the regular trade winds blow within the limits above mentioned.

(327.) From about 30° of north or south latitude to 40°, chiefly westerly winds prevail, though not with the same regularity as the trade winds nearer the equator. They may be accounted for in some measure thus. When the air is rarefied near the line, it ascends, and forms a counter current to the air below. In the northern hemisphere it flows to the north; but having acquired at the equator the greatest easterly motion of the earth's surface, in passing to the north, it comes to parts that have a less rapid motion. It consequently takes a relative easterly direction. The northerly motion of this current is checked and destroyed in the track between 30° and 40°. Still however its easterly motion remains and is communicated to the substrata of air with which it here mixes; thus causing the westerly wind observed.

In like manner, within the limits in the southern hemisphere, the westerly winds prevail.

(328.) In maritime countries, where the heat of the sun is considerable, during the day the wind blows from the sea towards the land, and in the night in an opposite direction, or from the land towards the sea. The reason, after what has been said, will be easily seen. In the daytime the land, being a denser body than the sea, acquires heat faster, and communicates it to the superincumbent atmosphere, which is thus rarefied. The current of air is therefore from the sea. But in the night, the land, for a similar reason, loses heat faster than the sea, and thus becomes more cool and more dense. The current is therefore from the land to the sea. These winds are called land and sea breezes.

Having endeavoured in the above articles to give the seaman some general notion of the principal facts relating to the trade winds and monsoons, and the causes which produce them, it may be proper now to state

other subordinate observations that have been made on this subject, together with several modifications of the principal winds, described above, and exceptions to them, which arise from local circumstances.

(329.) The regular trade winds prevail only in the open seas. Towards the land they undergo different variations. In the Atlantic they extend farther north or south by 3° or 4° on the American side than on the African; extending on the American side to about 32°, and on the African to about 28°.

Towards the Caribbee Islands the trade wind blows more easterly, so as to be sometimes E. and E. by S.; but generally a point or two north or east.

Near the coast of Africa the winds deviate very greatly from the regular direction of the trade winds. From Cape Boyador to Cape Verde the winds are generally N. W.; from Cape Verde to the Island of St. Thomas they blow right on the shore, bending gradually to the W. and then to the S. W., as we approach the Cape of Good Hope.

On the coast of New Spain from California to the Bay of Panama, the winds blow almost constantly from the west and S. W., except during the months of May, June, and July, when the land winds prevail.

On the coast of Chili and Peru, from 20° to 30° south latitude to the equator, the wind blows constantly from the south, varying according to the direction of the land towards which it inclines.

The trade winds are interrupted sometimes by westerly winds in the Bay of Campeachy and the Bay of Honduras.

In most *tropical* countries, it appears that the wind generally blows from the nearest ocean, except during the coldest month, when it blows towards the nearest ocean.

In the *temperate* zones, the winds are by no means so regular as between the tropics: they may hence be considered as variable, though upon the whole it is found that the westerly winds are the prevalent ones (330).

Over the whole eastern coast of North America in the temperate zones the winds are most frequently from the west. In South America within the same limits, S. W. winds predominate, and the N. W. winds become gradually more frequent in approaching the frigid zone.

In the Mediterranean the wind blows nearly three-fourths of the year from the N.; about the equinoxes there is always an easterly wind. In the Gut of Gibraltar there are seldom any winds but E. and W. At Bastia, in the Island of Corsica, the prevailing wind is the S. W.

The following is an average account for 10 years of the direction in which the wind blows at London:—

| Winds. | Days. | Winds. | Days. |
|---|---|---|---|
| S.W. | 112 | S. E. | 31 |
| N. E. | 58 | E. | 26 |
| N. W. | 50 | S. | 18 |
| W. | 53 | N. | 16 |

(330.) The following table shows the number of days during which westerly or easterly winds have been found on an average to prevail in different parts of England. By westerly winds are meant N. W., W., S. W., S.; the term easterly is taken with the same latitude.

| Years of Observation | Places. | Winds. | |
|---|---|---|---|
| | | Westerly. | Easterly. |
| 10 | London . . . . . | 233 | 132 |
| 7 | Lancaster . . . . . | 216 | 149 |
| 51 | Liverpool . . . . . | 190 | 175 |
| 9 | Dumfries . . . . . | 227.5 | 137.5 |
| 10 | Branxholm . . . . . | 232 | 133 |
| 7 | Cambuslang . . . . . | 214 | 151 |
| 8 | Hawkshill, near Edinburgh . . | 229.5 | 135 5 |
| | Medium . . | 220.3 | 144.7 |

In Ireland the S. W. and W. are the prevailing winds, blowing most in summer, autumn, and winter. The N. E. blows most in the spring, and nearly double to what it does in autumn and winter.

Upon the whole it appears that the prevailing winds on the south coasts of Europe are the N., N. E., and N. W.; and on the western coasts the S. W. Westerly winds are most frequent on the N. E. coast of Asia.

In the south temperate zone, which is in a great measure covered with water, the winds may be supposed to be more uniform than in the north temperate zone, where their direction will frequently be affected by mountains and other causes.

At the Cape of Good Hope the principal winds are the S. E. and N. W.; other winds seldom blow more than a few hours; and the E. and N. E. winds very seldom. The S. E. wind blows chiefly from October to April; the N. W. prevails from April to October, being accompanied with rain and storms. Between the Cape of Good Hope and New Holland the winds are commonly westerly, and blow in the following order · N. W., S. W., W., N.

In the Great South Sea from latitude 30° to 40°, the S. E. trade wind is prevalent, especially in our winter months. The wind next to it in frequency is the N. W., and next to that the S. W.

Beyond the influence of the trade winds, which extend farther into the south temperate zone than their usual limits, particularly in the southern summer, the winds are usually westerly, and they blow in the following order: N. W., S. W., W.

(331.) The sea and land breezes which prevail on the coast of all tropical countries, and where the sun has great power, have been already mentioned and explained. It may be proper to add here, that such places are also liable to sudden and violent squalls from the land, especially where the country is mountainous. For, when rarefied air is raised over the sea by the heat of the sun, in floating along the upper regions of the atmosphere, it frequently falls in with the tops of the hills, and is suddenly cooled and condensed: in consequence whereof it is precipitated towards

the coast, and forms a strong wind in that direction. The seaman well knows how necessary it is, in such situations, to be constantly on his guard against the effects of these sudden land squalls

(332.) Very often before a gale of wind, or bad weather at sea, the mercury in the barometer will fall very rapidly. This instrument therefore furnishes the seaman with a very simple and important method of often foreseeing and preparing for such changes. The quicksilver is raised up the tube, from which the air is exhausted, by the pressure of the external air on the quicksilver in the basin or bulb; and whenever this pressure undergoes any change by the accumulation or reduction of the external air, by its horizontal motion in high winds, by electric or other chemical changes, the quicksilver will rise or fall. It is difficult in many instances to account for the variations to which it is liable: the seaman must trust principally to the results of his own repeated observations, if he wish to derive all the advantages from the barometer which it is possible to do. The following phenomena have been deduced from a number of observations.

1. The rising of the mercury presages, in general, fine weather; and its falling, foul weather, as rain, snow, high winds and storms.

2. In very hot weather, the falling of the mercury foreshows thunder.

3. In winter, the rising presages frost; and in frosty weather, if the mercury falls three or four divisions, there will certainly follow a thaw. But in a continued frost, if the mercury rises, it will certainly snow.

4. When foul weather happens soon after the falling of the mercury expect but little of it; and on the contrary, expect but little fair weather when it proves fair shortly after the mercury has risen.

5. In foul weather when the mercury rises much and high, and thus continues for two or three days before the foul weather is quite over, then expect a continuance of fair weather to follow.

6. In fair weather, when the mercury falls much and low, and thus continues for two or three days before the rain comes, then expect a great deal of wet, and probably high winds.

7. The unsettled state of the mercury denotes uncertain and changeable weather.

(333.) A particular kind of barometer, called a Marine Barometer, is constructed for use at sea. The lower part of the tube is made very small, and for about five inches at the head of the quicksilver the tube is enlarged; the instrument is suspended by a spring and jimbols. By these contrivances the tube is kept nearly vertical, and its oscillations rendered less sudden. And, from the smallness of the bore of the tube downwards, sufficient mercury cannot be propelled through it, in one of these oscillations, to disturb much the head of the mercury.

Experiments have been made, though not of a decisive kind, to determine the velocity of the wind. In a great storm it is supposed to move from 60 to 70 miles in an hour; in a fresh gale about 21 miles an hour; in a small breeze, about 10 miles*.

* On the subject of winds, see article *Meteorology* in Encyclopedia Britannica, from which most of the above facts respecting them are taken.

### *On Hadley's Sextant.*

(334.) By *light* is meant that medium, which connects any object with the eye, so as to produce the sensation of vision. It is supposed to consist of very minute particles of matter, which are incessantly thrown off from each point of a luminous body, in the direction of radii diverging from that point as a centre. The velocity with which these particles move has been found from astronomical observations to be about 195,000 miles in a second.

By a *ray* of light is meant a single line of such particles; or, considering light as a fluid extremely thin and rare, a ray may be defined to be the least quantity of that light which can be stopped or propagated alone.

By a *pencil* of rays is meant a number of rays taken collectively and distinctly from the rest.

When a pencil of rays fall on the eye, one of them, which is called the *axis* of the pencil, is supposed to pass through the eye in a straight line. The other rays of the pencil are refracted by the different parts of the eye, so as to meet the axis on the *retina* or innermost coat. The impression there made by the impact of the whole together is communicated by the optic nerve to the brain, and the sensation is caused which is called vision.

Hence it appears that, with respect to the direction in which an object is seen, we may suppose vision to be produced by the axis of the pencils alone, that is, by single lines proceeding from the several points of an object. Such lines will be hereafter called *visual rays* or *lines of vision*.

Light is propagated in straight lines, as long as it continues in the same medium, as in air of uniform density, water, glass, &c. This we conclude from our not being able to see objects through tubes, unless they are straight; and from observing the shadows of opaque bodies, that is, of bodies not penetrable by light, to be formed agreeably to such a supposition. But whenever light falls obliquely on the surface of a medium different from that in which it has before moved, it is then bent from a straight course, either by *refraction* or *reflection*.

A ray of light is said to be *refracted* when it afterwards enters the other medium, but in a bent course: it is said to be *reflected* when it turns back into the medium from which it came.

The plane passing through an incident and refracted ray, or through an incident and reflected ray, is always perpendicular to the surface upon which the ray has fallen: also the angles which the incident and reflected rays make with the surface are equal. This is the result of experiment.

An object is not always seen in the direction in which a visual ray flows from it, but in the direction in which a visual ray enters the eye and make an impression on the retina. And hence it often happens, when the course of rays is changed in their transit, that objects appear in places where in reality they do not exist. Thus rays from the sun, moon, &c. falling obliquely on the surface of a river are reflected to the eye, and the images of those shining bodies are seen beneath the water.

(335.) To apply the above general observations to the construction and use of Hadley's sextant, let an object at A (fig. Art. 208) be viewed by an eye placed at E, through a straight line XY, which both transmits and reflects light, and let AC, a visual ray, proceeding from A, in the plane of

the paper, fall on another reflecting straight line PQ, which makes equal angles with CA and CD, and therefore reflects it along the line CD, making the same angle with XY that DE does.

Then, by the laws of reflection (334), XY will again reflect the ray CD in the direction DE; consequently the impression on the eye by this reflected ray will coincide with that from the direct ray ADE. The object at A therefore seen directly and by reflection will appear single.

The reflection, as well as the direct vision, is supposed to take place in the plane of the paper.

Let now a second visual ray, proceeding from another object B in the same plane, fall on the reflecting straight line at C, making with it an angle BCP. Then, if PQ be turned in the plane of the paper through an angle PCI equal to half ACB, the angle BCI, which the incident ray makes with the reflector, will still be equal to the angle which DC makes with it; for the less of two unequal angles BCP and DCQ is thus increased by half their difference, and the greater diminished thereby. Consequently BC will be reflected by IN along CD, and, after a second reflection at D, the ray from B will enter the eye at E in the same line with the ray AE from E; or in that position of the reflectors the two objects at A and B will be seen in the same direction.

Let IN and PQ be supposed to be produced to cut a graduated arc, described from the centre C and with any radius CF, in G and F; then the degrees, minutes, &c. in FG will measure the angle FCG, or half the angle ACB, between the objects A and B.

The reflections have been supposed to be produced by straight lines XY and PQ placed in the plane of the arc FG; the same conclusions would manifestly hold good, if these lines and the course of the rays were elevated above or depressed below that plane, provided they were in a plane parallel thereto, and the point of the intersection of PQ and IN were immediately over or under the centre of FG. In other words, our conclusions would be true, if XY and PQ were reflecting surfaces, as of glass, placed perpendicular to the plane of FG; supposing PQ to be turned round an axis perpendicular to the plane of FG, and passing through the centre of FG; and the view to be directed along a line ED parallel to the same plane.*

(336.) Hence we easily see, in a general point of view, the construction and use of Hadley's sextant. A small square piece of finely polished glass quicksilvered at the back is placed at C perpendicular to the plane of the instrument. It is attached to a moveable radius, by which it is turned round an axis perpendicular to the plane of the instrument, and passing through the centre of an arc FG. Another similar piece of glass is placed at D, with its surface also perpendicular to that of the instrument. The lower half of this is quicksilvered at the back; the upper half is left transparent. At E there is a small plate of brass, in which is a small hole where the observer places his eye. To take the angle between two objects, he looks directly at the left hand object through the middle of the fixed glass, just at the upper edge of the quicksilver. He then moves the radius attached to the moveable glass, and thus turns round the reflector at C, till

* When the two reflecting planes are perpendicular to the plane of the arc, the course of every axis of a pencil of rays, by which an image is formed in the eye, must evidently be in a plane parallel to the arc, as is supposed here.

ne sees the right hand object in the same direction with the other. He afterwards brings the moveable radius back, and places it so as to see the left hand object by reflection, and directly in the same line, that is, till it appears single. The arc between the two stations of the index on the moveable radius, thus determined, is half the angle which the objects subtend at the middle of the moveable reflector. Let FG (fig. p. 90) be that arc; then if the divisions commence at O, and F lie to the right of O, there will be two readings off, namely, OG on the arc and OF off the arc. In that case the sum will be the degrees, minutes, &c. in half the required angle, if the arc were divided into its proper number of degrees, minutes, &c.; but the arc on Hadley's sextant being divided into twice the number of degrees it should properly contain, the sum read off will be the whole arc required at once. If F coincide with O, there will be but one reading off; if F be to the left of O, or on the same side of O as G, the difference of the arcs read off will be the angle required.

### *Reading off on Hadley's Sextant.*

(337.) The arc of Hadley's sextant is divided into degrees by lines cut therein, which lines tend to the centre of the instrument. A degree is subdivided in some cases into two equal parts, each of which is 30′; in others into three equal parts, each of which is 20′; in others again, into four equal parts, each of which is 15′; and, lastly, into six equal parts, each of which must be 10′. The index, up to which an arc is read off, is a line cut in a plate at the end of the moveable radius, tending also to the centre of the quadrant. Supposing this index to stand exactly at any of the lines on the arc, that is, so that the two lines are in the same direction; in such a case the reading off is easily known: for it must be a certain number of divisions and subdivisions of which the value is seen at once. Thus, if a degree on the arc be subdivided into three equal parts of 20′, and the index stand at the second line from the one marked 30°, then the reading off is 30° 40′.

But suppose the index not to stand exactly at any line whatever on the arc, but somewhere between two, as, in the just-mentioned example of division, between the second and third; then the reading off will be 30° 40′, together with the small space which the index is in advance of 40′. The value of this small space is known by means of a few divisions on the index plate to the left of the index. These divisions are made less than the arc divisions, so that the line on the plate immediately to the left of the index is somewhat nearer to the corresponding one on the arc than the small space to be determined. It is nearer thereto, as is manifest by the difference of a division on the arc and one on the index plate. In like manner the second line, reckoning from the index, must be nearer to the corresponding arc line by two differences, the third by three, and so on. At length therefore there must be a coincidence of two lines, or nearly so, that is, they must appear to an eye placed directly over them to lie in the same direction, or nearly so. And since, upon the whole, the lines on the index plate have approached those on the arc through the small part the index is in advance of 40′, this excess must be equal to as many times the difference of two divisions, as there are lines, reckoning from the index, before this coincidence takes place. Hence, if we know the value of a difference, we easily know the value of the excess in question.

This difference is known as follows:—By examining the index plate we always find some of the lines distinguished by numbers; these denote

minutes. Thus the numbers 5, 10, denote 5′ and 10′; that is, they show that the difference between the divisions up to these marks is 5′ or 10′. Suppose it appears that the interval between 5 and 10 is subdivided into 5 parts, then it is evident that the single difference in question must be 1′; if into 10 parts it must be 30″. Again, suppose the numbers on the index plate are 1, 2, 3, &c. which denote 1′, 2′, 3′, &c.; and the interval between them is divided into 6 parts; then the difference of a division on the arc and one on the index plate must be 10″. This last is the most usual kind of division.

(338.) To read off then on Hadley's sextant, we first examine the divisions and subdivisions on the arc, up to the line which stands before the index. We then move a microscope on the index plate, and examine the numbered lines. If any one of these coincide in direction with the opposite line on the arc, the reading off to be added will be so many minutes. If not, we observe between which numbered lines the coincidence actually takes place; and then reckon the preceding minutes as numbered, and afterwards the subdivisions of index plate, as so many minutes or seconds. For example, the arc of the sextant is divided into degrees, and each degree into 6 parts of 10′; and the index stands between the second and third subdivisions from 30°. In reading off, first 30° 20′ is noted on the arc; and then running the microscope farther on the arc, it is observed, that a line on the index plate and an arc line are in the same direction between 4 and 5. The farther reading off is therefore 4′ and some seconds. On examining the interval between 4 and 5, it appears to be divided into 6 parts, and the third line is in the same direction with the opposite one on the arc. The remaining reading off is therefore 30″. Hence the whole reading off is 30° 24′ 30″. Again the arc of another sextant is divided into degrees, and each degree into 3 parts of 20′, and the index stands between the second and third subdivisions from 60°. The reading off is therefore 60° 40′, and something more. On examining the index plate it is observed that the coincidence takes place between the numbers 10 and 15; the farther reading off is therefore 10′, and something more. On examining the intermediate divisions it is found that there are five longer lines, which must be minutes, and five shorter lines which must be 30″, and that the coincidence lies at the short line next to the third longer from 10′. The remaining reading off is therefore 3′ 30″; and upon the whole the arc is 60° 53′ 30″.

(339.) The division of the arc and of the index plate has been supposed above to be from right to left. But a similar method of reading off is pursued when the division is from left to right. The line on the arc is noted, which lies immediately before, that is, in this case, to the left of the index, and the additional small space is known by moving the eye along the line on the index plate from left to right.

(340.) Sometimes it is required to read off an arc divided from left to right by means of an index plate divided from right to left. In this case it is only necessary, in reading off the minutes and seconds on the index plate, to consider the terminating line on the plate as the index, and reckon the divisions back. Thus, if there be twenty divisions on the plate, and the numbers are 5, 10, 15, 20, the line marked 20 is considered as the index, 15 is considered as 5, and 5 as 15. The reading off is in other respects the same as before.

(341.) Sometimes the index plate is divided both to the right and left of the index, in which case, in reading off, we proceed as usual to the termination of the lines on the plate, going the same way as the divisions on the arc. If there be not a coincidence up to the end, we then pass to the other extreme line, which is similarly situated with respect to its opposite line on the arc as the one on the left, and then examine from thence the line back to the middle or index. In other respects we proceed as before.

### *Adjustments of Hadley's Sextant.*

(342.) Before we describe the adjustments of Hadley's sextant, it may be proper to give a more particular account of the manner in which it is used in taking the angle between any two objects A and B, of which A is supposed to be the left of B.

The observer takes the handle of the sextant, which is underneath the instrument, in the hollow of his right hand, and closes his hand gently upon it, so as to hold it securely and yet not too firmly. Having estimated the angle between the objects A and B by the eye, he moves the index with his left hand nearly to that angle on the arc; bringing the instrument, with the graduated arc or face upwards, to his eye, and holding it, as nearly as he can guess, so as to lie in the plane* of A and B, he directs his view from the place for the eye through the middle of the fixed reflector, just above the quicksilver, to the left hand object A. If the angle to which the index is put be nearly right, and the face of the instrument is held so as to be in the plane of A and B, he will then see not only A directly, but also the image of B near to A. But it is not probable that he will hold the instrument in the proper position at first: as soon therefore as he sees A, he turns the quadrant slowly round the hand, by which he holds it, to the right and left, by which he is sure of bringing it into the proper position. If, therefore, in so turning it, he sees the image of B near A, he alters the index a little, if necessary, with his left hand, till this image more nearly coincides with A, and then turns the screw under the index plate and arc; thus fixing the index at its present place. He then takes the screw at the end of the index plate, called the tangent screw,† between the forefinger and thumb of the left hand, the thumb being at the top; at the same time supporting the sextant with the other fingers of his left hand under the arc. Turning this screw gradually, the index is moved also gradually, and thus the image of B is brought exactly to coincide with A.

If, on turning the instrument round, as described above, he does not see the image of B near A, the observer in that case tries a little on each side of A till he finds the image, which he then moves up to B by pushing forward or back the index. He then clamps the screw under the arc, and makes a coincidence with the tangent screw as above.

*Or thus.* Holding the index plate with the left hand, direct the view through the fixed reflector to the *right hand* object B, keeping the plane of the sextant so as nearly, when extended, to pass through B and A. Then push forward the index gently, by which the image of B will appear to separate from B itself, and to move to the left. Thus carry the image up

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* This plane may be nearly estimated by passing the open hand between the two objects.

† This first step should be taken without the telescope in a rough way. When the tangent screw is to be used the telescope should be screwed in. (See following Articles.)

to A, or nearly so; and then clamp the index plate. Having done this, make an exact coincidence of the image of B with A by means of the tangent screw.

The arc at which the index stands must now be read off, first the divisions and subdivisions of the arc, then the divisions and subdivisions of the index plate (see Art. 338). Having read off this arc, the observer unclamps the screw under the arc, and brings, with his left hand, the index nearly to the commencement of the divisions; moving it gently backwards and forwards there, till he sees the image of A near A itself; he then brings this image as near to A as possible by the hand. The screw being again clamped, he proceeds to bring them exactly together, that is, to make A single by the tangent screw. The arc at which the index now stands being read off, it is added to the arc already noted, or subtracted therefrom, according as the index stands, in the latter operation, to the right or left of the commencement of the divisions. The result will be the angle which A and B subtend at the eye.

(343.) Sometimes it is necessary, in observing the angle between two objects A and B, to look directly at the one to the right, and make the image of the left hand object coincide therewith. In this case the face of the sextant is held downwards, the right hand of the observer and the handle being above, so that the instrument is suspended from the hand. The view is then directed from the eye-hole through the fixed reflector to the left hand object A. The image of A is then brought up to B, and made to coincide with it as in the former case, and the arc read off. When this is done, the index is brought back nearly to the commencement of the divisions on the arc, and the right hand object B is made to coincide with itself, in the same manner as before. The sum or difference of the readings off, according as in the latter operation the index stands off or on the arc, will be the angle required.

(344.) If, as is frequently the case, a telescope be used in observing the angle between two objects A and B, in that case we proceed as follows. The image of the right hand object B is brought up very nearly to A without the use of the telescope, as explained above. The telescope is then adjusted to distinct vision, by looking through it at a distant object, and is afterwards gently screwed into the socket at E, or the place of the eye. If necessary, it is raised by a screw or depressed, so as to point to the edge of the quicksilver on the fixed reflector. When this is done, the observer looks through the telescope, and turns round the eye tube, that is, the tube which carries the eye glass and is pushed in or pulled out to get distinct vision, till two wires in the field of view appear parallel to the plane of the sextant. Lastly, he views the left hand object through the telescope, and alters the eye tube, if necessary, till it is seen quite distinctly. The instrument is thus prepared for taking the angle.

After resting a short time, the observer brings the telescope to his eye, holding the sextant so that its plane may pass nearly through A and B. He looks through the telescope at the left hand object A, and vibrates the instrument till he sees B near A. He then makes an exact coincidence by means of the tangent screw at the middle of the field of view.

(345.) Having read off the arc, the observer unclamps the screw under the arc, and bringing the index nearly to the commencement of the

divisions, makes the left hand object nearly coincide with itself. He again clamps the screw, and makes an exact coincidence by the tangent screw at the middle point between the wires. The arc at which the index stands being then read off, it is applied to the former reading off by addition or subtraction, according as it is off or on the arc. The result is the angle required.

(346.) Generally, the telescope, used with a sextant, inverts objects seen through it; that is, in looking through it, objects on the right appear to the left, and those on the left appear to the right: also objects really above others appear below, and conversely. Such a telescope is used, in order to get a considerable magnifying power with less loss of light than would take place in a telescope of equal magnifying power which does not invert. The observer will experience some little difficulty at first from this apparent misplacing of objects, but after a very little practice it will not occasion any trouble or error.

We shall now explain the adjustments of the sextant, which it is very necessary the observer should thoroughly understand. We shall afterwards describe particularly the different kinds of astronomical observations made with this instrument, as taking the altitude of a heavenly body at sea, the distance of the moon from the sun or star, &c.; giving at the same time such directions as may appear useful.

### *First Adjustment.*

347.) The moveable reflector placed at the centre of the sextant has been above supposed to be perpendicular to the plane of the arc. It is necessary therefore from time to time to see that this is the case. For this purpose take the handle of the instrument in the left hand, with the face of the quadrant up. Bring the movable reflector near to the eye, and look into it obliquely (as in the line BC, fig. p. 90), so as to see the image of the arc. If this image be in the same plane with the arc itself, so as to form apparently a single unbroken arc, in that case the moveable reflector is right placed.

But if this image be thus seen above or below the arc itself, in that case the fixed reflector is not perpendicular to the plane of the arc, and its position must be gradually and carefully altered by means of the screws at the back of it, till the adjustment is by this criterion shown to be complete.

It must be observed, however, that this adjustment is very seldom found to be erroneous, as instrument makers fix the reflector in question very securely in its proper position at first.

### *Second Adjustment.*

(348.)* The fixed reflector should also be perpendicular to the plane of the arc. Whether it is or not may be ascertained as follows:—look

* The telescope is supposed to be adjusted to distinct vision, to be properly screwed into the collar, and the wires by turning round the eye-tube to be set parallel to the plane of the sextant. The two suns viewed are supposed to be seen distinctly at the middle point of the field of view, and to be brought to a convenient and equal brightness, by placing a dark glass on the eye end of the telescope, by other dark glasses before the reflectors, and in a smaller degree by screwing the telescope nearer to or farther from the plane of the sextant.

this coincidence may be made with the tangent screw, which moves gradually the index, in which case the reading off is called the index correction.

On the whole it is found most advantageous to determine the index correction, for the following reason. Turning the adjusting screw too often, and thus altering the position of the fixed reflector, renders this part of the instrument very liable to get out of order, and the adjustment very precarious. Hence, in the use of the best instruments of this kind, observers always prefer finding the index correction; which is done, generally speaking, by making the image of the direct object coincide with the object itself, and reading off the arc, which will be the index correction; additive, if the reading off be *off* the arc, and subtractive, if it be *on* the arc.

For all objects at a greater distance from the observer than half a mile, the index correction will be the same, unless the position of the fixed reflector has changed. For objects *within* that distance there will be a new index correction for every different distance.

In applying this instrument to astronomical purposes, as in taking the altitude of a heavenly body, or the angular distance between the moon and the sun or a star, it is necessary to determine the index correction with great exactness, for doing which the following methods are generally made use of.

### *First Method by the Reflected Horizon.*

(352.) Hold the instrument perpendicular to the horizon, and bring by the hand the direct and reflected boundary lines of the horizon, so as to be nearly in the same line. Clamp the moveable radius, and by the tangent screw make one exactly a continuation of the other. The reading off is then the index correction for heavenly bodies or any distant objects; additive if *off* the arc, subtractive if *on* the arc.

The mode of reading off on the arc to the right of zero, or the *arc of excess*, is pointed out in Art. 340. The arc is read off first to the line, next to the *left* of the index. Then the farther space up to the index is known, by considering the extreme significant line on the left of the index plate as the index, and reading back, that is, to the right.

### *Second Method by measuring the Sun's Diameter.*

(353.) Put in a telescope of considerable power and set two wires parallel to the plane of the sextant. Darken the direct and reflected suns by placing the proper dark glasses before each reflector; and make them as nearly as possible of the same brightness,* having at the same time a distinct and well defined edge. Bring the reflected sun by the hand nearly to touch the other on the left (by an inverting telescope apparently on the right); clamp the moveable radius and make an exact contact by the tangent screw at the middle point between the wires. The reading off will be the angular distance of the centres of the two suns, or the sun's diameter. If this be equal to twice the sun's diameter in the Nautical Almanac, there is no index correction for distant objects: if it be greater, the difference is

* Sometimes a dark glass is put on the eye end of the telescope for this purpose, in which case a single dark glass before the fixed reflector will be sufficient. A smaller alteration in the brightness of one of the suns is made by screwing the telescope nearer to or further from the plane of sextant.

the index correction *subtractive*: if less. the difference is the index correction *additive*.

Or, after measuring the sun's diameter, as above, on the arc, bring by the hand the reflected sun to the right of the direct one (by an inverting telescope apparently to the left), and make it touch the other on that side nearly. Then make an exact contact as before, by the tangent screw. If the reading off on the arc of excess, where the index will now be found, be equal to that on the arc, there is no index correction for distant objects; if it be not, take the difference, and half this difference will be the index correction; subtractive or additive, according as the reading off on the arc is greater or less than that on the arc of excess. Should the readings be both on or both off the arc, half their sum will be the index correction; subtractive when *on*, additive when *off*.

*Ex.* October 13, 1820, sun's diameter measured on the arc of the sextant N°. 84 was 32′ 30″, off the arc 31′ 50″: required the index correction.

| | | | | | |
|---|---|---|---|---|---|
| Sun's Semid. in Naut. Alm. | 16′ | 4″.5 | Dr. Measured on Arc . | 32′ | 30″ |
| | | 2 | Dr. Measured off Arc . | 31 | 50 |
| Dr. in Naut. Alm. . . | 32 | 9 | Diff. . . . . | | 40 |
| Reading off . . . . | 32 | 30 | | | |
| | | | Index Corr. . . . | | −20 |
| Index Corr. . . . . | | −21 | | | |

Of the two foregoing methods by measuring the sun's diameter, the latter is the more correct, since any slight error in making a contact on one side will probably be cancelled by a similar error on the other side.

(354.) In measuring the sun's diameter as above care must be taken to measure the horizontal diameter; that is, the reflected sun must be moved to the right and left of the sun seen directly, and not above and below it. This is done by holding the plane of the instrument at right angles to the vertical diameter of the sun. To make an exact contact of the two suns proceed as follows. Bring them nearly together by the hand, then by the tangent screw move them gradually towards each other. As long as the dark line of the sky can be seen between them they do not touch each other. They should therefore be made to approach each other, till this dark line can only be just perceived; a very slight touch of the tangent screw will then make a contact. To ascertain that they just touch and no more, trace by the eye that part of the circumference of each which lies near the point of contact. If each arc appear perfect and uninterrupted, the two suns do not cut each other; if no dark line can be perceived between them, they are not open; they therefore exactly touch each other. By attending to these directions the observer will soon get a habit of measuring the diameter of the sun correctly.*

* Several diameters may be measured *on* the arc and a mean of the readings off taken. The same *off* the arc. Also the limbs may be placed (by hand before the tangent screw is used) alternately a little open and a little close, so that in making the contact the tangent screw may be turned different ways. Thus a more accurate result may be expected. Too much time, however, should not be taken up in doing this, as the exposure of the instrument to the sun. in some cases might alter the index correction.

*Third Method by any distant well defined Object.*

(355.) When neither of the above methods can be used, any well defined object more than half a mile from the observer must be selected, as a church spire, a flagstaff, a star, &c., and the image must be made to coincide with the object. The reading off will then be the index correction for distant objects.

*Method of finding the Index Correction for near Objects.*

(356.) When, in taking an angle with the Sextant, the object viewed directly is less than half a mile distant, the index correction must always be found by making the image of that object coincide with the object itself. The reading off will then be the correction required.

Having thus explained the construction and necessary adjustments of the instrument, we shall next describe more particularly the nautical observations made with it.

*To observe the Sun's Altitude at Sea.*

(357.) To take the sun's altitude at sea, first place a dark glass before the moveable reflector. Estimate the altitude by the eye* and set the index by the hand to this altitude. Look from the place of the eye through the middle of the transparent part; and direct the view to that part of the horizon where an imaginary circle of altitude passing through the sun may be supposed to cut it, holding at the same time the instrument in a vertical position. Then, if the arc to which the index is put be nearly right, by vibrating the instrument slowly round the line of vision the reflected sun will be seen near the horizon. Should that not be the case, try a little above or below the horizon till the sun is found, and then by hand bring the lower edge or limb of the sun to touch the horizon, or very nearly so, at one point only. Clamp the moveable radius, put in the telescope, set the wires parallel to the plane of sextant, and make an exact contact; immediately vibrating the instrument, and thus making the image describe a circular arc, which should fall above the horizon, except at the aforesaid point. If an inverting telescope be used, the horizon will appear to be above the sun, and the arc thus described below it.

Either after the altitude is taken, or before, the index correction for the instrument is determined by measuring the sun's diameter, or by the boundary line of the horizon (Art. 352). Or, if the observer prefer making the adjustment, he does it before he takes the altitude, by setting the index to zero, and bringing the reflected horizon into the same line with the direct horizon by the adjusting screw: there is then no index correction.

*To observe the Moon's Altitude at Sea.*

(358.) The moon's altitude is observed in the same manner as the sun's, when the lower limb is illumined; excepting that it is not always necessary to place a dark glass before the moveable reflector. The ob-

* Or, holding the instrument vertically and the index near 0, and putting dark glasses up, look through the fixed reflector at the sun, and then moving forward the index, bring the image of the sun down to the point of the horizon (as nearly as can be estimated) immediately below it: then, removing the dark glasses from the fixed reflector, make the sun's L. L. just touch the sea horizon on turning the sextant round the line of vision, as explained above.

server directs his view either through the middle of the transparent part of the fixed reflector, or just over the edge of the quicksilver, as appears most advantageous.

When the lower limb of the moon is not illumined, the image of the upper limb must be made to touch the horizon at the point found by vibrating the instrument. In this case, the moon's semidiameter must be subtracted, in deducing the apparent altitude of the centre from the observed altitude of the upper limb.

### *To observe the Altitude of a Star.*

(359.) As a general rule, it is best to bring the index nearly to zero by hand, then holding the sextant vertically, to direct the view to the star from the place for the eye through the fixed reflector. By a slight motion of the index, the image of the star will be seen in the quicksilvered part of the reflector. When this is the case, move forward gently the index, and at the same time follow the image downwards by leaning forward, till it is seen nearly to touch the horizon immediately under the star at one point. Put in then a telescope of small power, which adjust, and make an exact contact. In some cases a plain tube may be used instead of a telescope.

### *To take the Sun's Altitude on Shore by Reflection from an Artificial Horizon.*

(360.) The surface of any fluid, as quicksilver, oil, water, &c. is horizontal. It likewise reflects strongly rays of light. Let an observer be supposed to put a small quantity of quicksilver in a flat dish, and, standing on the opposite side of the dish to that on which the sun is supposed to be, to alter his position till his eye receives reflected rays from the surface of the quicksilver, that is, till rays coming from the sun and falling obliquely on the quicksilver are reflected to his eye. He will then see the image of the sun below the quicksilver, and, since the incident and reflected rays make equal angles with the surface, the depression of the image will be equal to the elevation of the sun; consequently, the angle between the two suns will be twice the altitude of the sun. To determine therefore the sun's altitude, the index is put to twice the estimated altitude; the view is then directed (without telescope) from the place for the eye through the fixed reflector to the sun seen below the quicksilver: the instrument is turned round the line of vision, and if the other image is seen there, it is brought nearly to touch with its L. L. the U. L. of the one below the quicksilver: if it is not seen thus, the observer tries a little above and below the sun under the quicksilver till he finds it; he then brings it to touch nearly with its L. L. the U. L. of the other. He then puts in the telescope, adjusts it to distinct vision, sets the wires parallel to the plane of sextant, and makes an exact contact by the tangent screw at the middle point between the wires. The arc is then read off; the result is twice the observed altitude of the sun's L. L.: correcting this for *index correction*, and then dividing by 2, we get the apparent altitude of the L. L.

By bringing the image down so as to touch with its upper limb the lower limb of the image in the artificial horizon, we should in like manner get the apparent altitude of the sun's U. L.

When an inverting telescope is used, the observation for the L. L. will seem to be that for the U. L., and conversely.

(361.) The artificial horizon commonly made use of is a small quantity of clean quicksilver poured into a shallow rectangular vessel. The surface of the quicksilver rises nearly as high as the edge of the vessel. Over the whole a prismatic cover of glass is placed, like the roof of a house. The rays of light from the sun pass through the cover to the quicksilver, and are reflected through the roof again to the eye. The use of the roof is to keep the wind from disturbing the quicksilver.

(362.) Sometimes water and sometimes oil is used in a similar manner; and sometimes the artificial horizon is made of metal or glass, in which case it is necessary to adjust the surface so as to be exactly horizontal. For this purpose a spirit level is placed on it in the direction of two of its feet, and the bubble is brought to the middle by turning the screws of these feet. It is then placed at right angles to the first position, and the bubble brought to the middle by the other screws. It is afterwards placed in its first position, and the operation is repeated, till the bubble rests in the middle in all positions. We here suppose the feet or surface of the spirit level contiguous to the artificial horizon to be parallel to the axis of the fluid in the level. If it is not, the above criterion can never be established; for although the surface were in fact strictly horizontal, yet in that case, when the level is placed in any position on it, the bubble cannot rest in the middle. The above adjustments, therefore, are made in the first instance, half by the foot screws of the artificial horizon, and half by those of the level; by which means an erroneous position of either is gradually corrected.*

In some cases the artificial horizon is a fine plate of glass, which is made horizontal by being floated in a vessel of quicksilver. From the regularity of its form, it is supposed to sink equally on all sides, and therefore to have its own surface parallel to that of the quicksilver, which is horizontal.

(363.) In the use of the artificial horizon, it is important to prevent as much as possible any motion in the adjoining ground; as the communication of such motion to the fluid used for the artificial horizon would render it impossible to get a good observation. For this purpose the artificial horizon should be put on a piece of ground not easily moved, and no weights should pass near the place. The external air should also be excluded as much as possible both by the glass roof and by other means.

(364.) The interior and exterior surfaces of the glass roof ought to be exactly parallel; for if they are not, rays of light in passing through will

* It is not absolutely necessary to touch the screws on the spirit level at all. Make a fine dot, with a pencil or a pen, at one extremity of the bubble as it stands at first; invert the level, and bring the extremity of bubble half way to the dot by screws that raise and depress the end of level. Make a fresh dot at the extremity of bubble; invert again and proceed as before. Repeat this, till the extremity of bubble rests exactly at the dot in both positions. Then, placing the level at right angles to its first position, bring the extremity of bubble to the dot by screws that raise or depress the end of level. Try the same adjustments over again, and re-adjust, if required, till the extremity of bubble rests at the dot in any position in which the level can be horizontally turned. It will be convenient lastly (though not absolutely necessary) to bring the extremities of bubble to the marks or scratches on the glass (or so as to be equidistant therefrom) by the screws on the spirit level itself. If a scale is attached to the level, the extremities of bubble may be thus brought so as to be equidistant from middle of scale.

be bent so as to fall on the artificial horizon at an angle different from what they would have done without the roof. After reflection also, in rising to the eye, they would, from a similar cause, undergo a similar deviation. By inverting the ends of the cover in a second observation, that is, by placing that side towards the observer which was before towards the object, an error of the opposite kind will be introduced. A mean of the two readings off therefore will be more nearly right than either of them singly.

### *To observe the Sun's Altitude by means of an Artificial Horizon, with a Sextant fixed on a Stand.*

(365.) A stand for the sextant is a small brass pillar mounted on three feet, in each of which there is a screw to raise or depress it. The instrument, by a hole in the handle, is mounted on a pivot at the top, which pivot may be made to turn horizontally round its own axis, or vertically round a horizontal axis. The pivot enters the exterior surface of the handle of the instrument, and is clamped by a screw on the other side. The instrument, by the two motions which it has, is then brought into the position in which it is wanted. It is made to rest horizontally on the top of the pillar, or vertically by the side of it; in which latter case two weights, which move with it, are brought to the opposite side of the pillar, as a counterpoise to its weight; or it is placed obliquely to the horizon, in which case the counterbalancing weights are also used. In the observation under consideration the artificial horizon, roof, &c., being adjusted, the stand is placed before it, so that the image of the sun reflected from the artificial horizon may be seen distinctly, first without the telescope, through the fixed reflector in the middle of the fluid or metal surface; the instrument being at the same time placed at the side of the pillar, as nearly as can be estimated perpendicular to the horizon.

The index is then set to twice the estimated altitude of the sun, and the dark glasses placed before the reflectors. Keeping the sun reflected from the artificial horizon still in view, the instrument is turned slowly round the line of vision, till the sun reflected from the glasses is seen near the other. If it is not thus seen, the place of the index must be altered till it is. When the two images are thus seen nearly together, bring that which is reflected from the glasses (which may be known by its moving when the index is moved) near the other, leaving only a very small space between the limbs. Screw the telescope into the collar, and adjust it so that the two images may be seen through it with the greatest distinctness, placing at the same time the wires perpendicular to the horizon. Alter the dark glasses till the two images are of equal brightness and also well defined. Sometimes a small dark glass is fitted to the eye end of the telescope, which darkens both the images; in this case the dark glasses may be removed from the reflectors, with the exception of one before the fixed reflector, which may probably be found necessary in order to render the darkened images of equal brightness. It must be noticed also that a slight alteration in the relative brightness of the image may be made by raising or depressing the telescope parallel to itself, by a screw underneath the instrument; by raising the telescope it is pointed more to the transparent part of the fixed reflector and less to the quicksilvered part, by which the direct image is rendered something brighter, and the one reflected from the glasses something fainter. Bring the moveable image

exactly above the other, and at a short distance from it; if the telescope invert, it will appear below. This may be done most correctly and expeditiously by one of the foot screws, which with that view ought to be set, in the first place, two in the line of the artificial horizon and one to the right or left, by which last the sextant is inclined gradually to the right or left, and this adjustment made.

The images of the points to be brought in contact being thus seen in the middle of the field of view, at equal distances from the wires, the index is clamped, and an exact contact made by the tangent screw.

The images may then, if necessary, be made to touch on the other side; or the observer may wait till by the rising or falling of the sun this contact on the other side takes place without moving the index.

The altitude of the moon's upper or lower limb is observed with the sextant placed on a stand in a similar manner.

*To observe the Distance of the Sun and Moon.*

(366.) Put a dark glass before the moveable reflector, and set the index by the hand to the distance estimated, or the distance given in the Nautical Almanac.* When the moon is on the left of the sun, with the face of the instrument upwards, otherwise with face downwards, direct the view, without the telescope, through the fixed reflector to the moon, holding the plane of the instrument so as to pass nearly through the sun and moon. (See note, Art. 342.) Vibrate the instrument slowly round the line of direct vision, and the image of the sun will be seen near the moon. Move the index by the hand, so as to make the image nearly touch the moon; then clamp the index. Screw in the telescope, adjust it to distinct vision, placing the wires at the same time parallel to the plane of the sextant. Alter the dark glasses, and elevate or depress the telescope by the screw underneath the instrument, till the image of the sun is of equal brightness and distinctness with the moon seen directly. While the observer is thus preparing to take the distance, two others are usually preparing to take the altitudes, one that of the sun, and the other that of the moon. All of them being ready, the principal observer, after resting his arm and eye a short time, directs his view through the telescope to the moon, and turning the instrument slowly round the line of vision, brings the image of the sun into the field of view. By the tangent screw he makes the image of the sun just touch the moon at the middle point between the wires, and the altitudes are taken at the same instant. The exact contact is known by the disappearance of the dark line of the sky between them, and by the edge of each being at the same time perfect.

The readings off on the different instruments are then put down, and a second set of observations made in the same manner. The distance is this time taken by unclamping the index plate, and moving with the hand the image of the sun on the moon; that is, it is first moved so as to cut the moon by the hand, and then the tangent screw is turned till there is a contact again. This will, in some measure, correct any error in the moveable radius, by which it is bent without turning the moveable reflector. If necessary, several pairs of observations are thus made, and a mean of the

* Or, putting dark glasses before the reflectors, bring the image of the sun up to the moon, by moving forward the index; and then remove the dark glass from the fixed reflector.

whole taken; but it must be considered that after two, or at farthest three observations, the arm of the observer as well as his eye becomes a little fatigued. It is a question, therefore, whether the observation upon the whole does not become rather vitiated than improved, by taking a very great number of distances at the same time.

When the altitudes of the bodies are not taken, it is necessary to note the time by a watch when each distance is observed. The mean of all the distances will then be the distance corresponding to the mean of all the times.

### *To take the Distance of a Star from the Moon.*

(367.) If the star is to the left, the instrument is held with its face upwards, and the view directed through the fixed reflector to the star. The index is set to the estimated distance, or to the distance taken from the Nautical Almanac, as in the case of the sun and moon, and the contact is nearly made without a telescope.* Then, having put the telescope in its place, and adjusted it to distinct vision, with the wires parallel to the plane of the instrument, an exact contact is made by means of the tangent screw, at the middle point between the wires. If, on vibrating the instrument slowly round the line of vision, immediately after making the contact, the star appears on the face of the moon or wholly off it, in that case the contact is not exact. The tangent screw must be used, till the star on this vibration passes the edge of the moon, so as to be seen partly on it and partly off, the edge of the moon appearing to bisect it. Proceed then as in Art. 366.

If the star is to the right of the moon, the face of the instrument is turned downward; the contact is made by the same steps as before.

### *Causes of Error, and Cautions to be observed in the Use of Sextant.*

(368.) Although the greatest possible care is taken in the construction and adjustment of the sextant, yet there are causes of error, which it is difficult altogether to remove. It is necessary therefore that the observer should be aware of them, in order that, in the first place, he may choose an instrument as perfect as possible, and, in the next place, that he may preserve the instrument in that state.

### *Parallelism of the Surface of the two Reflectors.*

(369.) If the fore and back surfaces of the reflectors are not parallel, the images reflected therefrom will not coincide, so as to form one single perfect image; but the images will be separated from each other, at least sufficiently so to make the image, which is seen, confused: Before therefore an instrument of this kind is bought, the seaman should carefully examine the glasses as follows. Place the eye near the reflector, so as to look very obliquely into it and to see therein the image of a distant well defined object. If the image be single and well defined, the surfaces are parallel; but if two images are seen, or rather if the single image be badly defined and obscure about the edges, in that case the surfaces are inclined to each other, and the instrument defective.

* Or the image of the moon is brought up to the star by moving the index on the arc.

### *The Surfaces of the Reflectors should be plane.*

(370.) In the theory of the sextant, the surfaces of the reflectors are supposed to be plane. To ascertain whether they are so or not, observe in the usual manner the angle between two distant well defined objects, which are nearly on the same level, and bring the image of the right hand object to coincide with the left hand object seen directly at the edge of the quicksilver, so that the image and object may appear to move along the edge of the quicksilver. If they continue coincident, the surfaces are plane; but if they separate from each other, the surfaces are not plane. In making this experiment, care should be taken not to alter the position of the plane of the sextant, that is, not to turn it round the line of vision; since, by such a motion, the image would be at once separated from the object, although the surfaces under consideration were perfect.

### *Form of the Dark Glasses.*

(371.) The surfaces of the dark glasses should be plane, and parallel to each other, for if they are not rays of light in passing through them will have their direction altered, and consequently an object or image seen through them would appear in a different place from what it would independently of these glasses. There are two ways of examining the correctness of their form. The first is, to put a piece of dark glass on the eye tube of the telescope, and then to make the image of the sun touch the sun seen directly. When this is done, take off the dark glass from the eye end of the telescope, and put different combinations of the dark glasses before the reflectors. If the contact remain perfect, the surfaces of the dark glasses used may be considered as parallel; if not, they are inclined to each other. The second method is to measure the sun's diameter carefully both on and off the arc; do this with different combinations of dark glasses. Then if the sum of the two diameters, so measured, be equal, or very nearly equal, to four times the semidiameter in the Nautical Almanac, there can be no great error in the form of the dark glasses.

### *The True Circular Form of the Arc, and the True Centering.*

(372.) The arc of a Sextant should be exactly circular; otherwise it cannot measure half the angle round which the moveable radius is turned. Also the centre of this circular arc should be in the axis, round which the radius is turned as the index is moved forward. These, however, are adjustments which cannot be accurately proved by any common method practicable to seamen. If the index be moderately clamped, and then moved along the arc by the hand, the equability with which it yields to the pressure forward, and the smoothness of its motion will form some criterion of the correctness of the adjustments in question. Beyond this, the seaman must depend on the care and skill of the instrument maker.

### *Bending of the movable Radius.*

(373.) When in taking an angle, the index plate is clamped, and then gradually moved by the tangent screw, the radius thus pushed forward is liable to bend, so that the place of the index on the arc is not an accurate criterion of the position of the moveable reflector.

To determine whether or not an instrument is imperfect in this respect, bring the image of the sun by hand nearly to touch the direct sun,

leaving between them a very small opening. Then clamp the index plate, and observe carefully, whether or not, on turning the tangent screw either way, this opening varies, that is, is increased or diminished. If it does not, this circumstance must be owing to the bending of the radius without affecting the glass; in which case the instrument is defective.

To obviate any error of consequence likely to occur, from the above-mentioned causes, in observing any angle between two objects, it is advantageous first *by the hand* to bring the image a little short of the object, and then to make a coincidence or a contact, by the tangent screw; and afterwards, having noted down the first reading off, to unclamp the index plate, and again *by the hand*, to move the image a little beyond the direct object, and by the tangent screw to bring the image back to the object.

Thus, if the radius be bent, it must be bent different ways, in the two cases, and the errors arising therefrom in the angles read off will tend to cancel each other.

Or, with a similar view of correcting any error produced by the bending of the moveable radius, the observer may determine the index correction by measuring the sun's diameter only on the arc (353), and then, afterwards in observing an angle, by taking care to move the tangent screw the same way he did before. For thus the error in the index correction will tend to cancel the error in the angle read off.

The above remarks will, in some measure, enable a seaman to examine a sextant previous to purchasing it. They tend also to show him what great difficulty there must be in constructing a good instrument of this kind, and the care requisite in the use of it. If he has by him an instrument whose accuracy he has ascertained, he will beyond doubt compare any new one with this, and such a comparison will enable him to form the most correct estimate of its goodness; but as this is not likely to be often the case, he must go through the different points of examination in the manner pointed out above.

## *The Reflecting Circle.*

(374.) The instruments first constructed by Hadley were called *quadrants*, from the circumstance of their being constructed to measure an angle of about 90° at most. Instruments exactly on the same principle were soon made to measure angles as far as about 120°, the arc being about half this or 60° (335): these have by way of distinction been called *sextants*. Every direction which can be offered respecting the adjustment and use of one is applicable to the other; as they differ in nothing but the name, and the extent to which they measure angles.

But there is another instrument of this kind, called a *reflecting circle*, concerning which it is proper in this place to make a few separate observations, as the use of it is in some essential points different from that of the sextant. Indeed it is a very superior instrument to either, and claims the particular attention of the seaman.

Suppose the arc of a sextant to be continued quite round, so as to form an entire circle; the reflectors and place for the eye or telescope either remaining as before, or, if necessary, being changed; taking care only that lines from the place of the eye and from the moveable reflector at the centre of the arc, to the fixed reflector, should make equal angles therewith; which is all that is indispensably necessary in their position (335). When the two reflectors are parallel, let the index stand at 0 or

nearly at 0. Then in taking an angle, the index, as in the sextant, is pushed forward, being first moved by the hand and afterwards by the tangent screw, till the image is made to coincide with or to touch the object seen directly. After this is done, the index may be brought back to 0, and moved on the continuation backward of the arc, by which movement the central reflector must be turned from its parallel position the opposite way to what it was before. Let it be thus carried back to the same angle from the parallel position that it stood at before *on* the arc; and then let the circle be turned round the line of vision, so that the reflectors may be downwards. By this inversion, the index and the reflectors will be brought into the same relative position they had when the image and direct object were together before. Consequently they will be so again.

By taking the angle between two objects therefore in the usual way, and by then inverting the instrument and taking it again, we get two observations and two readings off. But there will be a much greater advantage in this, than the simple multiplication of observations or readings off. For, in the first place, the dark glasses which may be used, by the inversion of the circle are also inverted; and if their surfaces be inclined to each other instead of being parallel, the direction of the inclination is thus changed; consequently the effect on the angle measured will be of a contrary kind, that is, if it increased the angle before, it will now diminish it as much. Again, if the commencement of divisions one way be erroneous, it will now be as far wrong the other way, diminishing the angle read off in one case as much as it increases in the other. The mean of the two readings off will therefore be the true angle between the objects, independent of the errors of dark glasses or index correction.

These advantages alone are sufficient to give the reflecting circle a decided advantage over the sextant, however accurately the latter may be constructed. But it has much greater advantages than these.

We have mentioned hitherto but one moveable radius, by which the central glass is turned round; but in fact there are three, at equal distances from each other on the circumference. They are all attached to the central reflector, and are carried round with it, through equal angles. Each moveable radius also carries an index and an index plate; so that, whenever an angle is observed, there are three readings off on different parts of the arc. The divisions indeed are numbered only for one reading off; but this is of no consequence, since, having got the degrees from this, we want only the minutes and seconds on the other.

By having these three readings off, and taking a mean of them, we get a compensation for any slight errors in reading, as well as in the divisions themselves. And should the form of the arc have got warped, or undergone any slight alteration in its form, it is manifest, that one reading off will tend to correct another. This will be the case also, if the axis round which the radii are turned should be out of the centre of the circle; since, although an arc on one side may be greater than the angle at a point out of its centre, the arc on the other side will be less than it.

It appears therefore that in using the reflecting circle we have no mistakes of consequence to apprehend from the imperfect form of the dark glasses, from the errors of division, from the warping or misformation of the arc, or from the misplacing of the axis of the instrument; all which causes of error operate more or less in the very best sextants. If this instrument therefore be constructed with care, it must manifestly give great confidence to the seaman in the result of his observations.

### *Use of the reflecting Circle.*

(375.) The use of the reflecting circle differs in nothing from that of the sextant, as heretofore explained, except that when an angle is taken with the reflectors upwards, the index being moved from right to left, the index is brought back to zero, and then the instrument being inverted or the reflectors placed downwards, it is pushed again from right to left, and the angle thus repeated. The readings off are three in each case, and the mean of the six is the true angle. The manner of holding the instrument will be evident on seeing it, and need not be explained here.

When the circle is used with the stand, it is screwed on the top thereof, first with the reflectors upward, and then with them downwards.

The adjustments of this instrument are the following. The two reflectors must be set perpendicular to the plane of the arc. This is done in the same manner as for the sextant. The image of the arc seen in the central reflector must be single and well defined; by this means the surface of the reflector is proved to be plane and also perpendicular to the arc. The image of a well defined object, on moving the index slowly through zero, must pass exactly over the objects seen directly (348). The line of vision must be parallel to the plane of the arc, and if a telescope is used (which is generally the case), its axis must be brought parallel thereto as explained in Art. 349. Lastly, if the observer, in any case, should only be able to get the angle with one face of the instrument upward, he must determine and apply the index correction as for the sextant.

### *Theodolite.*

(376.) A theodolite is an instrument by which may be measured either the angle of elevation of any object above the horizon, or the horizontal angle between any two objects. In a telescope are fixed two wires at right angles to each other, which are distinctly seen through the eye glass. One wire is made horizontal by adjustment, and the other vertical; the straight line joining the intersection of these wires and the centre of the object glass is considered as the axis of the telescope, or the line of vision. This line of vision is directed to an object A, so that A is seen at the intersection of these wires. The place of an index on a horizontal circle is then noted, and also the place of another index on a vertical circle, by which latter is known the elevation of A. The line of vision is then directed to B, and the two readings off are again noted down, of which the latter, as before, is the elevation of the object viewed; the difference of the horizontal readings off is the horizontal angle between the objects.

(377.) In order to adjust the instrument so that the arcs traversed by the axis of the telescope may be thus exactly known, it is necessary to proceed as follows. In the first place the stand on which the instrument is mounted must be securely and firmly fixed, and at the same time placed in such a manner, that the plate at the top may be as nearly horizontal as can be estimated by the eye.

The instrument consists of a horizontal brass circle, and another circle or part of one placed vertically over it. The first adjustment is to make the former revolve in a horizontal plane, as it is turned round the central axis on the stand, for which purpose a spirit level is fixed or hung on so as

to revolve with it. The circle is turned round till this level is parallel to two screws, by which the circle can be raised on one side and depressed on the other; and by easing one screw and screwing up the other, the bubble is brought into the middle. The circle is then turned round till the level is reversed, end for end; that is, till the end that was to the right is on the left. If the bubble does not rest, as before, in the middle, it is brought half way by the screws under the circle in the direction of which the level is placed, and half way by the screws at the ends of the level itself. Then, by turning the circle, the level is brought into its first position and adjusted if necessary as before. Repeat this operation till the bubble rests in the middle in both positions. The axis of the level is thus rendered parallel to the circle (see note Art. 362).

Next turn the circle, so that the level may be at right angles to its former position, and, if necessary, by means of the screw or screws which raise the circle, bring the bubble to the middle; and afterwards try it all round, altering the adjusting screws of the circle, till it remains exactly in the middle, in making an entire revolution.

If there is a second spirit level on the circle, at right angles to the first, the bubble in it must be brought to the middle, when the above adjustments are completed, by means of its own screws.

The surface of the horizontal circle is now truly horizontal, and the bubbles in the two levels will be a criterion of its remaining so, at least for a short time. If either of the bubbles move from the middle, it must be brought back again by the adjusting screws of the circle. It may indeed be supposed, that the axis of each bubble is parallel, or nearly so, to the circle, before the above adjustment is begun. And upon this supposition, the bubbles are generally first brought to the middle by the screws raising or depressing the circle, and then tried by the method described above. This will often save a good deal of trouble, and the adjustment be thus made without turning the screws at the ends of the levels too much (or see note, Art. 362).

(378.) The circle being horizontal, if the axis of a telescope coincided with any of its diameters, it is manifest that, the edge being graduated and turning past a fixed index, the difference of two readings off would be the horizontal angle between any two objects to which the telescope may have been successively directed.

The same will be true, if the axis of the telescope be situated above the circle, anywhere in a plane perpendicular to it and passing through its centre. Now this is the case in a properly adjusted theodolite. A telescope is fixed over the horizontal circle, being attached to a vertical circle, or part of a vertical circle, which is intended to show through what angle the axis of the telescope may have been traversed perpendicular to the horizon; the before-mentioned circle showing at the same time through what angle it has been made to traverse horizontally.

The telescope rests in two collars, of which the middle points are in a straight line, lying in a vertical plane that passes through the centre of the horizontal circle. One adjustment of the telescope is therefore to bring the line of vision so as to pass through these central points. Another adjustment is to render the same line of vision truly horizontal, when the index past which the vertical circle turns stands at zero. For these adjustments being made, it is manifest, while the index on the horizontal circle points out the horizontal angle traversed by the axis of the telescope or line of

vision, that the index of the vertical circle will show the angle traversed by it in altitude.

(379.) To adjust the line of vision so as to coincide with the middle line of the collars in which the telescope rests, direct the telescope, so that some distant well-defined object may be seen at the intersection of the wires. Then turn the telescope round in the angles supporting it, so that the part underneath may be above; and if the object be still seen at the intersection of the wires, the adjustment is correct; if not, bring the said intersection half way to the object by easing one of the screws on the telescope which translates the wires, and screwing up the other. Afterwards find a new well-defined object, and repeat the operation till the intersection cuts it in every position of the telescope in the collars. The axis of the telescope is thus supposed to be brought into the vertical axis of the instrument, that is, the axis round which it is turned horizontally.

(380.) To find the place of the index on the vertical arc or circle, when the axis of the telescope is exactly horizontal, bring the bubble of the level* attached to the telescope to the middle, by giving the vertical arc a motion round (at last very gradually by tangent screw); invert the spirit level, and if the bubble still rest in the middle, the necessary adjustment is made; if not, bring the bubble half way to the middle by the tangent screw to the vertical arc, and half way by the screws on level: invert again, and repeat till the adjustment is exact. If then the reading off on the vertical arc be nothing, zero is right, and there is no index correction; if not, the reading off must be considered as an index correction. †

The adjustment of the instrument may be now considered as exact, and either horizontal angles or vertical angles may be taken with it as follows. The telescope is directed to an object A, so that the intersection of the wires may be exactly upon it. The arc on the horizontal circle is then read off, and also that on the vertical circle. Afterwards, the telescope is, in a similar manner, directed to B, and the two corresponding readings off noted down. The readings off on the vertical circle corrected for index correction will be, respectively, the elevations or apparent altitudes of the objects above the level of the axis of the telescope when horizontal; the difference of the readings off on the horizontal circle (or the sum, if different ways) will be the horizontal angle between A and B.

(381.) In some instruments the index may be set to zero on the horizontal circle and clamped; and then the whole head of the instrument turned round till the axis of the telescope is pointed to A. The head is then clamped firmly, and the horizontal circle turned round till the telescope is pointed to B. Thus only one reading off on the horizontal circle becomes necessary, which is the horizontal angle between A and B.

Usually there is a magnetic needle on the horizontal plate. The index being set at zero or 360° on the horizontal circle (which zero is in the

* If the level on or attached to the horizontal circle be not sufficiently sensible, make the adjustment of the horizontal circle by means of the level attached to the telescope; using the elevating screws to the circle and the tangent screw to the vertical arc.

† This index correction is more exactly determined by observing with the instrument the altitude of the same object with face of the vertical arc first right and then left. Half the difference of the readings off is the index correction.

direction of the north and south line on the card), the whole head is turned round till the north end of the needle coincides exactly with the north end of the card. In this situation, therefore, the index, and consequently the line of vision of the telescope, is pointed to the magnetic or compass north—and on its being pointed to any other object, the horizontal index will show its bearing reckoned from the compass north.

Moreover, if the index be set to zero, and then the head turned round till the axis of the telescope is directed to the true north or south, the reading off afterwards, when pointed to any object B, will be the true bearing of B. The place of the index on the horizontal circle, when the axis of the telescope is pointed due north or south, may be found either by bringing the middle vertical wire into the meridian in the manner described in the articles on the portable transit, or more easily as follows. First see that the theodolite is in every respect adjusted. Then when a bright star is at least three or four points of true bearing from the meridian, point the telescope to it; and make the horizontal wire bisect the star at the middle point. Preserving the instrument from any motion or exposure that could affect the adjustments, when the true bearing of the star is nearly the same to the west of the meridian as it was before to the east, move the horizontal circle round, and thus (without touching the vertical circle) bring the telescope again towards the star, and continue to move the horizontal circle till the star is seen in the field of view. As it approaches the horizontal wire, move the horizontal circle very carefully, so that, in passing the wire, it may pass exactly at the middle point. Then the middle point between the places of the index on the horizontal circles, at the two observations, will be its place when the axis of the telescope is due south or north (see Art. 256).

Frequently in these instruments there is a second telescope underneath; which can either be clamped to the same position, whilst the circle is turned round, or turned round together with the circle. This second telescope is in the first place pointed in the same direction, that is, to the same object, with the upper telescope. Then the latter is turned round to a second object, independently of the former; and when the intersection of the wires is brought to the second object, the under telescope is examined, in order to ascertain the steadiness of the instrument during the observation.

### *Portable Transit Telescope.*

(382.) By a transit telescope is meant a telescope having a vertical wire across the axis or line of vision, so adjusted that when the whole is made to revolve round a transverse axis, by means of lateral arms supported on each side, this wire may move in the celestial meridian. Being thus adjusted, it is manifest, when a heavenly body is seen to pass the wire, that it is on the celestial meridian.

A second wire is placed at right angles to the one above mentioned; and the line joining the intersection of the two and the centre of the object glass is the axis or line of vision.

The telescope, as has been just observed, is supported by means of lateral arms, which rest on the tops of pillars in grooves or angles. These pillars are secured and rendered firm in various ways, as may seem most effectual and convenient. By means of a screw under one of the angles, or by means of the screws at the feet of the frame-work, this angle may be

elevated or depressed gradually. By means of another screw acting immediately upon it, it may be pushed gradually in a horizontal direction. It must be observed also, that the ends of the arms which rest on the supporting angles are made exactly round and equal.

(383.) To adjust this instrument, so that the axis of the telescope and the vertical wire may revolve in the meridian, the stand is first placed on a firm pediment, in such a position that the transverse line joining the middle of the two angles, in which the lateral arms of the telescope rest, may appear horizontal, and directed as nearly due east and west as can be judged by a compass corrected for variation. The lateral arms of the telescope are then placed in the angles, and the bubble of the spirit level, which is either attached to the transverse arms or mounted on its cylindrical ends, is brought to the middle, that is, to two marks on the glass equidistant from the middle point. The level is then inverted, the right hand end to the left, and the left hand end to the right. If the bubble does not rest in the middle, it is brought thither, half way by the screw elevating one of the supporting angles, and half way by the screws belonging to the level itself.* The level is then again inverted, and the bubble again brought to the middle as before. This operation is continued till the bubble rests very exactly in the middle, or at the same marks, in both positions of the transverse axis.

By this adjustment the transverse axis, that is, the line joining the middle points of the cylindrical ends round which the arms turn, is made truly horizontal.

(384.) Next, the telescope is turned round till a fine object is seen on the middle vertical wire. Then slowly turning the telescope, it is observed, whether or not the object continues on the middle wire. If it does, the wire is thus proved to be exactly vertical. If not, the wires are turned round in their socket, the screws which hold this socket in its place being first loosened, till a well-defined object appears, by proceeding as above, to run exactly along the wire. The socket of the wires is then screwed fast.

The telescope is now again turned round, till some distant well-defined object is seen exactly at the intersection of the middle wires. The transverse axis is then inverted, with respect to the angles supporting it, by which movement the telescope is made to revolve round its own axis. If therefore the intersection be still exactly on the same object as before, it is a proof that this intersection is in the said axis; which is the adjustment required. But if not, bring the intersection of the wires half way to the object by the screws on the telescope which move the wires horizontally; taking care to loosen one before the other is tightened. Invert the arms again, and proceed as before; and repeat the operation till the intersection of the wires continues on the same object.

It may be proper after this to try all the adjustments, hitherto mentioned, over again; making any slight alterations which may be necessary. The intersection of the wires now moves in a vertical circle, as the telescope is turned round the transverse axis between the lateral supports. The next thing is to cause it to move in the meridian.

* See note. Art. 362.

(385.) From an altitude of the sun, taken either from the sea horizon, or by means of an artificial horizon, and the time by the chronometer taken at the same instant, find the error of the chronometer on mean time, and knowing its rate nearly, compute the hour, minute, and second it will show when the sun's centre is on the meridian; and then, by applying the interval of the semidiameter's passage taken from the Nautical Almanac, find the hour, minute, and second when the eastern and western limbs of the sun pass. As this time approaches, direct the telescope to the sun, taking care to guard the eye by a dark glass. Prepare the adjusting screw for use, which turns one of the angles supporting the lateral arms horizontally. When the sun is seen in the field of view through the telescope, turn the said adjusting screw, so as to make the first or western limb touch the central wire, at the instant the chronometer shows the computed time. Do the same still more exactly, when the last or eastern limb passes.

The same approximation to the meridian may also be made by computing the time shown by the chronometer, when a bright star passes the meridian, and bringing the wire to bisect it, when this time is shown.

The nearer the star by which this adjustment is made is to the pole of the heavens the better; since its motion is more slow, and a slight error in the computed time of its transit will be of less consequence.

The next step is (if necessary) to bring the middle wire *exactly* into the plane of the meridian.*

*By a Star near the Pole.*

(386.) Try all the adjustments over again, and make them correct, if they are not so. When a star near the pole of the heavens passes the meridian (that is the wire of the telescope), either above or under the pole, note the second shown by the chronometer, supposed according to Gr. M. T. After an interval of nearly 12 hours, again note the time of its passing under or above the pole. Correct the interval of the transits for the rate of the chronometer, and if the result be $11^h\ 58^m\ 2^s$, the axis of the telescope is exactly in the meridian. If less than this, by the adjusting screw move one of the lateral arms horizontally a little, so as to increase the interval; if greater, shift it so as to make the interval less. Repeat the observations and alterations till the resulting interval is exactly $11^h\ 58^m\ 2^s$.

If the chronometer used be a sidereal one, the interval corrected for the rate should be 12 hours.

In order to move the wire by the horizontal adjusting screw very gradually, a well-defined object cut by the middle wire, when near the meridian, must be noted; or if there be no object of this kind in the range of the telescope, as it is turned round, one must be put up for this purpose. The slightest separation of the middle wire from it will then be perceptible.

*By the Transit of Stars differing much in Declination.*

(387.) Note carefully the hour, minute, and second shown by the chronometer when two bright stars pass the middle wire, one of which

* If the object of the observer be merely to determine the rate of his chronometer from repeated transits of the same heavenly body, as the sun, in that case the approximation to the meridian found above will be sufficiently near for the purpose.

stars is as near the pole of the heavens as possible, and the other as far from it as possible. The apparent right ascension of these stars may be taken at once from the Tables (see Naut. Alm.). Subtract the less right ascension from the greater, and, if the chronometer be regulated to mean solar time, turn the difference into mean time. Call this the true interval of the transits in mean time, which, if the axis of the telescope be exactly in the meridian, will be equal to the interval shown by the chronometer corrected for the rate. If it be not, in that case one of the angles supporting the lateral arms must be moved a little horizontally, and a second trial made by other stars the same night, or by the same stars as before on the following night. If the chronometer or clock show sidereal time, the difference of right ascension must be used as it is.

If the southern star pass the meridian wire *too soon* for the computed difference of right ascension, the telescope when pointed to the south is to the east of the true meridian. If the southern star pass the wire *too late*, the telescope when directed south is to the west of the true meridian. And this is true, whether the southern star pass the meridian before or after the other; it is true also either in north or south latitude. By attending to this, the observer will know in what direction to move the arm of the telescope by the adjusting screw, in order to bring it gradually into the meridian.

(388.) When the middle wire is made thus to revolve in the meridian, all the adjustments being at the same time perfect, it is proper to select some mark which the wire covers or touches, or to put up a mark for this purpose at the distance of at least five or six hundred yards. This is called a meridian mark, and enables the observer always to detect any error in the position of the telescope, and to rectify it.

The middle wire of the telescope being now supposed to revolve accurately in the meridian, we shall say a few words on the mode of taking the transit of different heavenly bodies.

### *To take the Transit of the Sun.*

(389.) When the sun comes near the meridian, point the telescope towards it: as soon as it is seen in the telescope, adjust the eye-glass, so that the sun and the wires may both be seen distinctly, a dark glass being previously placed before the eye. When the western limb of the sun is near the meridian wire, observe the second on the clock by the eye, and then count the additional beats by the ear, till this limb touches the wire, at which instant note the second and decimal fraction of a second.* Mark this down with the corresponding minute and hour, and wait till the eastern limb approaches the wire. Take the transit of this in a similar manner. The mean of the two times so noted down will be the time when the sun's centre is on the meridian.

We have here supposed only one vertical wire to be placed before the eye-glass. But there are generally three, the middle one or meridian wire, and one on each side of this, at equal distances from it. The transit of each limb of the sun is taken at every one of these wires, by which means the accuracy of the transit over the meridian is greatly increased. When the sun comes into the field of view of the telescope, the transit of

* When a chronometer is used, the second may be noted by an assistant.

the western limb is taken at the first, second, and third wires, and then the transit of the eastern limb at the same wires, in succession. The mean of the transit of the western limb at the first wire, and that of the eastern at the last wire, also the mean of the transit of the eastern limb at the first wire, and the western at the last, is the time of the centre's passing over the middle wire. The mean of the transits of the two limbs over the middle wire being added to the other means, and the sum being divided by 3, the result is the correct time of the transit of the centre over the meridian.

When the meridian transit of the sun or a fixed star has been observed, and the time at the same instant taken by a chronometer, the error of the chronometer on mean time, or sidereal time at the place (see Art. 204), may be easily deduced.

### *To take the Transit of a Planet.*

(390.) The transit of a planet is observed in a similar manner by noting the time of the appulse of the first and second limbs to each of the wires, and taking a mean, supposing both limbs to be visible. If not, proceed as for the moon.

### *To take the Transit of the Moon's Enlightened Limb.*

(391.) The transit of the moon is observed by noting the time by the clock of the appulse of the enlightened limb to each of the wires, and taking a mean of all the results. This mean is the time of the transit of the enlightened limb over the meridian.

### *To take the Transit of a Fixed Star.*

(392.) A transit of a fixed star is observed by noting the time shown by the clock when it passes over each wire, and taking a mean of the results.

(393.) To set the telescope to any particular polar distance, a fixed graduated arc is sometimes placed at the extremity of one of the transverse arms on which a radius with an index is moved as the telescope is turned round. When a star whose polar distance is known is at the intersection of the middle wires, the index is put by the hand so as to show the given polar distance. Then afterwards, when the index is set, by moving the telescope round to the polar distance of any other body on the meridian, the telescope will be pointed to it.

In the night the wires are illumined by a lamp placed at the end of one of the transverse arms of the telescope, which is hollow. The light passing from the lamp down this arm into the body of the telescope is there intercepted by a plane reflector placed at an angle of 45° to the axis, by which it is reflected down on the wires. A hole is left in the middle of the reflector, which transmits the central rays from the object. To proportion the quantity of light to the circumstances of the observation, a piece of coloured glass is interposed between the lamp and the hollow arm of the telescope. When this apparatus is wanting, the telescope and wires are illumined by a lamp placed near the object glass.

*Azimuth Compass.*

(394.) When a bar of steel has been touched with magnets, it is placed on the under surface of a circular card, the circumference of which is divided into 32 equal parts, called points, which are marked N., N. b. E., &c. (see Art. 29). The bar is fixed in the direction of a north and south line on the card. The card being then balanced on a pin in the centre, is carried round by the magnetic influence of the needle, and assumes a position in which (independently of the variation) the points marked on the card may be considered as indicating the corresponding points on the horizon of the place.

The box in which the card is placed turns on jimbols, so that while a ship rolls or pitches the card itself may remain nearly quiescent and horizontal, the axis of rotation with this view being made to pass through the point on which the card rests. The box also may be turned round the card, the axis of rotation in this case also being made to pass through the same point, namely, the extremity of the pin on which the card rests.

In the inside of the box an index is fixed, which, on turning the box horizontally, is carried along the edge of the card, or rather against a graduated circular rim of metal, by which the card is surrounded. This index has a motion towards and from the card, by which it may be pressed against the card, whenever this is necessary for the purpose of reading off.

(395.) When the azimuth compass is prepared for use, a cross bar is laid across the top of the box, being fitted on its edges. At each end of this bar is a brass stem, in one of which there is a long slit or narrow opening; in the other there is also lengthways a wider opening, down the middle of which runs a fine vertical thread. The observer therefore having fixed these right, and placed the eye at the aforesaid narrow opening in the upright bar, turns round the box, till the object of which he wishes to take the bearing is bisected by the thread; he then pushes the index plate close to the card, and reads off the arc.

The index plate is usually placed 90° to the right of the place where the thread, when produced down, would cut the edge of the card; so that the true bearing of the object is 90° farther to the left than the reading off.

To take the bearing of high objects, the eye is placed at the bottom of the narrow opening, and the object is bisected by the top of the thread; to take the bearing of low objects, from an eminence, the eye is placed at the top of the opening, and the object is bisected by the bottom of the thread. If the elevation or depression be more than 15°, the bearing cannot be taken with any accuracy.

To observe the bearing of the sun, a piece of dark glass is put on the opening at which the eye is placed, and the sun is bisected by the thread; the index plate or stop is then pressed against the card. Or it may be observed more conveniently and accurately thus. Paste a piece of white paper on part of the cross bar, so that the groove which runs along the middle of this bar may be seen at each end of the paper. Then, by turning the box round, throw the shadow of the thread along the middle of the transverse bar, so as at each end of the white paper to fall into the groove. When this is done, push the index plate, gently, close to the card, and read off.

When the bearing of the sun is taken at sea in this manner, it is necessary for a second person to read off at the moment the shadow of the thread

is thrown as described above; since if there were any delay, the ship by altering its course, or by any sudden movement, might change the place of the index on the card. This mode of making the observation is more accurate than stopping the card; for by pushing the index suddenly to the card, a slight alteration is frequently made in the position of the latter; and moreover, when one sight has been taken, the card being freed from the stop, will often oscillate some time before it is again steady. Whereas after reading off without stopping the card, a second observation may be taken immediately, and thus a mean of several sights used for the true bearing corresponding to the mean of the altitudes taken at the same time.

### *Station Pointer.*

(396.) A station pointer is an instrument used in finding the point on a chart corresponding to a place on ground surveyed, from which the angles which one known object makes with two others have been taken. Thus, if the position of each of any three objects A, B, and C is known on the chart, and the observer in surveying has from any station, as *a*, taken the angles between B and A, and B and C; then by a station pointer the spot on the chart corresponding to the station *a* can be at once found.

A station pointer has three rulers, one of which is fixed, and the other two moveable round a central axis, in which the edge of all three meet. The angles through which the moveable edges are turned from the fixed one are measured on a brass circle, described round the same central axis. In the use of this instrument the edges of the moveable rulers are set so as to make the observed angles with the fixed one. The instrument is then placed on the chart, so that the edges of the rulers may pass through the proper objects; that of the fixed ruler over the object from which the angles observed are reckoned, and each of the moveable edges over that object to which it is set. The centre of the instrument is then on the point of the chart required, which is marked by pressing a fine steel point through the opening left in the centre.

When the angles are observed with a sextant, it will generally be necessary to add two angles together, in order to get the greater angle to be set on the instrument the same way.

A station pointer may evidently be used in drawing a straight line to make a given angle with any other straight line at a given point. Set one of the moveable rulers to the angle. Then set the edge of the fixed ruler on the line, and the centre of the instrument on the point in it, from which the required line is to be drawn. In this position of the instrument, a line drawn along the edge of the moveable ruler, and produced to the given point, will be the line required.

### *Protractor.*

(397.) A protractor is an instrument (generally a circle of brass) having its circumference graduated; it is used to set off any proposed angle, that is, to draw a straight line making any proposed angle with another straight line. Thus let AB be any straight line, and let it be required to draw a second straight line making an angle of 30° with AB at the point A. A protractor is placed with its centre on A, and the radius corresponding to the commencement of the divisions on AB; then a dot being made on

the paper at the proposed degree on its periphery: a straight line drawn from A to this dot will make with AB the angle proposed.

A protractor is usually, as we have observed, a brass circle, having its circumference graduated, and an index which moves round it and may be set to any division proposed. A fine point is then pressed down, which makes a mark on the paper: this determines the position of the required line.

In some instruments, by moving the radius round the circle, two indices are carried on its circumference diametrically opposite to each other, and two marks made. These determine the position of the required line more exactly.

In others there is no moveable radius or index. The position of the line is found simply by looking along the arc of the protractor, and making a dot or mark on the paper, at the division corresponding to the given angle.

In common cases of instruments the protractor is generally a semicircle of brass, the use of which must be manifest from what has been observed above.

A protractor is sometimes in the form of a short ruler, the middle of the edge being the centre, and the edge itself corresponding to the diameter of zero or the commencement of the divisions. In setting off an angle, this edge is laid along a given line, with the central mark on a given point. Then, on the outer edges of the ruler, lines are cut diverging from this mark, which correspond either to degrees, or to points of the compass. At the line which denotes the angle to be set off, a dot is made, and then the straight line is drawn on the paper as before.

(398.) An angle may be set off also by means of a scale of chords, as follows. Let it be required to draw a line from A, making any proposed angle with AB. With a pair of compasses take, from the scale of chords, the distance corresponding to the chord of 60°; and with that distance, describe from the centre A a circular arc in pencil, cutting AB in a point C. Then take in the compasses the distance corresponding to the chord of the degrees, &c. in the proposed angle, and from the centre C, with this distance as a radius, describe a small circular arc cutting the other circle in a point E. The point of section will be the point to which the required line must be drawn from A.

## *Mercator's Chart.*

(399.) A Mercator's Chart is a representation of part of the surface of the earth made upon a plane surface, constructed as follows (see *App.* 1).

Draw a fine straight line BK (plate 1) along the bottom of a large sheet of paper. At B erect a perpendicular BN to BK, in the following manner: take any point C within the paper as far from B towards the middle of the paper as is convenient; placing the edge of a ruler, or of paper doubled, from B to C, make a mark on the edge at B and C. Then keeping the mark at C stationary, bring the other mark, by turning the edge round C, to a point D on the line BK. Draw a fine straight line DE in pencil through C, and take the distance between the marks on the edge from C to E. Join BE and produce it to the top of the paper; this will be the perpendicular required. With the edge of a ruler or of doubled

paper mark two points at small equal distances from this perpendicular within the paper, and through these points draw a fine line HI, which will be parallel to BN. In a similar manner draw FG within and parallel to BK. From H along the base line take as many equal distances as the chart is to contain degrees of longitude, leaving a sufficient space at the left hand side for a margin: this is done most easily by making two dots on the edge of doubled paper, by trying the distance of these dots on the line, and altering this distance till it appears that, laid as many times on the base line as there are to be degrees of longitude, a proper space only remains to the left. Then placing the edge between the dots on the base line repeatedly, beginning at H, make dots at the same equal distances on it. Divide the space between the dots on the edge of doubled paper into six equal parts (or as many as may be required) by trial, and putting the distance again on the corresponding divisions of the base line, make marks at each intermediate dot. Thus the base line HA will be divided into degrees and subdivisions of degrees. From A erect a perpendicular AM to the base line, in the same manner as the one at B was erected, and taking two small equal distances to the left of it, draw a second straight line KL parallel to it, towards the margin, cutting the interior base line at G. Mark in pencil the degrees of longitude on the base line.

(400.) Write down on a slip of paper the degrees of latitude which the chart is intended to contain, putting the highest degree at the top and the others in order underneath: take out from the tables and write opposite to each the corresponding *meridional parts*, of which take the successive differences from the top to the bottom. Measure with the edge of doubled paper the number of minutes or nautical miles in the lowest difference along the longitudinal scale, that is, along the base line as it has been divided; make two dots on the edge at this distance, and transfer it to the side lines as from F and G to 31. Then in a similar manner transfer the number of minutes in the second difference from the bottom measured on the longitudinal scale from 31 to 32, and so on as far as may be wanted. Mark the points thus got on the side lines with the degrees they represent; at the highest degree draw a line across the paper as NL, and, taking small equal distances above it, draw another line parallel to it as IM. Divide each space for a degree on the side into six equal parts, or as many as may be required, which is done by trial on the edge of doubled paper. Divide the top line similarly to the bottom one.

(401.) It must be observed that all the lines mentioned above are supposed to be drawn in pencil as finely and exactly as possible. The correctness of every step should also be proved by a second measurement. After the whole has been thus tried and found to be correct, the lines must be drawn in ink in the following manner. Take a steel drawing pen, and see that the point is perfect and clean; open the point a little by means of the screw, and fill it with ink; then close it gradually till the pen is found on trial to draw an uniform line, such as is wanted. Indian ink should be used, rubbed on a plate with water, till on trial the mixture is found to have the proper consistency. When the drawing pen is filled with ink, and a ruler laid on any of the pencil lines, the pen should be held in a position something inclined from the perpendicular, and drawn along the edge of the ruler leisurely and steadily; taking care that the edge of the ruler is turned to the light.

(402.) Having thus drawn the lines in ink and written the degrees in ink, the next thing is to draw the line of coast which is to be included in the chart. In the first place we will suppose that the object is only to copy another chart on a different scale. From the chart to be copied find the latitude and longitude of the prominent points of land: lay a ruler across the new chart at the latitude on both sides of any one of these points, and draw a short fine pencil line near the situation of the same point in the new chart, which situation may be estimated nearly; then place the edge of the ruler from top to bottom at the longitude of the point to be determined, and draw another short fine pencil line to cut the former: the intersection will be the point required, at which therefore write in pencil the name. In a similar manner get the places of as many other prominent points of land as may be considered necessary. Take now a piece of paper and sketch in with a pencil between the assumed points the different parts of the coast from the chart to be copied, and then transfer these sketches to the new chart; proceeding thus till the whole coast is delineated.

(403.) To put this outline into ink, take a common pen, and cut its point till a proper line can be drawn with it for the line of coast, which should be quite uniform and distinct, but not too thick. Draw the pen on the pencil lines between the prominent points or headlands; shifting the chart round so as always to draw the pen towards the person, and taking care that the line drawn has the natural waving of a coast, and is of uniform thickness throughout. After this is done, write in ink the names of the points of land, as much as possible on the land side. The line of coast may also, if judged necessary, be shaded in a slight degree always on the land side, and with the utmost neatness and regularity.

The situation of any sounding, anchorage ground, &c. on the coast will be best determined by means of a *station pointer*, the use of which is described in Art. 396. Place the centre of the instrument at the point it is wished to transfer to the new chart, and open the arms so as to pass over three prominent points of the coast; then carry the arms thus set over the corresponding prominent points on the new chart, and the centre will be at the place required. When a station pointer is not at hand, the place of any sounding, anchorage, &c. may be determined in the same manner as that of a headland, from its latitude and longitude.

Lastly, a circle should be described to represent the compass at some spot on the chart; if convenient, on the land. Take the intersection of a meridian and a parallel of latitude for a centre, and with an opening of a few inches describe a circle; mark the points of the circumference cut by the meridian N. and S., that towards the top N., and that towards the bottom S. Mark also the points of the circle cut by the parallel of latitude E. and W. Then divide each of the quadrants into two equal parts, and mark the points of division N.E, S.E., N.W. and S.W.; according to their position; bisect the arcs again for the points N.N.E., E.N.E., &c.; and again for N. b. E., N.E. b. N., &c. In a large chart it may be necessary thus to describe two or three circles on different parts (see plate 1).

### *Use of Mercator's Chart.* (See *App.* 1.)

(404.) A Mercator's Chart is used in Navigation to find the course and distance from one place to another. Place the edge of a parallel ruler on the two places as marked on the chart, and keeping one part of the

ruler fixed, move the other till the edge passes over the centre of the compass on the chart; the point on which the edge lies will show the course. Thus (plate 1) (1) let O and P be the two places, the course and distance between which are required. On placing one edge of a parallel ruler on O and P, and pushing half the ruler to the compass, the course is found to be N.N.E. The distance from O to P is found nearly by taking OP in a pair of compasses, or on the edge of a piece of paper, and measuring it on the side or latitude scale nearly opposite the two places O and P: the distance is thus found to be 52 nautical miles. The distance thus determined is not however exact, as is evident by completing the figure as on the chart. Through O draw OQ parallel to a meridian by means of a parallel ruler; join OP, and draw PQ parallel to a parallel of latitude by the same means. Then by the construction of the chart, OQ will be the meridional difference of latitude, and PQ the difference of longitude, of O and P. The angle POQ will therefore be the course from O to P, since OP : OQ :: *rad* : *cos* POQ (see Art. 11, p. 4): but OP will not be the distance, since by Art. 11 OP : OQ (*mer. diff. lat.*) : : *rad* : *cos* POQ or *cos Course*; and *Dist.* : *Tr. Diff. Lat.* : : *rad* : *cos Course*. To determine the distance exactly from the chart, observe how many minutes there are on the side between the latitude of O and that of P, and taking the same number of minutes in the longitude scale at the bottom or top, by a pair of compasses, or on the edge of doubled paper, set this distance off from O to R, and from R draw a line RS parallel to a parallel of latitude, cutting OP in S; then will OS, measured on the longitudinal scale, be the exact distance. For it is evident that OR is the *tr. diff. lat.*, and since OS : OR (*tr. diff. lat.*) : : *rad* : *cos* SOR (*cos Course*), OS must be the *dist* (see Art. 11).

(405.) When a chart is constructed in the manner described above, with the exception that the degrees of latitude at the side are made of the same length as those of longitude at the bottom or top, such a chart is called a *plane chart*. On this PQ would be the *diff. long.*, and OQ the *tr. diff. lat.*; consequently neither would the angle POQ be the *Course*, nor OP the *dist.* exactly; though for a limited space they might be so nearly enough for the practice of navigation.

### *Marine Surveying.*

(406.) A Marine Survey is the determining, by observations on the ground, of the prominent points of a sea-coast, so that they may be inserted in their true position, as to latitude and longitude, on a Mercator's chart. The intermediate parts of the coast are usually sketched, and the sketches transferred to the corresponding spaces in the chart. The method of determining the soundings, &c. will be apparent from the following description of the different steps of a marine survey in the order in which they may be taken.

(407.) The first thing is to estimate nearly the extent of the survey in latitude and longitude, and to construct a Mercator's chart on a large scale, so as to admit of a few seconds of a degree being set off distinctly on it. This being completed, we may proceed to the ground, and determine the latitude and longitude of a convenient spot or station by astronomical observations. The latitude is best found by repeated meridian altitudes of the sun with a good sextant or a reflecting circle. The method explained in Art. 214, &c. may be practised with very good effect; particularly with such

an instrument as is described generally in Art. 116. The longitude is best determined by means of a chronometer, the error of which on Greenwich mean time has been correctly found at some other place, as also its rate. The sun's altitude is taken both in the morning and the afternoon, when the sun bears nearly east or west, from which mean time at the station is got, and mean time at Greenwich being known from the chronometer, the longitude is easily computed. In these operations the sun's altitude is generally taken by means of an artificial horizon (see Art. 365).

The latitude and longitude of the first station being thus got, its place may be easily determined and marked on the chart.

(408.) The next step is to find the place on the chart of a second station at some distance from the first. This might be done by finding the latitude and longitude of this second station in the same manner as for the former. But as the relative position of the two first stations, upon which depends the correctness of the survey as to the relative position of the other places, might thus be considerably wrong, it is usual to proceed by one or other of the following methods.

*First*, measure a distance of a mile or two in a straight and horizontal line from the first station to a second assumed station. Also determine the true bearing of the second station from the first, by bringing the sun's image to touch it, at the same instant taking the altitude of sun (see Art. 307). Thus knowing the bearing and the distance, we can calculate (see Art. 11, &c.) the difference of latitude and the difference of longitude; and therefore the latitude and longitude of the second station (see App. 51, &c.)

In using this method there must be level ground between the two first stations, which it is often difficult to find to a sufficient extent. When there is such ground, this is the most exact method of getting correctly the relative position of the stations. In the operation of measuring, a chain is generally used, and sometimes rods laid horizontally. The distance is supposed to be got in nautical miles, and, if not, it must be reduced thereto; and the calculations are to be made with the greatest accuracy to the nearest second.

By referring to the figure in plate 2, two stations, such as have been described, will be seen at A and B.

A *second* method of proceeding is to determine the distance of the two first stations, as A and B, by means of a *micrometrical telescope;* by placing well-defined objects at short equal distances on each side of B, and measuring the angle they subtend at A by means of such a telescope.* The distance is then easily deduced with sufficient correctness for any nautical survey. The bearing is found as in the former method, and the calculations are made in the same manner.

The method by the micrometrical telescope has this advantage, that the distance may be thus measured over uneven ground, or over the water, as from one side of a harbour to another.

* There are two fine steel pins on opposite sides of the object glass, the points of which may be brought to coincide with any two distinct marks subtending a small angle at the eye, by drawing a second object glass out from the first. The angle is marked on the tube drawn out. Or a small angle between two distant distinct objects may be measured by substituting a divided object glass for the single moveable one in the instrument. The great accuracy of these measurements enables a surveyor to deduce a distance therefrom with a sufficient degree of accuracy for any nautical survey, and the instrument is on this account very valuable. An explanation of its use is sold with the instrument.

A *third* method is to determine by a good sextant the latitude of the second station B as well as that of A with as much exactness as possible. This is done by taking meridian altitudes of the sun at both stations on the same day by means of an artificial horizon (see Art. 212), or altitudes by the same means a little before and a little after noon (see Art. 214). The latitude of each station is thus known, and the bearing of one from the other being computed, the difference of longitude is deduced by the proportions in Art. 11, and thence the longitude of the second station.*

A *fourth* method is by observing the altitude of the sun or some other heavenly body at each station, when the bearing of the sun seen from one station is the same as the bearing of the other station. The difference of the corrected or true altitudes will then be the distance in nautical miles of the two stations,† and the bearing of the latter station will be the same as that of the sun.

A *fifth* method is by observing, by means of a watch, the interval in seconds between the flash and report of a gun fired first at one station and then at the other. The mean of two, or rather of several trials, will give the number of seconds very nearly. Allowing 1142 feet for one second, and 6075.5 feet to a nautical mile, the distance may be got with considerable accuracy.‡

These are the principal methods which may be practised in actual surveying; and by one or other of them we may suppose the places of A and B, in plate 2, to be got on the chart.

After having thus determined the two first stations A and B, the other steps of the survey will be best understood by giving an example.

(409.) Let it *first* be required to survey a harbour represented in plate 2, with great accuracy.

For this purpose surveyors have theodolites, sextants, measuring-chains, and every necessary instrument and apparatus. They first sail round the harbour and different inlets, and make an eye sketch. In doing this an extensive and level plane is discovered. At one extremity of this the first point A is fixed, and a line is measured from A exactly three *nautical* miles in length, to a second station fixed upon and called B. A theodolite is put up at A and properly adjusted, with its centre exactly over the point measured from. Another is put up at B, and properly adjusted, with its centre over the point measured to. Standing at A the distance of the sun from B is observed, and at the same instant the altitude of the sun's L. L., from which observations the bearing of B from A is found to be N. 40° 2′ E. (see rule, Art. 307). In the meantime the latitude of A is found from observed meridian altitudes, and the longitude by a chronometer, the error of which on Greenwich mean time is supposed to have been very lately ascertained at a place whose longitude is accurately known. The lati-

* In doing this care must be taken to compare the instruments used, by taking altitudes with them at the same place.

† This may be applicable in getting the distance of a boat from the ship or from another boat, when the sun is not too high. The point of contact of the sun on the horizon must be seen over one of the boats. The instruments used should be compared by taking several altitudes simultaneously at the same station from the two boats, or from the boat and ship; thus any error of instrument and dip may be removed.

‡ When Fahrenheit's thermometer stands at 32, velocity of sound is 1090 feet per second, in dry air. When it stands higher, add 1 foot for every degree above 32.

tude at A is 45° 10′ 30″ N., and the longitude 30° 2′ W. Having proceeded so far, assistants are sent round the coast or beach, and poles or flagstaffs are fixed at a distance of about half a mile from each other.

Having made these preparations for the farther prosecution of the survey, an observer at A takes the angle, which each flagstaff makes with B, and also the angle which each principal object in the neighbourhood makes with B. An observer at B then takes the angle, which each of these flagstaffs or objects makes with A; taking care at both principal stations A and B not to observe any angles less than about 10°. The soundings are next taken. A boat is rowed across the harbour, and at short distances the depth of water is measured; at the same instant a flag is hoisted, and the angles it makes at A with B, and at B with A, are measured; taking care as before that the boat is not brought into such a situation that the angle at A or B is less than about 10°. In the figure all station flagstaffs from *a* to *l* are determined from A and B, and all the intermediate soundings, together with the conspicuous objects C, D, and E. Afterwards the theodolites are taken to *d* and *f*, and all the station flagstaffs along the opposite beach from *w* to *dd* are thence determined, together with the soundings between those points which had not been found from A and B, and the conspicuous objects F, G, H, I, and K. The instruments are then moved to *g* and *i*, and the places of the station flagstaffs *m*, *n*, *o*, are thence fixed, with the intermediate soundings. In order to determine the place of *h*, a theodolite is carried thither, and the angles are taken between F and E, and E and D. In going round the beach the form of the coast between the different flagstaffs is sketched, and it is at the same time noted down whether the shore is rocky or sandy, steep or shelving. In sounding, not only the depth is put down, but also the nature of the bottom is noted at the corresponding spot on the chart.

(410.) We have in the above plan of proceedings supposed the figure to be the ground to be surveyed. It must now be considered as the chart containing the survey, the method of constructing which may be described in a few words.

Consider within what limits of latitude and longitude the survey is contained, as near as can be estimated roughly. Take a convenient distance, as one inch, two inches, &c. for a mile of longitude. Draw a fine line on the bottom of the paper, upon which take the proper number of miles, and proceed in getting in the side lines for setting off the latitude as directed in Art. 399, &c. Marking at the bottom the lowest latitude assumed, find meridional parts for the next mile, and taking them on the longitudinal scale, set them up the side line. Proceed in a similar way with the second line of latitude and so on to the top of the chart.

Draw the lines at the top of the chart, and then as many intermediate meridians and parallels of latitude as may appear necessary. Subdivide the miles of latitude, and, before anything further is done, put the lines already drawn into ink, and write the proper latitude and longitude at the principal divisions. The latitude and longitude of A are 45° 10′ 30″ N. and 32° 2′ W. From these and the bearing and distance of B, namely, N. 40° 2′ E. 3 miles, the latitude and longitude of B are computed to be 45° 12′ 47″.8 N. and 31° 59′ 15″.7 W. From these latitudes and longitudes, the places of A and B are easily determined on the chart. Put the centre of a protractor on A, and zero on the line AB or AB produced; make a dot with the steel point, properly set, at the different angles measured at A, or at as many of

them as can be included without confusion. Draw fine straight lines in pencil through these points from A, and mark each with the distinguishing letter of the object to be found. In a similar manner set off the corresponding angles observed at B, and draw straight lines through the spots thus got, marking them also with the name of the object observed. The points where the lines, drawn from A and B, and marked with the same letter, meet, will be the points required. At these put the distinguishing letters, and rub out the pencil lines. Draw other lines from A and B, and thus go on, till all the station flagstaffs, conspicuous objects, and points of sounding observed therefrom, are fixed on the chart. Each point of sounding must be marked with a figure denoting the depth of water at low water after an average spring tide (see Art. 315).*

(411.) Having determined all the points seen from A and B, put the protractor now first at *d* and then at *f*, and set off the angles observed there. Thus find the points seen from *d* and *f*. Proceed afterwards with the protractor to *g* and *i*, and determine the points seen thence. The situation of *h* is found by means of a station pointer. Set one ruler to the angle F*h*E, and the other to the sum of F*h*E and E*h*D. Put the edge of the fixed ruler on F, and shift the centre round till the edges of the moveable rulers pass over E and D. Through the central hole make a mark with the steel pen, and this will be the place of *h* on the chart.

Now sketch in the coast in pencil, and represent on it the parts that are rocky and abrupt, or sandy and flat. Shade it finely towards the land. Where a sand bank in the harbour is dry at low water, put dots; where rocks are dry at low water, put a little shading and small crosses. Sketch the conspicuous objects laid down, as D, E, &c. Denote the time of change tide, and the heights of spring tide and neap tide by Roman figures, in as many parts of the harbour as they have been observed and appear necessary. Describe a compass, if possible, on a part of the land, as there it will not interfere with the figures put for the depth of water. Finally, let all that has been thus done be put into ink with as much neatness and distinctness as possible; and the chart will be complete.

(412.) We have supposed in the above example of a marine survey, that the persons employed have an unlimited command of instruments and other means. But it will frequently happen that a single observer may be called upon to go through all the necessary operations himself with very few instruments. In such a case he may, if he choose, determine the conspicuous objects C, D, E, &c. with the flagstaffs *a*, *b*, *c*, &c. first by taking angles at A, and then B. Or, if he prefer this mode of proceeding, he may thus determine the places of the conspicuous objects C, D, E. &c.; and then those of the coast stations by taking at each the angles which one of the conspicuous objects makes with two others, using a station pointer to find the coast stations. Or he may possibly use both methods.

In fixing the points of sounding, he cannot proceed in the manner described in the above example; for in doing so he would be under the necessity of going from A to B at every sounding, for the purpose of taking the angles which the boat at that instant made with each of these principal points. Instead of this he must take two angles, at each place of sound-

* The rise and fall of the tide should be determined at some point at short intervals, while the sounding is going on, and thus the soundings taken at any time may be reduced to low water.

ing, between three of the principal objects, and by setting the station pointer to the angles he easily finds the place of sounding on the chart.*

The three objects chosen in taking these two angles should be such, that each of the angles may be as nearly as possible 120°; the instrument used in taking the angles is a sextant. The arms of the station pointer set to the angles are put on the chart over the spots corresponding to the three objects, and the centre of it at the place of sounding, which should be marked accordingly.

(413.) The following may be considered as a *second* example of marine surveying. It is required to survey the coast of the island in plate 3, without landing, and in as short a time as possible. For this purpose suppose three boats are anchored on the coast at A, B, and C, about 5 or 6 miles asunder, two of them. as A and B, being nearly north and south, so that when the sun is nearly east or west, it may be nearly abreast of AB. The latitude and longitude of A are determined, the former by meridian altitudes of the sun or by the method in Art. 214; the latter by means of a chronometer. The latitude of B is determined by similar methods to those used for A, and if practicable with the same instrument; and the true bearing of B from A by taking the sun's distance from B at the same instant the altitude of its L. L., when the sun is nearly abreast of the line AB (see Art. 307). Knowing the two latitudes and the bearing or course, the difference of longitude between A and B may be easily computed by the proportions in Art. 11, and thence the longitude of B. Thus therefore we know the latitude and longitude of both A and B, and can fix them on the chart.†

(414.) Let A and B therefore be now considered as known points on the chart. The next step is to determine the place of the boat at C, which is done by observing at A the angle between B and C, and at B the angle between A and C; these two angles being set off at the points A and B on the chart, and lines being drawn making those angles with AB, the point of their intersection will be at C. Thus the places of the three boats on the chart are found. When the boats A and C, or B and C, are more conveniently placed for taking the sun's distance and altitude, and computing the bearing of one from the other (see Art. 307), the observer may proceed thus: find, as above, the latitude and longitude of A and C, or B and C, and then, by means of angles taken at these two, the position of the third boat.

Let the boat C be now supposed to sail on the coast, and a person in it, to sound at short intervals, and at the same instant to hoist a flag, while the observers at A and B take angles, the former between B and the flag, the latter between A and the flag. These two angles being set off at A and B on the chart, the place thereon for the soundings is known, and thus a sufficient number of soundings are taken abreast

* It is usual in common cases to sail or row uniformly from one known point to another, sounding at equal intervals, and to divide the corresponding line on the chart into as many equal parts as intervals; thus putting in the corresponding soundings.

† If one of the boats be stationed so as to bear nearly east or west from another, it is possible that the *fourth* method (Art. 408) of determining its bearing and distance may be applied. If the *fifth* method be applied, the boats should be stationed so that, as points of reference, the ground and soundings may be most easily and correctly laid down by angles taken either from them or from the moveable boat or boats.

of A and B. At the same time the prominent points of land are determined in a similar manner by taking angles at A and B, and the line of coast is sketched in.

(415.) When the the angles taken from A and B become too acute, that is, less than 10°, let the sounding boat be anchored up the coast as at *o*, a point previously fixed on the chart from A and B, and let the boat A be shifted from A to some point outside as at D, so that B and D may be abreast of *o* and of a second portion of the coast. To find the place of D on the chart, take at B the angle between D and *o*, and at D take the angle between B and *o*, subtract the sum of these two angles from 180°, and the remainder will be the angle at *o*, between B and D. On the chart set off the angle at B, and at *o* the angle at *o*; the lines drawn will meet at the place of D. Then proceed as before, moving the sounding boat from *o*, taking new soundings, and fixing their places by angles taken at B and D, and also the prominent points, &c., of the coast as before. When this part of the survey is finished, the boat B must be moved farther up the coast, and a similar process to the one just explained must be repeated, till the whole coast is surveyed and entered on the chart.

It may be observed that the soundings should be taken as much as possible at low water, or if this be not practicable, an allowance should be made by noting the rise and fall of the water at some near point.

In continuing the survey round the island, the latitude should be found from a meridian altitude of the sun whenever it is practicable, and the survey verified or corrected by this latitude.

(416.) Sometimes in such a survey, in order to have the use of more boats in sounding, &c., buoys with flags are placed for known points of reference. Thus should there be only one boat, buoys may be fixed both at A and B, the angle taken at C between A and B, and then a buoy being left at C, the boat may be brought to A and the angle observed there between B and C. Or this method may be adopted: fix these buoys, one on each side of the part to be surveyed, as at A, B, and *d*. Fix the places of these buoys on the chart as A, B, and C were fixed (Art. 413), and then in sounding take two angles between these buoys, which with the aid of a station pointer will determine the place of the sounding boat on the chart. Any prominent point of the coast is determined by taking the angles between it and one of the buoys at two places of the sounding boat which may be considered as known. This part of the coast being surveyed, two of the buoys, as A and C, are shifted farther up the coast, their new places being fixed on the chart by taking angles from the last known station of the sounding boat, and from the buoy at B which has not been moved. The surveyor may thus extend his survey round the island.

(417.) The *third* example in marine surveying is merely to fix places on the chart of any prominent points of land or other objects in sailing past them.

Make correct observations in the ship to determine its latitude, as often as possible. Determine also the longitude by chronometer, whose error on Greenwich is supposed known at the commencement of the survey with considerable exactness; and keep the log account correctly, so that upon the whole the ship's place on a chart may be marked off at the end of every hour. When a point of land is seen, take its bearing with azimuth com-

pass, and then again afterwards, supposing the bearing of the point to have changed several points; taking care to note the hour and minute of each observation. Do this for the different prominent points of land as they are passed. Sketch the coast, and take soundings in the ship. Having constructed a chart to the limits of the run along the coast, mark off the ship's place at the beginning of each hour, and the track of the ship as nearly as possible in the intervals. From the places, whence two bearings of the same points of land were taken, draw straight lines in the direction of the true bearings; and they will meet in the spot on the chart corresponding to the point of land observed. Thus find the place on the chart of every object or headland, of which two bearings have been taken. Sketch in the coast, and add the soundings taken in the ship's track, by dividing the hour stations into equal parts.

Or (which would be far more accurate) the true bearings of the prominent points of land and other objects may be determined by taking the distance of the sun, moon, or a star from them and the altitude of the heavenly body at the same time; from which observations, properly taken, the bearing may be found with much greater accuracy than by means of the azimuth compass. The true bearing of any prominent object being thus got at two known positions of the ship, the place of the object is fixed on the chart as just explained (see Art. 307, and *App.* 50, &c.)

# EXAMPLES.

(418.) NOTE.—The following easy examples to the foregoing rules may perhaps be of some use to the young student in Navigation and Nautical Astronomy. They will be found arranged in sets, under distinct letters, A, B, C, &c., and the elements necessary for working them will be found subjoining each set. The answers considered as correct are added to the elements for each example.

In using the elements put down, the young student may at the same time turn to the proper page and column in any Nautical Almanac, whereby he will acquire a facility in taking the necessary elements from the Nautical Almanac, when required for observations made at sea.

It must be recollected that the R. A. of the *mean sun* is found in the Nautical Almanac, in page 11 of each month, in the column headed *Sidereal Time* (see note, p. 79): and also, that the *equation of time* is marked *Add* or *Subt.*; as directed in the note, p. 79.

## A.

1. Required the course and distance from A to B, lat. A 63° 53 S., long. A 15° 26′ E.; lat. B 59° 10′ S., long. B 22° 10′ E.

2. The latitude of a ship is 50° 4′ N. and long. 16° 21′ W.; required the course and distance to the Land's End.

3. A point of land bore from me E. b. N. ½ N., and a current run in the intermediate space due E. 4½ miles an hour; how must I steer a boat to fetch the point of land, supposing I can pull in still water 7 miles an hour?

4. Feb. 1, 1836, at noon, a point of land in latitude 49° 56′ S., and long. 7° 12′ E. bore by compass W. b. S. ½ S. distant 19 miles (variation 1¾ E.); afterwards sailed as by the following log account: required the latitude and longitude in on Feb. 2, at noon.

| H. | K. | $\frac{1}{10}$ths | Course. | Wind. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 4 | 2 | S.S.W. ½ W. | West. | 2¾ | P.M. |
| 2 | 4 | 5 | | | | |
| 3 | 3 | 7 | | | | |
| 4 | 3 | 6 | | | | |
| 5 | 4 | 0 | | | | |
| 6 | 3 | 7 | S.S.E. | East. | 2½ | Variation 1¾ E. |
| 7 | 4 | 3 | | | | |
| 8 | 4 | 5 | | | | |
| 9 | 4 | 7 | | | | |
| 10 | 8 | 4 | W. ½ N. | North. | 0 | |
| 11 | 9 | 2 | | | | |
| 12 | 10 | 3 | | | | |
| | | | | | | Remarks in H. M. S. February 2, 1836. |
| 1 | 10 | 5 | .. | .. | .. | A.M. |
| 2 | 10 | 6 | | | | |
| 3 | 10 | 4 | | | | |
| 4 | 11 | 5 | | | | |
| 5 | 4 | 6 | W.S.W. | S. ½ W. | 2½ | During the 24 hours a current set the ship by compass, N.N.E. ½ E. 24 miles. |
| 6 | 3 | 7 | | | | |
| 7 | 3 | 2 | | | | |
| 8 | 3 | 4 | | | | |
| 9 | 3 | 6 | | | | |
| 10 | 4 | 0 | | | | |
| 11 | 4 | 5 | | | | |
| 12 | 4 | 6 | | | | |

5. At what time (mean) will α Tauri (Aldebaran) pass the meridian of St. Petersburgh, on Feb. 8, 1836, and how far N. or S. of zenith?

6. Feb. 2, 1836, in longitude 76° 25′ E., the observed meridian altitude of the sun's L. L. was 30° 10′ 40″ (zenith N. of the sun); the index correction was —2′ 20″, and the height of the eye above the sea was 13 feet: required the latitude.

7. Feb. 21, 1836, at 3ʰ 50ᵐ P.M. (mean time nearly) in longitude 104° 13′ W., the observed meridian altitude of the moon's L. L. was 40° 25′ 32″ (zenith N. of the moon); the index correction was +4′ 10″; and the height of the eye above the sea was 20 feet: required the latitude.

8. Feb. 2, 1836, the observed meridian altitude of the star α Tauri (Aldebaran) was 29° 52′ 10″ (zenith S. of the star); the index correction was +5′ 20 , and the height of the eye above the sea was 15 feet: required the latitude.

9. Feb. 2, 1836, the observed meridian altitude of the star α¹ Crucis, under the S. Pole, was 11° 25′ 10″; the index correction was — 5′ 50″, and the height of the eye above the sea was 14 feet: required the latitude.

10. Feb. 2, 1836, at 1ʰ 20ᵐ A.M. (mean time nearly), in longitude 178° 22′ W., the observed altitude of α Urs. Min. (Polaris) was 54° 27′ 10″; the index correction was —2′ 45″, and the height of the eye above the sea was 13 feet: required the latitude.

11. Oct. 29, 1836, observed the following double altitude of the sun.

| Mean T. nearly | Chronometer. | Obs. Alt. Sun's L. L. | Tr. Bearing. |
|---|---|---|---|
| 11h 15m A.M. | 11h 21m 15s | 25° 26′ 20″ | S. ¾ E. |
| 11 30 A.M. | 11 37 55 | 25 55 0 | S. ¼ E. |

The run of the ship in the interval was S.W. 1 mile; the index correction was +3′ 50″; and the height of the eye above the sea was 20 feet: required the latitude at the second observtaion, the latitude by account being 52° N. and the longitude 47° 10′ W.

12. Feb. 8, 1836, at 4h 30m P.M., in latitude 36° 20′ S., and longitude by account 75° W., a chronometer showed 10h 48m 2s, and the observed altitude of the sun's L. L. was 25° 25′ 25″; the index correction was — 1′ 50″ and the height of the eye above the sea was 14 feet: required the true longitude.

The chronometer, at Gr. noon on Feb. 8, 1836, was *fast* on Greenwich mean time 1h 2m 21s, and its daily rate was 8s.6 *gaining*.

13. Feb. 2, 1836, at 11h 58m P.M. in latitude 22° 20′ N., and longitude by account 41° 50′ E., the following lunar observation was taken.

| Obs. Alt. α Tauri (Aldebaran) West. | Obs. Alt. Moon's L. L. | Obs. Dist. F. L. |
|---|---|---|
| 21° 58′ 30″ | 89° 10′ 40″ | 67° 39′ 30″ |
| 2 50+ | 1 10 — | 3 20 + |

The height of the eye above the sea was 14 feet: required the true longitude.

14. Feb. 3, 1836, at 7h 10m P.M., in latitude 49° 12′ S., and longitude 115° 28′ E., the sun set by compass W. 10° 42′ S.: required the variation.

15. Feb. 3, 1836, at 5h 0m A.M., in latitude 51° 10′ S., and longitude 125° 10′ W., the compass bearing of the sun was E. 2° 10′ N.: and the observed altitude of the sun's L. L. was 5° 20′ 10″; the index correction was +1′ 50″, and the height of the eye above the sea was 14 feet: required the variation.

16. Required the mean time of high water on Feb. 20, 1836, A.M. and P.M. Change Tide 4h 50m P.M. App. T., long. 50° W.

## *Elements for* A, *from Nautical Almanac* 1836, *with Answers.*

1. N. 34° 13′ E. 342′.2 miles.
2. East 410.2 miles.
3. N.E.b.E.
4. Corrected courses E ¼ S. 19′ Dep. Course; S. b. W ½ W. 20′; S. S. W. 17′.2; N.W. b. W. ¾ W. 70′.9; N.W. b. W. ¾ W. 31′.6; N.E. ¼ E. 24′. Latitude in 49° 32′ S., longitude in 5° 26′ E.
5. R. A. mean sun, Feb. 8, at Gr. mean noon, 21h 10m 32s.21. R. A. α Tauri 4h 26m 30s.9, decl. 16° 10′ 28″ N. At 7h 15m, S. of zenith 43° 45′ 30″.
6. Sun's decl. on Feb. 1, at Gr. mean noon, 17° 17′ 8″ S.; on Feb. 2. 17° 0′ 5″ S.; sun's semid. 16′ 15″. Latitude 42° 36′ 58″ N.
7. Moon's decl. on Feb. 21, at 10h mean time, 11° 18′ 9″ N., at 11h 11° 30′ 50″ N.; moon's semid. on Feb. 21, at Gr. mean noon, 15′ 6″.3, on Feb. 21, at Gr. mean midn. 15′ 1″.5; corresponding hor. par. 55′ 26″ and 55′ 8″. Latitude 60° 6′ 53″ N.
8. Decl. 16° 10′ 28″ N. Latitude 43° 57′ 32″ S.
9. Decl. 62° 11′ 5″ S. Latitude 38° 59′ 49″ S.
10. R. A. mean sun on Feb. 2, at Gr. mean noon, 20h 46m 52s.9. Latitude 55° 30′ N.
11. Sun's decl. on Oct. 29, at Gr. mean noon, 13° 34′ 33″ S., on Oct. 30, 13° 54′ 18″ S., sun's semid. 16′ 8″. Latitude 49° 56′ N.
12. Sun's decl. on Feb. 8, at Gr. mean noon, 15° 11′ 51″ S.; on Feb. 9, 14° 52′ 52″ S.: corresponding equ. time 14m 28s.5 A., and 14m 30s.8 A. Hour angle W. 4h 36m 22s. Longitude 73° 41′ 30″ W.
13. R. A. mean sun on Feb. 2, at Gr. mean noon, 20h 46m 52s.9; decl. of α Tauri 16h 10m 28s N.; R. A. α Tauri 4h 26m 31s. Moon's hor. semid. on Feb. 2, at Gr. mean noon, 15′ 7″.3, at Gr. mean midn., 15′ 11″.2: cor. hor. par. 55′ 29″.6, and 55′ 43″.8. True dist. 67° 30′ 20″; dist. from Naut. Alm. at IX, 67° 23′ 32″; at XI, 68° 57′ 39″. Hour angle 4h 49m 54s. Longitude 48° 46′ 7″ E.
14. Sun's decl. on Feb. 2, at Gr. noon, 17° 0′ 5″ S., on Feb. 3, 16° 42′ 45″ S. Tr. bearing W. 26° 7′ 30″ S. Variation 15° 25′ 30″ W.
15. Sun's decl. on Feb. 3, at Gr. mean noon, 16° 42′ 45″ S on Feb. 4, 16° 25′ 8″. S. semid. 16′ 14″ W. Tr. bearing S. 69° 59′ 15″ E. Variation 22° 10′ 45″ E.
16. Moon's Gr. mer. passage, Feb. 20, 3h 12m.8; Feb. 19, 2h 29m.4. Eq. T. 14m sub. to M. T., moon's semid. 15′ 17″. High Water 6h 58m A.M. and 7h 20m P.M.

## B.

1. Required the course and distance from A to B. Lat. A 56° 10′ N., long. A 1° 20′ W., lat. B 50° 15′ N., long. B 4° 30′ W.

2. Required the course and distance from A to B. Lat. A 65° 25′ S., long. A 120° 13′ W., lat. B 65° 25′ S., long. B 115° 40′ W.

3. A point of land bore from me North, and a current run in the intermediate space E.N.E., 3½ miles an hour; how must I steer a boat to fetch the point, supposing I can pull in still water 6 miles an hour?

4. Oct. 14, 1835, at noon a point of land in latitude 50° 20′ S., and longitude 20° 10′ E., bore by compass E. ½ N. distant 15 miles (variation 2½ W.); afterwards sailed as by the following log account: required the latitude and longitude in on Oct. 15, at noon.

| H. | K. | 1/10 ths | Course. | Wind. | Leeway. | |
|---|---|---|---|---|---|---|
| 1 | 3 | 5 | S.S.W. ½ W. | West. | 2¾ | P. M. |
| 2 | 3 | 6 | | | | |
| 3 | 4 | 0 | | | | |
| 4 | 4 | 2 | S.S.W. | W. ½ N. | 1¾ | |
| 5 | 4 | 3 | | | | |
| 6 | 4 | 4 | .. | .. | .. | Variation 2¼ W. |
| 7 | 4 | 1 | | | | |
| 8 | 3 | 7 | | | | |
| 9 | 3 | 6 | | | | |
| 10 | 4 | 2 | N.N.W. ½ W. | W. ½ S. | 2 | |
| 11 | 4 | 3 | | | | |
| 12 | 5 | 0 | | | | |
| | | | | | | Remarks in H. M. S. Oct. 15, 1835. |
| 1 | 4 | 2 | .. | .. | .. | A. M. |
| 2 | 4 | 3 | E. b. S. ¾ S. | S. ½ E. | 2½ | |
| 3 | 4 | 2 | | | | |
| 4 | 3 | 6 | | | | |
| 5 | 3 | 4 | S.W. b. W. | Do. | 2½ | |
| 6 | 3 | 5 | .. | .. | .. | A current set the ship E.S.E. 2 miles an hour the whole day. |
| 7 | 4 | 3 | | | | |
| 8 | 4 | 7 | | | | |
| 9 | 4 | 6 | | | | |
| 10 | 9 | 2 | S. ½ E. | West. | 0 | |
| 11 | 9 | 4 | | | | |
| 12 | 9 | 6 | | | | |

5. What bright fixed stars will pass the meridian of Greenwich between 11ʰ 10ᵐ P. M. on Feb. 22, 1836, and 1ʰ 40ᵐ A.M. on Feb. 23, 1836?

6. Feb. 11, 1836, in longitude 32° 20′ E., the observed meridian altitude of the sun's L. L. was 30° 25′ 10″, zenith N. of the sun; the index correction was —3′ 15″, and the height of the eye above the sea was 12 feet: required the latitude.

7. Feb. 11, 1836, at 7ʰ 0ᵐ A.M., in longitude 25° 16′ W., the observed meridian altitude of the moon's L. L. was 28° 10′ 40″ (zenith N. of moon); the index correction was +4′ 15″, and the height of the eye above the sea was 19 feet: required the latitude.

8. Feb. 10, 1836, the observed meridian altitude of α Arietis was 50° 25′ 10″ (zenith S. of the star); the index correction was +3′ 10″, and the height of the eye above the sea was 12 feet: required the latitude.

9. Nov. 15, 1836, the observed meridian altitude of α Argus (Canopus), under the South Pole, was 40° 20′ 50″; the index correction was +4′ 24″, and the height of the eye above the sea was 20 feet: required the latitude.

10. Feb. 8, 1836, at 10ʰ 40ᵐ P.M., in longitude 178° 40′ E., the observed altitude of α Urs. Min. (Polaris) was 68° 40′ 10″; the index correction was —4′ 10″, and the height of the eye was 11 feet: required the latitude.

11. June 2, 1836, the following double altitude of the sun was observed.

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L. L. | Tr. Bearing. |
|---|---|---|---|
| 9h 50m A.M. | 9h 52m 28s | 51° 17′ 45″ | S.E. ½ S. |
| 11 15 A.M. | 11 14 29 | 59 32 15 | S. b. E. |

The run of the ship in the interval was W.S.W. ½ W. 10 miles; the index correction was — 40″; and the height of the eye above the sea was 12 feet: required the true latitude, the latitude by account being 52° N., and the longitude 21° W.

12. June 5, 1836, at 9h 15m A. M. mean time nearly, in latitude 48° 32′ N., and longitude 14° 5′ W., a chronometer showed 9h 51m 5s, and the observed altitude of the sun's L. L. was 47° 10′ 15″; the index correction was +1′ 20″, and the height of the eye above the sea was 15 feet: required the true longitude.

May 27, 1836, at Gr. mean noon, the chronometer was *slow* on Greenwich mean time 12m 50s, and its daily rate was 4s.5 *losing*.

13. April 2, 1836, at 0h 15m A. M., in latitude 30° 10′ N., and longitude by account 46° 20′ E., the following lunar observation was taken.

| Obs. Alt. α Leonis West of Mer. | Obs. Alt. Moon's L. L | Obs. Dist. N. L. |
|---|---|---|
| 45° 25′ 20″ | 56° 42′ 10″ | 44° 2′ 10″ |
| + 1 30 | − 1 20 | − 0 50 |

The height of the eye above the sea was 18 feet: required the true longitude.

14. Feb. 10, 1836, at 5h 2m P. M. mean time nearly, in lat. 50° 48′ N., and longitude 142° 25′ E., the sun set by compass W. 5° 10′ N.: required the variation.

15. Feb. 10, 1836, at 8h 2m A. M., in latitude 50° 48′ N., and longitude 91° 10 W., the compass bearing of the sun was S. 70° 10′ E.; and the observed altitude of its L. L. was 7° 10′ 40″; the index correction was − 1′ 10″, and the height of the eye above the sea was 15 feet: required the variation.

16. Required the time of high water at A on April 10, 1836, A. M. and P. M. Change Tide at 4h 50m P. M. app. time. Long. A 89° 10′ W.

## *Elements for* B, *from Nautical Almanac* 1836, *with Answers.*

1. S. 17° 44′ 15″ W. 372′.7 miles.
2. E. 113′.5 miles.
3. N.N.W. ½ W.
4. Corrected courses S.W. b. W. ½ W. 15′ Dep. Course; S.S.E. ½ E. 11′.1; S.S.E 24′.3; N.N.W. ½ W. 17′.7; N.E. b. E. ½ E. 12′.1; S.W. b. W. ½ W. 20′.5; S.S.E. ½ E. 28′.2; E. ½ N. 48′. Latitude in 51° 10′ 30″ S.; longitude in 21° 27′ E.
5. R. A. of mean sun Feb. 22, at Gr. mean noon, 22h 5m 43s.97; R. A. α Hydræ 9h 19m 32s.6; R. A. γ Urs. Maj. 11h 45m 12s.3. From α Hydræ to γ Urs. Maj. inclusive.
6. Sun's decl. on Feb. 10, at Gr. mean noon, 14° 33′ 39″ S.; on Feb. 11, 14°14′ 10″ S. semid. 16′ 13″. Latitude 45° 11′ 4″ N.
7. Moon's decl. on Feb. 10, at 20h Gr. mean time, 22° 48′ 32″ S., at 21h 22° 57′ 11″ S.; moon's hor. semid. on Feb. 10, at Gr. midn., 16′ 10″.2, Feb. 11, at noon 16′ 12″.6, corresponding hor. par. 59′ 20″ and 59′ 29″. Latitude 37° 48′ 5′ N.
8. Decl. α Arietis 22° 41′ 3″ N. Latitude 16° 54′ 50″ S.
9. Decl. of α Argus (Canopus) 52° 36′ 13″ S. Latitude 77° 43′ 29″ S.
10. R. A. of mean sun on Feb. 7, at Gr. mean noon, 21h 6m 35s.66. Latitude 68° 56′ N.
11. Sun's decl. on June 1, at Gr. mean noon, 22° 6′ 22″ N., on June 2, 22° 14′ 14″ N.; semid. 15′ 47″, Latitude 50° 47′ 45″.
12. Sun's decl. on June 4, at Gr. mean noon, 22° 28′ 48″ N.; on June 5, 22° 35′ 30″ N.; cor. Eq. T. 2m 3s.3 S., and 1m 53s.1 S.; semid. 15′ 47″. Longitude 14° 29′ 30″ W.
13. R. A. mean sun on April 1., at Gr. mean noon, 0h 39m 29s.57; moon's hor. semid. on April 1, at Gr. mean noon, 15′ 58″.7, at Gr. midn. 16′ 3″.5; cor. hor. par. 58′ 38″.1, and 58′ 55″.9. True dist. 44° 9′ 4″; dist. from Naut. Alm. at 1X 44° 3′ 39″, at midn. 45° 48′ 46″. Hour angle 2h 58m 21s W. Longitude 46° 56′ E.
14. Sun's decl. on Feb. 9, at Gr. noon, 14° 52′ 52″ S., on Feb. 10, 14° 33′ 39″ S. True bearing W. 23° 44′ 45″ S. Variation 28° 42′ 15″ W.
15. Sun's decl. on Feb. 10, at Gr. mean noon. 14° 33′ 39″ S.; on Feb. 11, 14° 14′ 10″ S.; semid. 16′ 13″. Tr. bearing N. 123° 47′ 15″ E. Variation 13° 57′ E.
16. Moon's Gr. mer. passage on April 10, 20h 42m. M. T., April 9, 19h 49m: semid, 15′ 51″. Eq T. 1m S. from M. T. High Water 0h 31m A. M., and 0h 57m P. M.

## C.

1. Required the course and distance from A to B. Lat. A 57° 36′ N., long. A 2° 10′ E.; lat. B 64° 15′ N., long. B. 5° 16′ W.

2. Find the course and distance from X to Y. Lat. X 49° 15′ N., long. X 20° 15′ W.; lat. Y 49° 15′ N., long. Y 10° 2′ E.

3. On Dec. 1, 1836, a point of land bore from me N.N.E., and a current run in the intermediate space, N.b.W. 3 miles an hour; how must I steer, supposing I can pull in still water 5 miles an hour?

4. On Dec. 1, 1836, in longitude 18° 26′ E., and latitude 34° 28′ S., a point of land bore N. W. 10 miles (variation of the compass 2¼ W.); afterwards sailed as by following log account; required the latitude and longitude in on Dec. 2, 1836.

| H. | K. | ¼ 16ths. | Course. | Wind. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 5 | 4 | N. b. E. ½ E. | N.W. ½ W. | 2½ | A. M. |
| 2 | 5 | 2 | | | | |
| 3 | 5 | 8 | | | | |
| 4 | 6 | 1 | | | | |
| 5 | 6 | 5 | S.S.W. | N.W. | ¼ | Variation 2¼ W. |
| 6 | 7 | 3 | | | | |
| 7 | 7 | 0 | | | | |
| 8 | 7 | 2 | | | | |
| 9 | 6 | 8 | N.W. b. W. | S.E. | 0 | |
| 10 | 6 | 5 | | | | |
| 11 | 6 | 1 | | | | |
| 12 | 5 | 8 | S. b. W. ¾ W. | S.E. ½ E. | 2½ | . |
| | | | | | | Remarks in H. M. S., Dec. 2, 1836. |
| 1 | 6 | 0 | .. | .. | .. | A. M. |
| 2 | 6 | 5 | | | | |
| 3 | 6 | 8 | | | | |
| 4 | 6 | 4 | N.N.E. | N.W. | 2 | |
| 5 | 6 | 0 | | | | |
| 6 | 6 | 5 | .. | .. | .. | A current set the ship the last 5 hours |
| 7 | 6 | 8 | | | | N.W. 2 miles an hour. |
| 8 | 7 | 2 | N.W. | East. | 0 | |
| 9 | 7 | 6 | | | | |
| 10 | 7 | 9 | | | | |
| 11 | 8 | 1 | | | | |
| 12 | 8 | 5 | | | | |

5. At what time was γ Draconis on the meridian of Lisbon on May 1, 1836; and how far N. or S. of the zenith?

6. Oct. 20, 1836, in longitude 150° 25′ E. the observed meridian altitude of the sun's L. L. was 50° 25′ 10″ (zenith S. of the sun); the index correction was —5′ 10″; and the height of the eye above the sea was 19 feet: required the latitude.

7. Oct. 12, 1836, at 4$^h$ 27$^m$ A.M. mean time nearly, in longitude 50° 40′ E., the observed meridian altitude of the moon's L. L. was 39° 52′ 40″ (zenith N. of the moon); the index correction was —10′.40″, and the height of the eye above the sea was 20 feet: required the latitude.

8. July 5, 1836, the observed meridian altitude of α Arietis was 40° 20′ 25″ (zenith N. of the star); the index correction was —4′ 25″, and the height of the eye above the sea was 19 feet: required the latitude.

9. Jan. 15, 1836, the observed meridian altitude of α Urs. Maj., under the North Pole, was 13° 42′ 20″; the index correction was — 4′ 10″, and the height of the eye above the sea was 20 feet: required the latitude.

10. July 7, 1836, at 5$^h$ 20$^m$ A. M. mean time nearly, in longitude 100° 20 E., the observed altitude of α Urs. Min. (Polaris) was 70° 20′ 10″; the index correction was +1′ 50″, and the height of the eye above the sea was 12 feet: required the latitude.

11. On April 10, 1836, the following double altitude of the sun was observed:—

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L. L. | Tr. Bearing. |
|---|---|---|---|
| 11h 0m A. M. | 6h 5m 10s | 40° 10′ 15″ | S.S.E. |
| 2 0 P. M. | 9 6 10 | 35 15 40 | S.W.b.S. |

The run of the ship in the interval was N. N. E. 29 miles; the index correction was + 2′ 10″; and the height of the eye above the sea was 18 feet: required the true latitude, the latitude by account being 50° 15′ N., and the longitude 110° 15′ W.

12. May 10, 1836, at 3h 10m P. M. mean time nearly, in latitude 48° 12′ N., and longitude by account 45° 10′ E., when a chronometer showed 0h 10m 42s, the observed altitude of the sun's L. L. was 37° 20′ 10″; the index correction was +3′ 10″, and the height of the eye above the sea was 18 feet: required the true longitude.

On May 1, at Gr. mean noon the chronometer was *fast* on Gr. mean time 9m 50s, and its daily rate was 3s.2 *gaining*.

13. March 22, 1836, at 3h 30m P. M. mean time nearly, in latitude 50′ 50″ N., and longitude by account 48° W., the following lunar observation was taken:—

| Obs. Alt. Sun's L. L. | Obs. Alt. Moon's L. L. | Obs. Dist. N. L. |
|---|---|---|
| 23° 50′ 10″ | 57° 10′ 30″ | 61° 40′ 40″ |
| Ind. cor. − 1 20 | + 2 10 | − 0 40 |

The height of the eye above the sea was 12 feet: required the true longitude.

14. Feb. 3, 1836, at 7h 10m P. M. mean time nearly, in latitude 49° 12′ S., and longitude 115° 28′ E., the sun set by compass W. 10° 42′ S.: required the variation.

15. Feb. 3, 1836, at 5h 0m A. M. mean time nearly, in latitude 51° 10′ S., and longitude 125° 10′ W., the compass bearing of the sun was E. 2° 10′ N.; and the observed altitude of the sun's L. L. was 5° 20′ 10″; the index correction was +1′ 50″, and the height of the eye above the sea was 14 feet: required the variation.

16. Required the mean time of high water on May 19, 1836, A.M. and P.M. Change Tide 3h 50m P. M. app. time. Long. 110° W.

## *Elements for* C, *from Nautical Almanac* 1836, *with Answers.*

1. N. 28° 23′ 45″ W. 453′.6
2. East 1186′.1
3. N.E. ½ N.
4. Corrected courses E. b. S. ¾ S. 10′ Dep. Course; N. b. E. ¼ E. 22′.5; S. ½ E. 28′; W. ¾ N. 19′.4; S. b. W. ¾ W. 25′.1; N. b. E. ¾ E. 25′.7; W. b. N. ¾ N. 39′.3: W. b. N. ¾ N. 10′. Latitude in 34° 17′ 54″ S.; longitude in 17° 32′ E.
5. R.A. of mean sun May 1, at Gr. mean noon, 2h 37m 46s.2. R. A. γ Draconis 17h 52m 49s.7, decl. 51° 30′ 19″ N. At 15h 12m 28s; north of zenith 12° 48′ 19″.
6. Sun's decl. on Oct. 19, at Gr. mean noon, 10° 6′ 23″ S.; on Oct. 20, 10° 27′ 59″ S.; semid. 16′ 6″. Latitude 49° 47′ 38″ S.
7. Moon's decl. on Oct. 11, at 13h, 13° 47′ 30″ S., at 14h, 14° 1′ 48″ S. Moon's hor. semid. on Oct. 11, at Gr. mean midn. 16″ 0″.2, on Oct. 12, at Gr. mean noon 16′ 3″.6; corresponding hor. par. 58′ 43″.8 and 58′ 56″. Latitude 35° 33′ 51″ N.
8. Decl. α Arietis 22° 41′ 5″ N. Latitude 72° 30′ 30″ N.
9. Decl. of α Urs. Maj. 62° 37′ 56″ N. Latitude 40° 51′ 53″ N.
10. R.A. of mean sun on July 6, at Gr. mean noon, 6h 57m 59s.01. Lat. 68° 46′ N.
11. Sun's decl. on April 10, at Gr. mean noon, 8° 3′ 56″ N., on April 11 8° 26′ 0″ N.; semid. 15′ 58″. Arc. (1) 44° 45′ 45″. Arc (2) 86° 39′ 30″. Arc (3) 66° 12′ 30″. Latitude 56° 56′ 26″ N.
12. Sun's decl. on May 10, at Gr. mean noon, 17° 42′ 16″ N.; Eq. T. 3m 51s.4 S., sun's semid. 15′ 51″. Longitude 51° 51′ 0″ E.
13. Sun's decl. on March 22, at Gr. mean noon, 0h 45m 45s N.; on March 23 1° 9′ 24″ N.; cor. Eq. T. 6m 57s.6 A and 6m 39s.2 A; sun's semid. 16′ 3″. Moon's hor. semid. on March 22, at Gr. mean noon, 14′ 49″.9, at Gr. mean midn. 14′ 48″.0; cor. hor. par. 54′ 25″.6, and 54′ 18″.6. True dist. 62° 11′ 52″; dist. from Naut. Alm. at VI. 61° 48′ 40″, at IX. 63° 10′ 27″. Hour angle 3h 25m 14s. Longitude 49° 44′ 15″ W
14. Sun's decl. on Feb. 2, at Gr. mean noon, 17° 0′ 5″ N., on Feb. 3, 16° 42′ 45″ S. Tr. bearing W. 26° 7′ 30″ S. Variation 15° 25′ 30″ W.
15. Sun's decl. on Feb. 3, at Gr. mean noon, 16° 42′ 45″ S., on Feb. 4, 16° 25′ 8″ S.; semid. 16′ 15″. Tr. bearing S. 69° 53′ 45″ E. Variation 22° 10′ 40″ E.
16. Moon's Gr. mer. passage on May 19, 3h 7m, on May 18 2h 17m; semid. 14′ 47″. Eq. T. 4m A to M. T. High water 5h 58m A. M., and 6h 23m P. M.

## D.

1. Required the course and distance from A to B. Lat. A 71° 50′ S., long. A 14° 25′ W.; lat. B 66° 42′ S., long. B 20° 10′ W.

2. Sailed from A due West 478 miles; required the latitude and longitude in; lat. A 65° 12′ S., long. A 14° 25′ E.

3. A point of land bore S. W. ½ S. and a current run in the intermediate space S. ½ E. 3.7 miles an hour; how must I steer a boat to fetch the point, supposing I can pull in still water 5.9 miles an hour?

4. Feb. 1, 1836, at noon, a point of land in latitude 49° 56′ S., and longitude 7° 12′ E. bore by compass W. b. S. ½ S. distant 19 miles (variation 1 ¼ E.); afterwards sailed as by the following log account: required the latitude and longitude in on Feb. 2, at noon.

| H. | K. | ½ knots. | Course. | Winds. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 4 | 2 | S.S.W. ½ W. | West. | 2¼ | P.M. |
| 2 | 4 | 5 | | | | |
| 3 | 3 | 7 | | | | |
| 4 | 3 | 6 | | | | |
| 5 | 4 | 0 | | | | |
| 6 | 3 | 7 | S.S.E. | East. | 2½ | Variation 1¾ E. |
| 7 | 4 | 3 | | | | |
| 8 | 4 | 5 | | | | |
| 9 | 4 | 7 | | | | |
| 10 | 8 | 4 | W. ½ N. | North. | 0 | |
| 11 | 9 | 2 | | | | |
| 12 | 10 | 3 | | | | |
| | | | | | | Remarks in H. M. S. Feb. 2, 1836. |
| 1 | 10 | 5 | .. | .. | .. | A.M. |
| 2 | 10 | 6 | | | | |
| 3 | 10 | 4 | | | | |
| 4 | 11 | 5 | W.S.W. | S. ½ W. | 2½ | |
| 5 | 4 | 6 | | | | |
| 6 | 3 | 7 | .. | .. | .. | During the 24 hours a current set the ship N.N.E. ½ E. 24 miles. |
| 7 | 3 | 2 | | | | |
| 8 | 3 | 4 | | | | |
| 9 | 3 | 6 | | | | |
| 10 | 4 | 0 | | | | |
| 11 | 4 | 5 | | | | |
| 12 | 4 | 6 | | | | |

5. What stars will pass the meridian of Greenwich between 4ʰ 4ᵐ P.M., and 11ʰ 0ᵐ P.M., on Feb. 3, 1836?

6. On Nov. 8, 1836, in longitude 89° 40′ E., the observed meridian altitude of the sun's L. L. was 40° 20′ 30″ (zenith S. of the sun); the index correction was −5′ 20, and the height of the eye above the sea was 22 feet: required the latitude.

7. March 8, 1836, at 5ʰ A.M., in longitude 59° 10′ E., the observed meridian altitude of the moon's L. L. was 41° 25′ 30″ (zenith N. of the moon); the index correction was +5′ 20″; and the height of the eye above the sea was 18 feet: required the latitude.

8. March 20, 1836, the observed meridian altitude of the star Regulus was 39° 20′ 50″ (zenith N. of the star); the index correction was + 3′ 50″, and the height of the eye above the sea was 20 feet: required the latitude.

9. July 7, 1836, the observed meridian altitude of the star α Ursæ Majoris, under the North Pole, was 30° 20′ 50″; the index correction was —3′ 20″, and the height of the eye above the sea was 23 feet: required the latitude.

10. Feb. 2, 1836, at 3ʰ 50ᵐ A.M., in longitude 103° 50′ W., the observed altitude of the Pole Star was 47° 52′ 25″; the index correction was —2′ 30″, and the height of the eye above the sea was 25 feet: required the latitude.

11. On April 12, 1836, the following double altitude was observed:—

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L. L. | Tr. Bearing. |
|---|---|---|---|
| $10^h\ 45^m$ A.M. | $7^h\ 30^m\ 20^s$ | 53° 0′ 20″ | S.E.b.S. |
| 2 45 P.M. | 11 29 40 | 40 59 10 | S.W.b.W.$\frac{1}{2}$W. |

The run of the ship in the interval was S. S. E. 25 miles; the index correction was —5′ 20″; and the height of the eye above the sea was 14 feet: required the true latitude; at the second observation, the latitude by account being 40° 29′ N., and the longitude 35° 45′ E.

12. March 12, 1836, at $4^h\ 10^m$ P.M., in latitude 50° 48′ N., and longitude by account 65° E., when a timekeeper No. 10 shewed $11^h\ 50^m\ 20^s$, the observed altitude of the sun's L. L. was 14° 50′ 10″; the index correction was —2′ 20″, and the height of the eye above the sea was 18 feet: required the true longitude.

On Feb. 25, 1836, at Gr. mean noon, No. 10 was *slow* on Gr. mean time $1^m\ 40^s.2$, and its daily rate was $3^s.5$ *gaining*.

13. April 19, 1836, at $8^h\ 40^m$ A. M. mean time nearly, in latitude 35° 10′ N., and longitude by account 89° 35′ W., the following lunar observation was taken.

| Obs. Alt. Sun's L. L. | Obs. Alt. Moon's L. L. | Obs. Dist. N. L. |
|---|---|---|
| 37° 2′ 40′ | 10° 6′ 30″ | 40° 55′ 10″ |
| Ind cor. — 0 50 | — 2 40 | — 0 50 |

The height of the eye above the sea was 14 feet: required the true longitude.

14. Sept. 2, 1836, at $6^h\ 27^m$ A.M. in latitude 40° 16′ S., and longitude 110° 13′ E., the sun rose by compass E. 10° 16′ N.: required the variation of the compass.

15. Aug. 26, 1836, at $5^h\ 30^m$ P.M. in latitude 50° 15′ N., and longitude 75° 30′ W., the compass bearing of the sun was S. 80° 10′ W., and the observed altitude of the sun's L. L. was at the same time 11° 30′ 15″; the index correction was — 4′ 10″, and the height of the eye above the sea was 18 feet: required the variation of the compass.

16. Required the time of high water at A on Aug. 5, 1836, both A. M. and P. M. Change Tide at A $5^h\ 40^m$ P. M. App. T. Long. A 110° 20′ E.

## *Elements for* D, *from Nautical Almanac* 1836, *with Answers.*

1. N. 21° 31′ 15″ W. Distance 331′.3 miles.
2. Lat. in 65° 12′ S. Long. in 4° 35′ W.
3. S.W. b. W. $\frac{1}{4}$ W.
4. Corrected courses E. $\frac{1}{4}$ S. 19′ Dep. course; S. b. W. $\frac{1}{4}$ W. 20′; S. S. W. 17′.2; N. W. b. W. $\frac{1}{4}$ W. 59′.4; N. W. b. W. $\frac{1}{4}$ W. 43′.1; N.E. $\frac{1}{4}$ E. 24′. Latitude in 49° 32′ S. longitude in 5° 27′ E.
5. R. A. of mean sun Feb. 3, at Gr. mean noon, $20^h\ 50^m\ 49^s.45$; R. A. $\alpha$ Columbæ $5^h\ 35^m\ 43^s.4$; R. A. $\beta$ Geminorum $7^h\ 35^m\ 17^s.2$. From $\alpha$ Columbæ to $\beta$ Geminorum inclusive.
6. Sun's decl. on Nov. 7, at Gr. mean noon, 16° 23′ 48″ S., on Nov. 8 16° 41′ 19″ S.; semid. 16′ 10″. Latitude 66° 11′ 4″ S.
7. Moon's decl. on March 7, at Gr. mean time $13^h$, 16° 24′ 24.6″ S., at $14^h$ 16° 37′ 19″.7 S.; moon's semid. on March 7, Gr. mean midn. 16′ 5″, on March 8. at Gr. mean noon, 16′ 6″.3; corresponding hor. par. 59′ 1″.2 and 59′ 6″.0 Lat. 31° 9′ 1″ N..
8. Decl. $\alpha$ Leonis 12° 45′ 57″ N. Latitude 63° 26′ 52″ N.
9. Decl. $\alpha$ Urs. Maj. 62° 38′ 18″ N. Latitude 57° 32′ 50″ N.
10. R. A. of mean sun on Feb. 1, at Gr. mean noon, $20^h\ 42^m\ 56^s.34$. Lat. 49° 18′ N.
11. Sun's decl. April 11, at Gr. mean noon, 8° 26′ 0″ N., on April 12, 8° 47′ 56″ N., on April 13, 9° 9′ 42″ N.; semid. 15′ 58″. Arc (1) 59° 3′ 45″, Arc (2) 85° 2′ 15″, Arc (3) 43° 51′ 0″. Latitude 41° 23′ 7″ N.
12. Sun's decl. on March 11, at Gr. mean noon 3° 34′ 45″ S., on March 12, 3° 11′ 10′ S.; corresponding Eq. T. $10^m\ 9^s.41$ A, and $9^m\ 53^s.08$ A. Hour angle $4^h\ 6^m\ 5^s$. Longitude 66° 13′ 30″ E.
13. Sun's decl. on April 19, at Gr. mean noon, $11^h\ 17^m\ 1^s$ N.; on April 20, 11° 37′ 37″ N.; cor. Eq. T. $0^m\ 59^s.3$ S. and $1^m\ 12^s.4$ S. Moon's hor. semid. on April 19, at Gr. mean noon, 14′ 46″.9, on April 19, at Gr. mean midn., 14′ 45″.5; cor. hor. par. 54′ 14″.7 and 54′ 9″.7. True dist. 40° 49′ 48″; dist. at $0^h$ 39° 37′ 14″, at III 40° 59′ 14″. Hour angle $20^h\ 31^m\ 22^s$ W. Longitude 92° 14′ W.
14. Sun's decl. on Sept. 1, at Gr. mean noon, 8° 11′ 44″ N., on Sept. 2, 7° 49′ 50″ N. Tr. bearing E. 10° 32′ N. Variation 0° 16′ W.
15. Sun's decl. on Aug. 26, at Gr. mean noon, 10° 10′ 5″ N., on Aug. 27, 9° 59′ 7″ N.; semid. 15′ 51″. Tr. bearing N. 87° 55′ 15″ W. Variation 11° 54′ 45″ E.
16. Moon's Gr. mer. passage on Aug. 5, at Gr. mean noon, $19^h\ 16^m$, on Aug. 6, $18^h\ 29^m$: moon's semid. 14′ 53″. Eq. T. $6^m$ S. from M. T. High Water $11^h\ 8^m$ A. M., and $11^h\ 32^m$ P. M.

## E.

1. Required the course and distance from A to B. Lat. A 71° 10′ N. long. A 5° 10′ E., lat. B 65° 40′ N., long. B 0° 25′ W.

2. Sailed from A due W. 1000 miles: required the latitude and longitude in. Lat. A 62° 25′ N., long. A 1° 25′ E.

3. A ship bore from me N.E. ½ E., and a current run in the intermediate space E. ½ S. 5.2 mile per hour; how must I steer a boat to fetch the ship supposing I can pull in still water 8.2 miles per hour?

4. On Aug. 14, 1836, at noon, a point of land in latitude 50° 10′ N., and long. 25° 10′ W., bore by compass E. b. N. ½ N. distant 25 miles (variation 2½ E.); afterwards sailed as by the following log account: required the latitude and longitude in on Aug. 15, at noon.

| H. | K. | ¼ 16ths | Course. | Wind. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 3 | 5 | N.W. ½ W. | N.N.E. | 1¾ | P. M. |
| 2 | 3 | 6 | | | | |
| 3 | 4 | 2 | | | | |
| 4 | 4 | 0 | | | | |
| 5 | 5 | 2 | | | | |
| 6 | 5 | 1 | E. b. S. ¾ S. | Do. | 2½ | Variation 2½ E. |
| 7 | 5 | 0 | | | | |
| 8 | 4 | 2 | | | | |
| 9 | 4 | 6 | | | | |
| 10 | 4 | 3 | | | | |
| 11 | 4 | 2 | | | | |
| 12 | 3 | 7 | | | | |
| | | | | | | Remarks in H. M. S. Aug. 15, 1836. |
| 1 | 3 | 5 | E.S.E. | S. ½ W. | 2½ | A. M. |
| 2 | 3 | 6 | | | | |
| 3 | 3 | 2 | | | | |
| 4 | 3 | 4 | | | | |
| 5 | 3 | 5 | | | | |
| 6 | 4 | 2 | | | | |
| 7 | 4 | 7 | W. b. S. | Do. | 2¾ | |
| 8 | 4 | 6 | | | | |
| 9 | 4 | 2 | | | | |
| 10 | 4 | 7 | | | | |
| 11 | 4 | 6 | | | | |
| 12 | 5 | 2 | | | | |

5. What time will the fixed star α Aquilæ pass the meridian of St. Petersburgh, on Oct. 14, 1836, and how far N. or S. of the zenith?

6. May 27, 1836, in longitude 56° 25′ E., the observed meridian altitude of the sun's L. L. was 37° 42′ 10″ (zenith S. of the sun); the index correction was −2′ 50″, and the height of the eye above the sea was 13 feet: required the latitude.

7. May 27, 1836, at 9ʰ 10ᵐ P. M. mean time nearly, in longitude 85° 50′ W., the observed meridian altitude of the moon's L. L. was 47° 10′ 42″ (zenith N. of the moon); the index correction was +3′ 10″, and the height of the eye above the sea was 19 feet: required the latitude.

8. May 27, 1836, the observed meridian altitude of the star α Crucis was 75° 10′ 30″ (zenith N. of the star); the index correction was −1′ 40″, and the height of the eye above the sea was 14 feet: required the latitude.

9. Oct. 12, 1836, the observed meridian altitude of α Pavonis, under the South Pole, was 5° 10′ 20″; the index correction was + 2′ 50″, and the height of the eye above the sea was 19 feet: required the latitude.

10. March 12, 1836, at 2ʰ 20ᵐ A. M., in longitude 49° 26′ W., the observed altitude of Polaris (α Urs. Min.) was 60° 25′ 30″; the index correction was −4′ 10″, and the height of the eye above the sea was 13 feet: required the latitude.

11. April 21, 1836, the following double altitude of the sun was observed:—

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L.L. | Tr. Bearing. |
|---|---|---|---|
| 10h 0m A.M. | 10h 2m 35s | 44° 20′ 40″ | S.E. b. S. |
| 11 24 A.M. | 11 24 34 | 50 20 40 | S. b. E. |

The run of the ship in the interval was 0., the index correction was 0., and the height of the eye above the sea was 0.; required the true latitude at the second observation; the latitude by account being 50° 48′ N., and the longitude 1° 6′ W.

12. March 24, 1836, at 9h 50m A.M., mean time nearly, in latitude 50° 48′ N., and longitude by account 20° W., a chronometer showed 10h 2m 15s, and the observed altitude of the sun's L. L. was 26° 45′ 10″; the index correction was +3′ 20″, and the height of the eye above the sea was 17 feet: required the true longitude.

March 18, 1836, at Gr. mean noon, the chronometer was *fast* on Gr. mean time 50s.2, and its daily rate was 1s.6 *losing*.

13. May 24, 1836, at 4h 25m P.M., mean time nearly, in latitude 50° 48′ N., and longitude by account 3° 5′ W., the following lunar observation was taken.

| Obs. Alt. Sun's L.L. | Moon's L.L. | Dist. N.L. |
|---|---|---|
| 30° 7′ 30″ | 37° 32′ 10″ | 101° 8′ 20″ |
| Ind. cor. +4 20 | +4 40 | −2 6 |

The height of the eye above the sea was 18 feet: required the true longitude.

14. May 6, 1836, at 5h 30m A.M., in latitude 50° 48′ N., and longitude 47° 12′ E., the sun rose by compass E. 2° 10′ S.: required the variation.

15. Nov. 10, 1836, at 8h 20m A.M., in latitude 50° 30′ N., and longitude 80° 19′ E., the compass bearing of the sun was N. 85° 16′ E., and the observed altitude of the sun's L. L. was 6° 10′ 30″; the index correction was −3′ 20″, and the height of the eye above the sea was 15 feet: required the variation of the compass.

16. Required the mean time of high water on April 4 and 12 P. M. and A. M. Change Tide 4h 10m P.M. app. time. Long. A 100° E.

## *Elements for* E, *from Nautical Almanac* 1836, *with Answers.*

1. S. 20° 22′ 30″ W. 352 miles.
2. Lat. 62° 25′ N. Long. 34° 35′ W.
3. N.N.E. ½ E.
4. Corrected courses W. b. N. 25′ Dep. Course; N.W. ½ N. 20′.5; S. b. E. ½ E. 31′.1; E.S.E. 21′.4; N.W. ½ N. 28′.0. Lat. in 50° 12′ 54″ N. Long. in 25° 54′ 0″ W.
5. R. A. of mean sun, Oct. 14, at Gr. mean noon 13h 32m 14s.53. R. A. α Aquilæ 19h 42m 48s.5, decl. 8° 26′ 34″ N. At 6h 9m 53s, S. of zenith 21° 59′ 26″ S.
6. Sun's decl. on May 26, at Gr. mean noon, 21° 11′ 14″ N.; on May 27, 21° 21′ 21″ N.; semid. 15′ 48″. Lat. 30° 49′ 49″ S.
7. Moon's decl. on May 27, at 14h Gr. mean time, 10° 10′ 11″ S.; at 15h, 10° 25′ 35″ S.: moon's hor. semid. on May 27, at Gr. mean midn., 16′ 15″.9; on May 28, at Gr. mean noon, 16′ 22″.6; cor. hor. par. 59′ 41″.4 and 60′ 5″.7. Lat. 31° 30′ 34″ N.
8. Decl. α′ Crucis 62° 11′ 41″ S. Lat. 47° 16′ 35″ S.
9. Decl. α Pavonis 57° 15′ 21″ S. Lat. 37° 43′ 48″ S.
10. R. A. mean sun, March 11, at Gr. mean noon, 23h 16m 41s.96. Lat. 61° 50′ N.
11. Sun's decl. on April 20, at Gr. mean noon, 11° 37′ 37″.5 N., on April 21, 11° 58′ 2″.1 N.; semid. 15′ 55″. Arc. (1) 20° 2′ 45″. (2) 87° 47′ 45″. (3) 62° 22′ 45″. Lat. 50° 45′ 34″ N.
12. Sun's decl. on March 23, at Gr. mean noon, 1° 9′ 24″ N., on March 25, 1° 33′ 1″ N.; corresponding Eq. T. 6m 39s.2 A., and 6m 20s.7 A.; semid. 16′ 3″. Hour angle 20h 53m 8s. Longitude 15° 31′ W.
13. Sun's decl. on May 24, at Gr. mean noon, 20° 49′ 54″ N.; on May 25, 21° 0′ 45′ N., cor. Eq. T. 3m 29s.2 S. and 3m 23s.6 S., sun's semid. 15′ 48″; moon's hor. semid. on May 24, at Gr. mean noon, 15′ 23″.2, at Gr. mean midn. 15′ 30″.3; corresponding hor. par. 56′ 27″.8, and 56′ 54″.0. True dist. 101° 3′ 31″; dist. at III., 100° 15′ 43″, at VI., 101° 48′ 13″. Hour angle 4h 28m 32s. Longitude 1° 15′ 30″ W.
14. Sun's decl. on May 5, at Gr. mean noon, 16° 20′ 35″ N., on May 6, 16° 37′ 28″. True bearing E. 26° 43′ 30″ N. Variation 28° 53′ 30″ W.
15. Sun's decl. on Nov. 9, at Gr. mean noon, 16° 58′ 33″ S.; on Nov. 10, 17° 15′ 30″ S.; semid. 16′ 11″. Tr. bearing N. 126° 43′ 30″ E. Variation 41° 27′ 30″ E.
16. Moon's Gr. mer. passage on April 4, 14h 49m; on April 3, 13h 54m: semid. 16′ 17″. Eq. T. 3m *subt.* from M. T. High Water 5h 13m A.M., and 5h 40m P.M. Moon's Gr. mer. pass. April 12, 22h 17m; April 11, 21h 31m. Semid. 15′ 35″. Eq. T. 1m *subt.* from M. T. High Water 1h 30m A.M., and 1h 53m P. M.

## F.

1. Required the course and distance from A to B. Lat. A 67° 20′ S., long. A 18° 25′ W.; lat. B 61° 42′ S., long. B 22° 36′ W.

2. Required the course and distance from A to B. Lat. A 80° 10′ N., long. A 110° 42′ E.; lat. B 80° 10′ N., long. B 115° 42′ E.

3. A ship bore from me N.E. b. N. ½ N., and a current run in the intermediate space E. ½ S. 4.6 miles an hour; how must I steer a boat to fetch the ship, supposing I can pull in still water 7.8 miles an hour?

4. May 16, 1836, at noon, a point of land in latitude 62° 48′ N., and longitude 83° 17° W. bore by compass N. b. E ¼ E. distant 16 miles (variation of compass 2¼ E.); afterwards sailed as by the following log account: required the latitude and longitude in on May 17, at noon.

| H. | K. | ¼ 101ths. | Course. | Wind. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 4 | 2 | N. b. E. | E. | 2½ | P.M. |
| 2 | 3 | 9 | | | | |
| 3 | 4 | 5 | | | | |
| 4 | 4 | 5 | | | | |
| 5 | 4 | 5 | N.E. ¼ E. | N. b. W. | 3½ | Variation of the Compass 2¼ E. |
| 6 | 5 | 0 | | | | |
| 7 | 5 | 1 | | | | |
| 8 | 4 | 8 | | | | |
| 9 | 5 | 7 | W. ¼ N. | N. | 1¼ | |
| 10 | 6 | 2 | | | | |
| 11 | 6 | 3 | | | | |
| 12 | 6 | 4 | | | | |
| | | | | | | Remarks in H. M. S. May 17, 1836. |
| 1 | 6 | 5 | | | | |
| 2 | 5 | 9 | E.S.E. | S. | 3 | A.M. |
| 3 | 5 | 8 | | | | |
| 4 | 5 | 7 | | | | |
| 5 | 4 | 9 | S.E. ½ S. | N. b. E. | 0 | |
| 6 | 4 | 8 | .. | .. | .. | A current set the ship the last 5 hours 4½ miles an hour E.N.E. |
| 7 | 4 | 8 | | | | |
| 8 | 5 | 1 | | | | |
| 9 | 6 | 0 | W. ¼ S. | N. b. W. | 3½ | |
| 10 | 6 | 3 | | | | |
| 11 | 6 | 3 | | | | |
| 12 | 6 | 3 | | | | |

5. What bright stars will pass the meridian of Greenwich between 10$^h$ P.M., on May 6, 1836, and 1$^h$ A.M. on May 7, 1836?

6. May 20, 1836, in longitude 78° 29′ W., the observed meridian altitude of the sun's L.L. was 39° 26′ 47″ (zenith N. of the sun); the index correction was +7′ 28″, and the height of the eye above the sea was 22 feet: required the latitude.

7. April 19, 1836, at 2$^h$ 18$^m$ A.M., in longitude 120° 12′ E., the observed meridian altitude of the moon's L. L. was 40° 19′ 27′ (zenith N. of the moon); the index correction was + 7′ 28″, and the height of the eye above the sea was 12 feet: required the latitude.

8. May 27, 1836, the observed meridian altitude of the star α Hydræ was 30° 28′ 53″ (zenith N. of the star); the index correction was −7 38, and the height of the eye above the sea was 11 feet: required the latitude.

9. June 16, 1836, the observed meridian altitude of the star α Eridani, under the South Pole, was 20° 47′ 56″; the index correction was −2′ 59″, and the height of the eye above the sea was 23 feet: required the latitude.

10. On March 10, 1836, at 10$^h$ 28$^m$ P.M. mean time, in longitude 83° 18′ W., the observed altitude of the star α Urs. Min. was 52° 10′ 37″; the index correction was −5 29″, and the height of the eye above the sea was 12 feet: required the latitude.

11. On March 13, 1836, the following double altitude of the sun was observed.

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L.L. | Tr. Bearing. |
|---|---|---|---|
| $7^h\ 0^m$ A.M. | $7^h\ 2^m\ 20^s$ | $7°\ 20'\ 15''$ | E. b. S. $\frac{1}{4}$ S. |
| 11 0 A.M. | 11 2 20 | 41 10 10 | S.S.E. $\frac{1}{2}$ E. |

The run of the ship in the interval was N.W. 18 miles; the index correction was $-3'10''$ and the height of the eye above the sea was 15 feet; required the latitude at the second observation; the latitude by account being 42° 10′ N., and the longitude 45° 19′ W.

12. March 1, 1836, at $7^h\ 44^m$ P.M., in latitude 44° 25′ N., and longitude 58° E., when a chronometer No. 10 showed $5^h\ 10^m\ 42^s.5$, the observed altitude of fixed star $\alpha$ Arietis was 30° 10′ 10″, W. of meridian; the index correction was $+3'\ 10''$, and the height of the eye above the sea was 19 feet: required the true longitude.

On Feb. 20, 1836, at Gr. noon, No. 10 was *fast* on Greenwich mean time $1^h\ 10^m\ 15^s$, and its daily rate was 1.5 seconds *losing*.

13. May 20, 1836, at $4^h\ 20^m$ P.M. mean time nearly, in latitude 50° 48′ N., and longitude by account 3° 20′ W., the following lunar observation was taken.

| Obs. Alt. Sun's L.L. | Moon's L.L. | Obs. Dist. N.L. |
|---|---|---|
| 30° 53′ 50″ | 65° 0′ 40″ | 55° 43′ 58″ |
| Ind. cor. + 4 11 | 0 0 | − 36 6 |

The height of the eye above the sea was 18 feet: required the true longitude.

14. Sept. 28, 1836, at $5^h\ 51^m$ A. M., in latitude 47° 25′ S., and longitude 75° 25′ E., the sun rose by compass E. 12° 10′ S.: required the variation.

15. April 13, 1836, at $7^h\ 10^m$ A.M., in latitude 48° 52′ N., and longitude 152° 12′ E. the compass bearing of the sun was S. 68° 25′ E., and the observed altitude of the sun's L. L. at the time was 14° 45′ 10″; the index correction was $-3'\ 50''$, and the height of the eye above the sea was 20 feet: required the variation.

16. Required the time of high water on May 26, 1836, A. M. and P. M.
Change Tide....$4^h\ 10^m$ P.M. App. T. Long....92° E.

## *Elements for* F, *from Nautical Almanac* 1836, *with Answers.*

1. N. 17° 38′ 45″ W. 354.7 miles.
2. East 51.2 miles.
3. N. $\frac{1}{2}$ W.
4. Corrected courses S.W. $\frac{1}{2}$ S. 16′ Dep. Course; N. b. E. 17′.1; S.E. b. E. $\frac{1}{4}$ E. 19′.4. W. b. N. $\frac{1}{4}$ N. 31′.1; E. b. S. $\frac{1}{4}$ S. 17′.4; S. b. E. $\frac{1}{4}$ E. 19′.6; W.S.W. $\frac{1}{4}$ W. 24′.9; E. $\frac{1}{4}$ S. 22′.5. Lat. in 62° 18′ N. Long. in 83° 15′ W.
5. R. A. of mean sun, May 6, at Gr. mean noon, $2^h\ 57^m\ 29^s.0$; R.A. $\alpha$ Virginis $13^h\ 16^m\ 35^s$; R. A. $\beta$ Scorpii $15^h\ 55^m\ 56.4$. From $\alpha$ Virginis to $\beta'$ Scorpii inclusive.
6. Sun's decl. on May 20, at Gr. mean noon, 20° 2′ 57″ N.; on May 21, 20° 15′ 13′ N.; sun's semid. 15′ 49″. Lat 70° 21′ 12″ N.
7. Moon's decl. on April 18, at $6^h$, 21° 4′ 53″ N.; at $7^h$, 21° 13′ 52″ N.; moon's hor. semid. on April 18, at Gr. mean noon, 14′ 51″, on April 18, at Gr. mean midn., 14′ 48″.8: cor. hor. par. 54′ 29″.8 and 54′ 21″.5. Lat. 69° 48′ 45″ N.
8. Decl. $\alpha$ Hydræ 7° 57′ 7″ S. Lat. 51° 46′ 33″ N.
9. Decl. $\alpha$ Eridani 58° 3′ 57″ S. Lat. 52° 33′ 44″ S.
10. R. A. mean sun, March 10, at Gr. mean noon, $23^h\ 12^m\ 45^s.40$. Lat. 53° 2′ N.
11. Sun's decl. March 12, at Gr. mean noon, 2° 11′ 10″ S.; March 13, 2° 47′ 32″ S.; March 14, 2° 23′ 53″ S.; sun's semid. 16′ 6″. Lat. 43° 19′ 48″ N.
12. R. A. mean sun, on March 1, at Gr. mean noon, $22^h\ 37^m\ 16^s.43$; decl. of $\alpha$ Arietis 22° 41′ 2″ N.; R. A. $\alpha$ Arietis $1^h\ 57^m\ 55^s$. Hour angle $4^h\ 37^m\ 33^s$ W. Longitude 59° 12′ 30″ E.
13. Sun's decl. on May 20, at Gr. mean noon, 20° 2′ 57″ N.; on May 21, 20° 15′ 13′ N., cor. Eq. T. $3^m\ 46^s.4$ S. and $3^m\ 42^s.9$ S., moon's hor. semid. on May 20, at Gr. mean noon, 14′ 46″.5, on May 20, at Gr. mean midn. 14′ 48″.9; corresponding hor. par. 54′ 13″.2, and 54′ 22″.1. True dist. 55° 39′ 43″. Dist. at III, 55° 2′ 57″, at VI, 56° 24′ 58″. Hour angle $4^h\ 19^m\ 58^s$. Longitude 1° 7′ 15″ W.
14. Sun's decl. on Sept. 27, at Gr. mean noon, 1° 44′ 47″ S., on Sept. 28, 2° 8′ 11″ S. Tr. bearing E. 2° 53′ 15″ S. Variation 9° 16′ 45″ W.
15. Sun's decl. on April 12 at Gr. mean noon, 8° 47′ 56″ N.: on April 13, 9° 9′ 42 N.; sun's semid. 15′ 58″. Tr. bearing N. 93° 22′ 15″ E. Variation 18° 12′ 45″ W.
16. Moon's Gr. mer. passage on May 26, $8^h\ 37^m$; on May 25, $7^h\ 51^m$: semid. 15′ 53′ Eq. T. $3^m$ A. to M. T. High Water $0^h\ 19^m$ P.M No Tide A.M.

## G.

1 Required the course and distance from A to B. Lat. A 60° 25′ S., long. A 3° 10′ E.; lat. B. 55° 20′ S., long. B. 10° 0′ E.

2. Required the course and distance from A to B. Lat. A 53° 42′ N., long. A 2° 55′ W.; lat. B 53° 42′ N., long. B 4° 10′ W.

3. A ship bore from me E. $\frac{1}{4}$ N. and a current set in the intermediate space S. E. 4.7 miles an hour; how must I steer a boat to fetch the ship, supposing I can pull in still water 7.2 miles an hour?

4. June 7, 1836, at noon, a point of land in latitude 42° 12′ S. and longitude 42° 58′ W. bore by compass E. b. N. $\frac{1}{2}$ N. distant 21 miles (variation 1 $\frac{3}{4}$ W.); afterwards sailed as by the following log account: required the latitude and longitude in on June 8, at noon.

| H. | K. | Knots. | Course. | Wind. | Leeway. | |
|---|---|---|---|---|---|---|
| 1 | 4 | 2 | S.S.E. $\frac{1}{2}$ E. | East. | 2 | P. M. |
| 2 | 4 | 3 | | | | |
| 3 | 5 | 0 | | | | |
| 4 | 5 | 2 | | | | |
| 5 | 4 | 0 | | | | |
| 6 | 4 | 1 | N.N.E. | Do. | 2$\frac{1}{2}$ | Variation 1 $\frac{3}{4}$ W. |
| 7 | 3 | 8 | | | | |
| 8 | 3 | 5 | | | | |
| 9 | 3 | 2 | | | | |
| 10 | 3 | 5 | S.W. $\frac{1}{2}$ W. | W.N.W. | 1$\frac{1}{2}$ | |
| 11 | 3 | 6 | | | | |
| 12 | 4 | 0 | | | | |
| | | | | | | Remarks in H. M. S. June 8, 1836. |
| 1 | 4 | 2 | .. | .. | .. | A. M. |
| 2 | 4 | 3 | N. $\frac{1}{2}$ E. | Do. | 2$\frac{1}{2}$ | |
| 3 | 4 | 4 | | | | |
| 4 | 4 | 5 | | | | |
| 5 | 6 | 2 | S. S. W. | West. | $\frac{1}{2}$ | |
| 6 | 6 | 4 | .. | .. | .. | A current set the ship during the whole day 26 miles W. S. W. |
| 7 | 6 | 2 | | | | |
| 8 | 6 | 5 | | | | |
| 9 | 6 | 2 | N N.W. $\frac{1}{2}$ N. | Do. | $\frac{1}{2}$ | |
| 10 | 5 | 7 | | | | |
| 11 | 5 | 3 | | | | |
| 12 | 5 | 4 | | | | |

5. At what time will $\alpha'$ Crucis pass the meridian of St. Helena on June 8, 1836, and how far N. or S. of the zenith?

6. June 8, 1836, in longitude 52° 10′ E., the observed meridian altitude of the sun's L. L. was 57° 2′ 40″ (zenith N. of the sun); the index correction was + 2′ 10″, and the height of the eye above the sea was 10 feet: required the latitude.

7. June 8, 1836, at $9^h\ 2^m$ A. M. mean time nearly, in longitude 70° 22′ W., the observed meridian altitude of the moon's L. L. was 32° 10′ 50″ (zenith S. of the moon); the index correction was −1′ 50″, and the height of the eye above the sea was 12 feet: required the latitude.

8. June 10, 1836, the observed meridian altitude of $\alpha$ Cygni was 20° 10′ 40″ (zenith S. of the star); the index correction was + 3′ 10″, and the height of the eye above the sea was 15 feet: required the latitude.

9. June 10, 1836, the observed meridian altitude of $\alpha$ Ursæ Majoris, under the North Pole, was 11° 10′ 50″; the index correction was − 3′ 40″, and the height of the eye above the sea was 16 feet: required the latitude.

10. June 10, 1836, at $1^h\ 50^m$ A. M. mean time, in longitude 35° 26′ E., the observed altitude of $\alpha$ Urs. Min. (Polaris) was 60° 25′ 10″; the index correction was −1′ 10″, and the height of the eye above the sea was 13 feet: required the latitude.

11. April 11, 1836, the following double altitude of the sun was observed:—

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L.L. | Tr. Bearing. |
|---|---|---|---|
| $9^h\ 46^m$ A.M. | $0^h\ 44^m\ 53^s$ | 41° 30′ 20″ | S.E. |
| 14 15 A.M. | 2 14 48 | 48 32 15 | S.S.E. |

The run of the ship in the interval was S. E. b. E. 18 miles; the index correction was − 1′ 20″, and the height of the eye above the sea was 17 feet; required the true latitude, the latitude by account being 42° N., and the longitude 80° 5′ W.

12. Feb. 10, 1836, at $9^h\ 5^m$ P.M. mean time nearly, in latitude 28° 20′ N., and longitude by account 31° 2′ W., a chronometer showed $11^h\ 16^m\ 25^s$, and the observed altitude of the star α Leonis (Regulus) was 41° 55′ 10″ E. of meridian; the index correction was +1′ 20″, and the height of the eye above the sea was 25 feet: required the true longitude.

Feb. 1, 1836, at Gr. mean noon, the chronometer was *fast* on Greenwich mean time $5^m\ 20^s.6$, and its daily rate was 2.7 seconds *losing*.

13. May 24, 1836, at $8^h\ 1^m$ P.M. mean time nearly, in latitude 50° 48′ N., and longitude by account 10° 0′ W. the following lunar observation was taken:—

| Obs. Alt. of Venus bearing W. | Moon's L.L. | Obs. Dist. N.L. |
|---|---|---|
| 31° 50′ 20″ | 43° 46′ 20″ | 57° 42′ 57″ |
| Index cor. + 4 20 | + 4 25 | + 0 10 |

The height of the eye above the sea was 19 feet: required the true longitude.

14. June 15, 1836, at $8^h\ 10^m$ P.M. mean time nearly, in latitude 50° 48′ N., and longitude 100° 14′ W., the sun set by compass W. 21° 47′ 10″ N.: required the variation.

15. June 15, 1836, at $9^h\ 39^m$ A.M. mean time nearly, in latitude 50° 48′ N., and longitude by account 3° W., the compass bearing of the sun was S. 38° 30′ E., and the observed altitude of the sun's L.L. was 50° 13′ 10″; the index correction was − 4′ 10″, and the height of the eye above the sea was 20 feet: required the variation of the compass.

16. Required the mean time of high water on Aug. 26, 1836, A.M. and P.M. Change Tide $2^h\ 15^m$ P.M. app. time. Long. 55° 20′ E.

## *Elements for* G, *from Nautical Almanac* 1836, *with Answers.*

1. N. 35° 29′ 30″ E. 374′.6
2. West 44.4
3. N. E. ½ E.
4. Corrected courses S. W. ¼ W. 21′ Dep. Course; S. S. E. ¼ E. 22′.7; N. N. W. 14′.6; S. b. W. 15′.3; N. b. E. 13′.2; S. ¼ E. 25′.3; N. N. W. ¼ W. 22′.6.; S. W. ¼ W. 26′. Lat. in 42° 56′ S. Long. in 43° 55′ W.
5. R. A. of mean sun, June 8, at Gr. mean noon, $5^h\ 7^m\ 35^s.38$; R. A. α′ Crucis, $12^h\ 17^m\ 32^s.8$, decl. 62° 11′ 42″ S. At $7^h\ 8^m\ 40^s$; S. of zenith 46°.16′ 42″.
6. Sun's decl. on June 7, at Gr. mean noon 22° 47′ 42″ N.; on June 8, 22° 53′ 13″ N.; semid. 15′ 46″. Lat. 55° 35′ 27″ N.
7. Moon's decl. on June 8, at $1^h$ Gr. mean time, 2° 56′ 54″ N.; at $2^h$, 3° 11′ 8″ N.; moon's hor. semid. on June 8, at Gr. mean noon, 15′ 11″.6. at Gr. midn. 15′ 6″.8; cor. hor. par. 55′ 45″.4 and 55′ 27″.7. Lat. 53° 46′ 27″ S.
8. Decl. α Cygni 44° 41′ 37″ N. Lat. 25° 10′ 59″ S.
9. Decl. α Urs. Majoris 62° 38′ 21″ N. Latitude 38° 20′ 3″ N.
10. R. A. mean sun, June 9, at Gr. mean noon, $5^h\ 11^m\ 31^s.93$; Lat. 60° 23′ N.
11. Sun's decl. April 11, at Gr. mean noon, 8° 26′ 0″ N., on April 12, 8° 47′ 56″ N., sun's semid. 15′ 58″. Lat. 49° 16′ 27″ N.
12. R. A. mean sun, on Feb. 10, at Gr. mean noon, $21^h\ 18^m\ 25^s.32$; R. A. α Leonis $9^h\ 56^m\ 39^s$; decl. α Leonis 12° 45′ 57″ N.; Hour angle $20^h\ 43^m\ 39^s$ W. Longitude 27° 6′ 45″ W.
13. R. A. mean sun, on May 24, at Gr. mean noon, $4^h\ 8^m\ 27^s.02$; R. A. Venus, on May 24, at Gr. mean noon, $7^h\ 21^m\ 36^s$; on May 25, $7^h\ 25^m\ 28^s$; cor. decl. of Venus, 25° 7′ 5″ N. and 24° 57′ 41″ N.; hor. par. 12″.6: moon's hor. semid. on May 24, at Gr. mean noon, 15′ 23″.2; on May 25, 15′ 30″.3: corresponding hor. par. 56′ 27″.8 and 56′ 54″.0. True dist. 57° 49′ 25″; dist. from Naut. Alm. at VI. 56° 36′ 11″, at IX. 58° 6′ 31″. Hour angle $4^h\ 38^m\ 40^s$ W. Longitude 8° 32′ 15″ W.
14. Sun's decl. on June 15, at Gr. mean noon, 23° 20′ 26″ N. on June 16, 23° 32′ 41″ N. Tr. bearing W. 38° 51′ 30″ N. Variation 17° 4′ 20″ E.
15. Sun's decl. on June 14, at Gr. mean noon, 23° 17′ 46″ N.; on June 15, 23° 20′ 26″ N., semid 15′ 46″. Tr. bearing N. 119° 46′ 45″ E. Variation 21° 43′ 15″ W.
16. Moon's Gr. mer. passage on August 26, $12^h\ 31^m$, Gr. mean time; on August 25, $11^h\ 38^m$; semid. 16′ 14″; Eq. Time $1^m$ *sub.* from mean time. High water $1^h\ 47^m$ A. M and $2^h\ 14^m$ P.M.

## H.

1. Required the course and distance from A to B. Lat. A 47° 50′ S., long. A 2° 25 E.; lat. B 42° 26′ S., long. B 1° 40′ E.

2. Sailed from New York 356 miles due East; required the latitude and longitude in.

3. A ship bore from me E.S.E., and a current run in the intermediate space E. b. N. ½ N. 4½ miles per hour; how must I steer a boat to fetch the ship, supposing I can pull in still water 6¾ miles per hour?

4. Aug. 11, 1836, at noon, a point of land in latitude 56° 11′ S., and longitude 14° 26′ E. bore by compass N.N.E. ½ E. distant 24 miles; afterwards sailed as by the following log account: required the latitude and longitude in, on Aug. 12, at noon.

| H. | K. | $\frac{1}{10}$ ths. | Course. | Wind. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 3 | 5 | N.N.W. ½ W. | N.E. ½ N. | 2 | P. M. |
| 2 | 3 | 4 | | | | |
| 3 | 3 | 2 | | | | |
| 4 | 4 | 0 | | | | |
| 5 | 4 | 2 | E. b. S. ½ S. | Do. | 2½ | Variation 2¼W. |
| 6 | 3 | 6 | | | | |
| 7 | 3 | 7 | | | | |
| 8 | 3 | 2 | | | | |
| 9 | 3 | 5 | | | | |
| 10 | 4 | 3 | S. b. E. ½ E. | S.W. | 3¼ | |
| 11 | 4 | 5 | | | | |
| 12 | 4 | 6 | | | | |
| | | | | | | Remarks in H. M .S. Aug. 12, 1836. |
| 1 | 8 | 2 | N. ½ E. | E.S.E. | 0 | A.M. |
| 2 | 8 | 6 | | | | |
| 3 | 8 | 7 | | | | |
| 4 | 9 | 0 | | | | |
| 5 | 8 | 5 | | | | |
| 6 | 8 | 4 | S.W. ¼ W. | S.S.E. | 2¼ | A current set the ship 20 miles E.S.E. ½ E. |
| 7 | 3 | 2 | | | | |
| 8 | 3 | 3 | | | | |
| 9 | 3 | 4 | | | | |
| 10 | 3 | 5 | | | | |
| 11 | 3 | 6 | | | | |
| 12 | 3 | 7 | | | | |

5. What bright fixed stars will pass the meridian of Paris between 9ᵃ 10ᵐ P.M. on Aug. 12, 1836, and 11ʰ 20ᵐ P.M. on Aug. 12, 1836?

6. Aug. 12, 1836, in longitude 92° 12′ E., the observed meridian altitude of the sun's L. L. was 42° 42′ 10″ (zenith S. of the sun); the index correction was −2′ 50″, and the height of the eye above the sea was 17 feet: required the latitude.

7. Aug. 18, 1836, at 4ʰ 30ᵐ P. M. mean time nearly, in longitude 82° 16′ E., the observed meridian altitude of the moon's L. L. was 33° 10′ 50″ (zenith N. of the moon); the index correction was −5′ 40″, and the height of the eye above the sea was 17 feet: required the latitude.

8. Aug. 15, 1836, the observed meridian altitude of α Cygni was 78° 52′ 10″ (zenith N. of the star); the index correction was +4′ 10″, and the height of the eye above the sea was 15 feet: required the latitude.

9. Aug. 13, 1836, the meridian altitude of α Cephei, under the North Pole, was 7° 10′ 40″; the index correction was −2′ 25″, and the height of the eye above the sea was 12 feet: required the latitude.

10. Aug. 15, 1836, at 2ʰ 20ᵐ A.M., in longitude 56° 10′ E., the observed altitude of α Ura. Min. (Polaris) was 51° 26′ 10″; the index correction was +3′ 50″, and the height of the eye above the sea was 20 feet: required the latitude.

11. Oct. 15, 1836, the following double altitude of the sun was observed.

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L. L. | Tr. Bearing |
|---|---|---|---|
| 11h 20m A.M. | 11h 15m 50s | 27° 31′ 50″ | S. b. E. |
| 1 20 P.M. | 0 50 32 | 25 45 5 | S.S.W. |

The run of the ship in the interval was S. b. W. 14 miles; the index correction was +2′ 55″, and the height of the eye above the sea was 15 feet, required the true latitude at the second observation; the latitude by account being 51° N., and the longitude 22° 52′ E.

12. April 28, 1836, at 8h 10m P. M. mean time nearly, in latitude 50° 15′ N., and longitude by account 61° W., a chronometer showed 0h 2m 5s, the observed altitude of β Geminorum (Pollux) was 46° 50′ 20″ W. of the meridian; the index correction was +1′ 50″, and the height of the eye above the sea was 17 feet: required the true longitude.

On April 14, at Greenwich mean noon, the chronometer was *slow* on Greenwich mean time 53s.5, and its daily rate was 0s.9 *losing*.

13. Aug. 21, 1836, at 7h 50m P. M. mean time nearly, in latitude 20° 15′ N., and longitude by account 111° 15′ W., the following lunar observation was taken.

| Obs. Alt. α Pegasi E. of Mer. | Moon's L.L. | Obs. Dist. F.L. |
|---|---|---|
| 15° 0′ 40″ | 46° 20′ 10″ | 85° 10′ 40″ |
| −1 40 | +1 10 | +0 40 |

The height of the eye above the sea was 19 feet: required the true longitude.

14. Oct. 28, 1836, at 8h 30m A.M. mean time nearly, in latitude 49° 40′ N., and longitude 116° 12′ W.; the compass bearing of the sun at rising was E. 3° 20′ N.: required the variation.

15. Nov. 15, 1836, at 7h 50m P. M. mean time nearly, in latitude 48° 31″ S., and longitude by account 142° 15′ E.; the compass bearing of the sun was S. 98° 10′ W., and the observed altitude of the sun's L. L. was 9° 58′ 10″; the index correction was −1′ 40″, and the height of the eye above the sea was 11 feet: required the variation.

16. Required the mean time of high water at A on Sept. 8, 1836, A.M. and P.M. Change Tide at A, 3h 50m P.M. app. time. Long. A 61° E.

## *Elements for* H, *from Nautical Almanac* 1836, *with Answers.*

1. N. 5° 35′ 15″ W. 325′.6 miles.

2. Latitude in 40° 42′ N. Long. in 66° 9′ 24″ W.

3. S.E. ½ S.

4. Corrected courses S. ½ W. 24′ Dep. Course; W. b. N. ½ N. 14′.1; E. b. S. ½ S 18′.2; E. b. S. 13′.4; N. b. W. ½ W. 43′.0; S.W. ½ W. 29′.1; E. ½ N. 20′. Lat. in 56° 16″ S. Long. in 14° 24′ E.

5. R. A. of mean sun Aug. 12, at Gr. mean noon, 9h 22m 51s.6. R. A. β Lyræ 18h 44m 3s.7; R. A. α Cygni 20h 35m 50s.9. From β Lyræ to α Cygni inclusive.

6 Sun's decl. on Aug. 11, at Gr. mean noon, 15° 12′ 52″ N; on Aug. 12, 14° 54′ 51″ N.; semid. 15′ 49″. Lat. 32° 10′ 28″ S.

7. Moon's decl. on Aug. 17, at 23h Gr. mean time, 13° 10′ 5″ S.; at 24h, 13° 23′ 53″ S.; moon's hor. semid. on Aug. 17, at Gr. mean midn. 15′ 42″.7; on Aug. 18, 15′ 47″.3: cor. her. par. 57′ 39″.5 and 57′ 56″.2. Lat. 42° 45′ 44″ N.

8. Decl. of α Cygni 44° 41′ 59′ N. Lat. 55° 49′ 40″ N.

9. Decl. of α Cephei 61° 53′ 39″ N. Lat. 35° 3′ 48″ N.

10. R. A. of mean sun, on Aug. 14, at Gr. mean noon, 9h 31m 44s.75. Latitude 49° 55′ N.

11. Sun's decl. Oct. 14, at Gr. mean noon, 8° 16′ 16″ S.; on Oct. 15, 8° 38′ 33″ S. semid. 15′ 4″. Lat. 53° 19′ N.

12. R. A. mean sun, on April 28, at Gr. mean noon, 2h 25m 56s.54; R. A. of β Geminorum 7h 35m 16s; decl. 28° 25′ 6″ N.; Hour angle 3h 19m 15s. Long. 54° 8′ 45″ W.

13. R.A. mean sun, on Aug. 21, at Gr. mean noon, 9h 59m 20s.62; R.A. of α Pegasi 22° 56′ 38″; decl. 14° 19′ 41″ N.; moon's hor. semid. on Aug. 21, at Gr. mean midn. 16′ 16″.8; on Aug. 22, at Gr. mean noon, 16′ 19″.7: corresponding hor. par. 56′ 49″.5 and 59′ 55″.3. True Dist. 84° 46′ 12″; dist. at XII, 86° 23′ 58″; at XV, 84° 44′ 30″. Hour angle 18h 43m 17s. Longitude 109° 41′ 15″ W.

14. Sun's decl. on Oct. 28, at Gr. mean noon, 13° 14′ 35″ S.; on Oct. 29, 13° 34′ 33″ S. Tr. bearing E. 20° 49′ 30″ S. Variation 24° 9′ 30″ E.

15. Sun's decl. on Nov. 14, at Gr. mean noon, 18° 20′ 15″ S.; on Nov. 15, 18° 35′ 39″ S.; semid. 16′ 12″. Tr. bearing S. 73° 17′ 15″ W. Variation 24° 52′ 45″ W.

16. Moon's Gr. mer. passage on Sept. 8, 22h 54m; mean time on Sept. 7, 22h 8m; semid. 15′ 0″; Eq. Time. 2m A to mean time. High Water 1h 45m A.M. and 2h 9m P. M.

## I.

1. Required the course and distance from A to B. Lat. A 47° 50′ S., long. A 42° 16 E.: lat. B 40° 49′ S., long. B 46° 25′ E.

2. Required the course and distance from A to B. Lat. A 58° 10′ N., long. A 72° 12 E.; lat. B 58° 10′ N., long. B 65° 10′ E.

3. A ship bore from me N. E. ½ E., and a current run in the intermediate space E. b. S. 5 miles an hour: how must I steer a boat to fetch the ship, supposing I can pull in still water 7.5 miles an hour?

4. Sept. 16, 1836, at noon, a point of land in latitude 47° 10′ N., and longitude 15° 32′ W., bore by compass E. b. N ½ N. (variation 2¼ E.), distant 16 miles; afterwards sailed as by the following log account.

| H. | K. | $\frac{1}{10}$ths. | Course. | Wind. | Leeway. | |
|---|---|---|---|---|---|---|
| 1 | 3 | 5 | N.W. ½ W | N.N.E. | 1¾ | P.M. |
| 2 | 3 | 6 | | | | |
| 3 | 3 | 2 | | | | |
| 4 | 4 | 0 | E. ½ S. | Do. | 2 | |
| 5 | 4 | 2 | .. | .. | .. | Variation 2¼ E. |
| 6 | 4 | 3 | | | | |
| 7 | 4 | 5 | | | | |
| 8 | 4 | 6 | | | | |
| 9 | 5 | 2 | S. b. E. ½ E. | S.W. | 2½ | |
| 10 | 5 | 0 | | | | |
| 11 | 5 | 3 | | | | |
| 12 | 5 | 6 | | | | |
| | | | | | | Remarks in H. M. S. Sept. 17, 1836. |
| 1 | 3 | 6 | W. b. N. ¾ N. | Do. | 2¾ | A.M. |
| 2 | 3 | 5 | | | | |
| 3 | 3 | 2 | | | | |
| 4 | 3 | 6 | | | | |
| 5 | 3 | 7 | S. ½ E. | W.S.W. | 2¼ | |
| 6 | 4 | 2 | .. | .. | .. | A current set the ship East 20 miles. |
| 7 | 4 | 3 | | | | |
| 8 | 4 | 5 | | | | |
| 9 | 4 | 6 | N.W. | Do. | 2¼ | |
| 10 | 4 | 7 | | | | |
| 11 | 5 | 2 | | | | |
| 12 | 6 | 0 | | | | |

5. What bright fixed stars will pass the meridian of New York between 9ʰ P.M. and 11ʰ P.M. on Sept. 16, 1836?

6. Aug. 29, 1836, in longitude 100° 5′ E., the observed meridian altitude of the sun's L.L. was 43° 20′ 10″ (zenith N. of the sun); the index correction was + 3′ 10″, and the height of the eye above the sea was 18 feet: required the latitude.

7. Sept. 18, 1836, at 6ʰ 30ᵐ P.M. mean time nearly, in longitude 142° 20′ E., the observed meridian altitude of the moon's L.L. was 22° 10′ 50″ (zenith N. of the moon); the index correction was −2′ 10″, height of the eye above the sea was 19 feet: required the latitude.

8. Aug. 29, 1836, at 10ʰ A.M. mean time nearly, in longitude 42° 10′ W., the observed meridian altitude of the planet Jupiter was 50° 25′ 10″ (zenith N. of planet); the index correction was −1′ 50″, and the height of the eye above the sea was 20 feet: required the latitude.

9. Sept. 19, 1836, the observed meridian altitude of α Urs. Maj., under the North Pole, was 2° 25′ 40″, the index correction was +4′ 50″, and the height of the eye above the sea was 18 feet: required the latitude.

10. Sept. 20, 1836, at 2ʰ 50ᵐ A.M. mean time nearly, in longitude 72° 10′ W., the observed altitude of α Urs. Min. (Polaris) was 49° 50′ 10″; the index correction was +4′ 50″, and the height of the eye above the sea was 12 feet: required the latitude.

11. Sept. 15, 1836, observed the following double altitude of the sun.

| Mean T. nearly. | Chronometer | 2 Obs. Alt. Sun's L.L.* | Tr. Bearing. |
|---|---|---|---|
| 9h 59m A.M. | 9h 53m 51s | 73° 12′ 30″ | S.E. b. S. |
| 11 52 A.M. | 11 46 32 | 84 24 10 | S. ½ E. |

The run of the ship in the interval was 0. The height of the eye was 0. The index correction was — 36′ 10″. Required the true latitude at the second observation; the latitude by account being 52 N., and longitude 2° W.

12. Sept. 24, 1836, at 8h 40m A.M. mean time nearly, in latitude 48° 48′ N., and longitude by account 18° 30′ W., a chronometer showed 9h 33m 12s, and the observed altitude of the sun's L. L. was 23° 43′ 50″; the index correction was — 3′ 15″, and the height of the eye above the sea was 12 feet: required the true longitude.

Sept. 10, 1836, at Gr. mean noon, the chronometer was *slow* on Greenwich mean time 12m 50s, and its daily rate was 2s.6 *losing*.

13. Sept. 3, 1836, at 9h 18m A.M. mean time nearly, in latitude 50° 48′ N., and longitude by account 2° W., the following lunar observation was taken.

| Obs. Alt. Sun's L.L. | Moon's L.L. | Obs. Dist. N.L. |
|---|---|---|
| 34° 46′ 0″ | 44° 41′ 0″ | 85° 33′ 20″ |
| Index cor. +4 10 | +4 5 | +2 16 |

The height of the eye above the sea was 19 feet: required the true longitude.

14. May 18, 1836, at 5h 25m A.M. in latitude 51° 5′ N., and longitude 112° 42′ W., the sun rose by compass E. 6° 40′ S.: required the variation.

15. April 3, 1836, at 6h 20m P.M. in latitude 50° N., and longitude 170° E., the compass bearing of the sun was W. 16° 20′ N.; and the observed altitude of the sun's L. L. was 11° 45′ 10″; the index correction was — 2′ 10″, and the height of the eye above the sea was 17 feet: required the variation.

16. Find the mean time of high water at A on Oct. 15, A.M. and P.M. Change Tide, 3h 50m P.M. app. time. Long. A, 78° 1′ W.

## *Elements for* I, *from Nautical Almanac*, 1836, *with Answers.*

1. N. 22° 53′ E. 457′.
2. West 222.5.
3. N. b. E. ½ E.
4. Corrected courses W. ¼ N. 16′ Departure Course; N.W. 10′.3, S.E. ½ S. 21′.6: S.S.E. 21′.1; N. b. W. ½ W. 13′.9; S. ½ E. 16′.7; N. ½ E. 20′.5; S.E. b. E. ¼ E. 20′ Latitude in 46° 52″ N. Long. in 15° 8′ W.
5. R. A. of mean sun, Sept. 16, at Gr. mean noon, 11h 41m 51s.02. R. A. 61′ Cygni, 20h 59m 35s.9; R. A. ζ Pegasi 22h 33m 19s.7. From 61′ Cygni to ζ Pegasi inclusive.
6. Sun's decl. on Aug. 28, at Gr. mean noon, 9° 37′ 57″ N.; on Aug. 29, 9° 16′ 37″ N., semid. 15′ 52″. Latitude 55° 48′ 26″ N.
7. Moon's decl. on Sept. 17, at 21h Gr. mean time, 27° 9′ 27″ S.; at 22h, 27° 11′ 6″ S.; moon's hor. semid. on Sept. 17, at Gr. mean midn. 16′ 6″.6; on Sept. 18, at Gr. mean noon 16′ 8″.1; cor. hor. par. 59′ 7″.1 and 59′ 12″.8. Latitude 39° 37′ 29″ N.
8. Decl. of planet Jupiter on Aug. 29, at Gr. mean noon, 19° 10′ 37″ N.: on Aug. 30, 19° 7′ 40″ N.; hor. par. 1″.47. Latitude 58° 52′ 22″ N.
9. Decl. α Urs. Maj. 62° 37′ 59″ N. Latitude 29° 31′ 40″ N.
10. R. A. of mean sun, on Sept. 19, at Gr. mean noon, 11h 53m 40s.7. Latitude 48° 27′ N.
11. Sun's decl. on Sept. 14, at Gr. mean noon, 3° 18′ 35″ N.; on Sept. 15, 2° 55′ 27″ N. Semid. 15′ 56″. Latitude 50° 47′ 48″ N.
12. Sun's decl. on Sept. 23, at Gr. mean noon, 0° 11′ 6″ S.; on Sept. 24, 0° 34′ 31″ S. cor. Eq. T. 7m 44s.8 S. and 8m 5s.3 S.; semid. 15′ 58″. Hour angle 20° 34′ 37″ W. Longitude 20° 1′ W.
13. Sun's decl. on Sept. 2, at Gr. mean noon; 7° 49′ 50″ N.; on Sept. 3, 7° 27′ 49″ N.; cor. Eq. T. 0m 32s.8 S. and 0m 52s.0 S.; semid. 15′ 53″; moon's hor. semid. Sept. 2, at Gr. mean midn. 14′ 51″.5; on Sept. 3, at Gr. mean noon, 14′ 49″.0: corresponding hor. par. 54′ 31″.5 and 54′ 22″.3. True Dist. 85° 39′ 34″; true dist. at XXI, 85° 49′ 36″; at XXIV, 84° 26′ 50″. Hour angle 21° 15′ 46″ W. Longitude 1° 14′ 15″ W.
14. Sun's decl. on May 18, at Gr. mean noon, 19° 37′ 24″ N.; on May 19, 19° 50′ 21″ N. Tr. bearing E. 32° 20′ N. Variation 39° 0′ 15″ W.
15. Sun's decl. on April 2, at Gr. mean noon, 5° 3′ 7″ N.; on April 3, 5° 26′ 5″ N.; semid. 16′ 0″. Tr. bearing N. 95° 49′ 45″ W. Variation 22° 9′ 45″ W.
16. Moon's Gr. mer. passage on Oct. 15, 4h 19m; Oct. 14, 3h 18m; semid. 16′ 11′. Eq. Time 14m A to mean time. High water 6h 36m A.M. and 7h 7m P.M.

* Observed by Artificial Horizon

## K.

1. Required the course and distance from A to B. Lat. A 50° 15′ S., long. A 5° 18′ E.; lat. B 45° 10 S., long. B 8° 29′ E.

2. Required the course and distance from A to B. Lat. A 39° 17′ S., long. A 83° 12′ E.; lat. B 39° 17′ S., long. B 97° 18′ E.

3. A ship bore from me E.N.E. ½ E., and a current run in the intermediate space S.S.E. 4 miles an hour; how must I steer to fetch the ship, supposing I can pull in still water 5½ miles an hour?

4. Oct. 23, 1836, at noon, a point of land in longitude 18° 28′ E. and latitude 34° 28′ S. bore by compass N.W., distant 10 miles (variation of compass 2¼ W.); afterwards sailed as by the following log account; required the latitude and longitude in, on Oct. 24, at noon.

| H. | K. | ¼ 16ths. | Course. | Wind. | Lee-way. | |
|---|---|---|---|---|---|---|
| 1 | 5 | 4 | N. b. E. ½ E. | N.W. ½ W. | 2¼ | |
| 2 | 5 | 2 | | | | |
| 3 | 5 | 8 | | | | |
| 4 | 6 | 1 | | | | |
| 5 | 6 | 5 | S.S.W. | N.N.W. | ¼ | |
| 6 | 7 | 3 | .. | .. | .. | Variation 2¼ W. |
| 7 | 7 | 0 | | | | |
| 8 | 7 | 2 | | | | |
| 9 | 6 | 8 | N.W. b. W. | S.E. | 0 | |
| 10 | 6 | 5 | | | | |
| 11 | 6 | 1 | | | | |
| 12 | 5 | 8 | S. b. W. ¾ W. | S.E. ½ E. | 2¼ | |
| | | | | | | Remarks in H. M. S. Oct. 24, 1836. |
| 1 | 6 | 0 | | | | |
| 2 | 6 | 5 | | | | |
| 3 | 6 | 8 | | | | |
| 4 | 6 | 4 | N.N.E. | N.W. | 2 | |
| 5 | 6 | 0 | | | | |
| 6 | 6 | 5 | .. | .. | .. | A current set the ship the last 5 hours |
| 7 | 6 | 8 | | | | N.W. by compass 2 miles an hour. |
| 8 | 7 | 2 | N.W. | E. | 0 | |
| 9 | 7 | 6 | | | | |
| 10 | 7 | 9 | | | | |
| 11 | 8 | 1 | | | | |
| 12 | 8 | 5 | | | | |

5. At what time will the star α Aurigæ pass the meridian of Gibraltar on May 17, 1836, and how far N. or S. of the zenith?

6. May 18, 1836, in longitude 93° 17′ E., the observed meridian altitude of the sun's L. L. was 39° 28′ 52″ (zenith N. of the sun); the index correction was −3′ 12″, and the height of the eye above the sea was 16 feet: required the latitude.

7. Dec. 17, 1836, at 7ʰ 54ᵐ P. M. mean time nearly, in longitude 100° 10′ W., the observed meridian altitude of the moon's L. L. was 56° 29′ 10″ (zenith N of the moon); the index correction was + 7′ 38″, and the height of the eye above the sea was 22 feet: required the latitude.

8. May 8, 1836, the observed meridian altitude of the star α Orionis was 49° 37′ 48′ (zenith N. of the star); the index correction was −3′ 18″, and the height of the eye above the sea was 20 feet: required the latitude.

9. May 4, 1836, the observed meridian altitude of the star α Argus, under the South

Pole, was 37° 12′ 17″; the index correction was −3′ 41″, and the height of the eye above the sea was 19 feet: required the latitude.

10. May 17, 1836, at 2ʰ 48ᵐ A.M. mean time nearly, in longitude 99° 17′ E., the observed altitude of the star α Urs. Min. was 43° 28′ 39″; the index correction was −3′ 14″, and the height of the eye above the sea was 12 feet: required the latitude.

11. March 14, 1836, the following double altitude of the sun was observed :—

| Mean T. nearly. | Chronometer. | Obs. Alt. Sun's L.L. | Tr. Bearing. |
|---|---|---|---|
| 1ʰ 5ᵐ P.M. | 8ʰ 2ᵐ 25ˢ | 41° 20′ 45″ | S.S.W. ½ W. |
| 5 6 P.M. | 0 3 30 | 7 29 30 | W. b. S. ½ S. |

The run of the ship in the interval was N.E. 18 miles; the index correction was −3′ 20″, and the height of the eye above the sea was 23 feet: required the true latitude at the second observation; the latitude by account being 45° N., and longitude 50° 20′ W.

12. May 14, 1836, at 9ʰ 30ᵐ A.M. mean time nearly, in latitude 50° 49′ N., and longitude by account 0°, a chronometer showed 9ʰ 26ᵐ 18ˢ, and the observed altitude of the sun's L. L. was 46° 49′ 7″; the index correction was +3′ 10″, and the height of the eye above the sea was 10 feet: required the true longitude.

On May 1, 1836, at Gr. mean noon, the chronometer was *slow* on Greenwich mean time 4ᵐ 2ˢ, and its daily rate was 3ˢ.5 *losing*.

13. Jan. 20, 1836, at 3ʰ 0ᵐ P.M. mean time nearly, in latitude 50° 50′ N., and longitude by account 22° 10′ E., the following lunar observation was taken.

| Obs. Alt. Sun's L.L. | Moon's L.L. | Obs. Dist. N.L. |
|---|---|---|
| 8° 32′ 20″ | 20° 41′ 30″ | 29° 12′ 35″ |
| Index cor. 1 10 + | 1 50 + | 0 40+ |

The height of the eye above the sea was 12 feet: required the longitude.

14. May 20, 1836, at 4ʰ 47ᵐ A.M. mean time nearly, in latitude 18° 42′ S., and longitude 160° E., the sun rose by compass E. 21° 18′ 30″ N.: required the variation.

15. March 7, 1836, at 2ʰ 50ᵐ P. M. mean time nearly, in latitude 51° 10′ N., and longitude 86° E., the compass bearing of the sun was S. 74° 42′ W.; and at the same time the observed altitude of the sun's L. L. was 21° 40′ 45″; the index correction was − 2′ 18″, and the height of the eye above the sea was 14 feet: required the variation.

16. Required the time of high water at A on August 17, 1836, A.M. and P.M. Change Tide at A, 5ʰ 18ᵐ A.M. app. time. Long. A, 93° E.

## *Elements for* K, *from Nautical Almanac* 1836, *with Answers.*

1. N. 22° 49′ E. 330′.9.
2. East 654′.8.
3. N. N. E.
4. Corrected courses E. S. E. ½ E. 10′ Dep. Course; N. b. E. ½ E. 22′.5; S ½ E. 28′; W. ¼ N. 19′.4; S. b. W. ¼ W. 25′.1; N. b. E. ¼ E. 25′.7; W. b. N. ¼ N. 49′.3. Latitude in 34° 17′ 54″ S. Longitude in 17° 32′ E.
5. R. A. of mean sun, May 17, at Gr. mean noon, 3ʰ 40ᵐ 51ˢ.11. R. A. α Aurigæ 5ʰ 4ᵐ 33ˢ.5, decl. 45° 49′ 30″ N. At 1ʰ 23ᵐ 26ˢ.; N. of zenith 9° 42′ 30″.
6. Sun's decl. on May 17, at Gr. mean noon, 19° 24′ 8″ N.; on May 18, 19° 37′ 24″ N.; semid. 15′ 50″. Latitude 69° 57′ 26″ N.
7. Moon's decl. on Dec. 17, at 14ʰ mean time, 11° 11′ 15″ N.; at 15ʰ, 11° 24′ 45″ N.; moon's hor. semid. on Dec. 17, at Gr. mean midn. 15′ 14″.2; on Dec. 18, 15′ 9″.7; cor. hor. par. 55′ 54″.9 and 55′ 38″.2. Latitude 44° 1′ 33″ N.
8. Star's decl. 7° 22′ 15″ N. Latitude 47° 52′ 58″ N.
9. Star's decl. 52° 36′ 41″ S. Latitude 74° 26′ 22″ S.
10. R. A. of mean sun, on May 16, at Gr. mean noon, 3ʰ 36ᵐ 54ˢ.54. Latitude 43° 35′ N.
11. Sun's decl. on March 14, at Gr. mean noon, 2° 23′ 53″ S.; on March 15, 2° 9′ 12″ S. Semid. 16′ 6″. Arc (1) 60° 13′, (2) 91° 23′ 15″, (3) 46° 23′ 45″. Latitude 44° 3′ 38″ N.
12. Sun's decl. on May 13, at Gr. mean noon, 18° 27′ 47″ N.; on May 14, 18° 42′ 21′ N.; corresponding Eq. T. 3ᵐ 56ˢ.0 S. and 3ᵐ 56ˢ.3 S.; hour angle 21ʰ 35ᵐ 35ˢ W. Longitude 0° 8′ 30″ E.
13. Sun's decl. on Jan. 20, at Gr. mean noon, 20° 16′ 3″ S.; on Jan. 21.

Example continued

20° 3′ 5″ S. corr. Eq. T. 11ᵐ 10ˢ.9 A, and 11ᵐ 28ˢ.7 A; sun's semid. 16′ 16″; moon's hor. semid. on Jan. 20, at Gr. mean noon, 16′ 1′.3; on Jan. 20, at Gr. mean midn. 15′ 54″.1; corresponding hor. par. 58′ 47″.7 and 58′ 21″.3. True dist. 30° 6′ 54″; dist. at mean noon 29° 17′ 10″, at III. 30° 53′ 17″. Hour angle 2ʰ 59ᵐ 54° W. Longitude 24° 29′ E.

14. Sun's decl. on May 19, at Gr. mean noon, 19° 50′ 21″ N.; on May 20, 20° 2′ 57″ N. Tr. bearing E. 21° 3′ 0″ N. Variation 0° 15′ 30″ E.

15. Sun's decl. on March 6, at Gr. mean noon, 5° 31′ 55″ S.; on March 7, 5° 8′ 36″ S.; semid. 16′ 8″. Tr. bearing N. 130° 44′ 0″ W. Variation 25° 26′ 0″ W.

16. Moon's Gr. mer. passage on Aug. 17, 3ʰ 55ᵐ, Aug. 16, 3ʰ 10ᵐ; semid. 15′ 38″ Eq time 4ᵐ S. from mean time. High water 7ʰ 39ᵐ A. M., and 8ʰ 1ᵐ P. M.

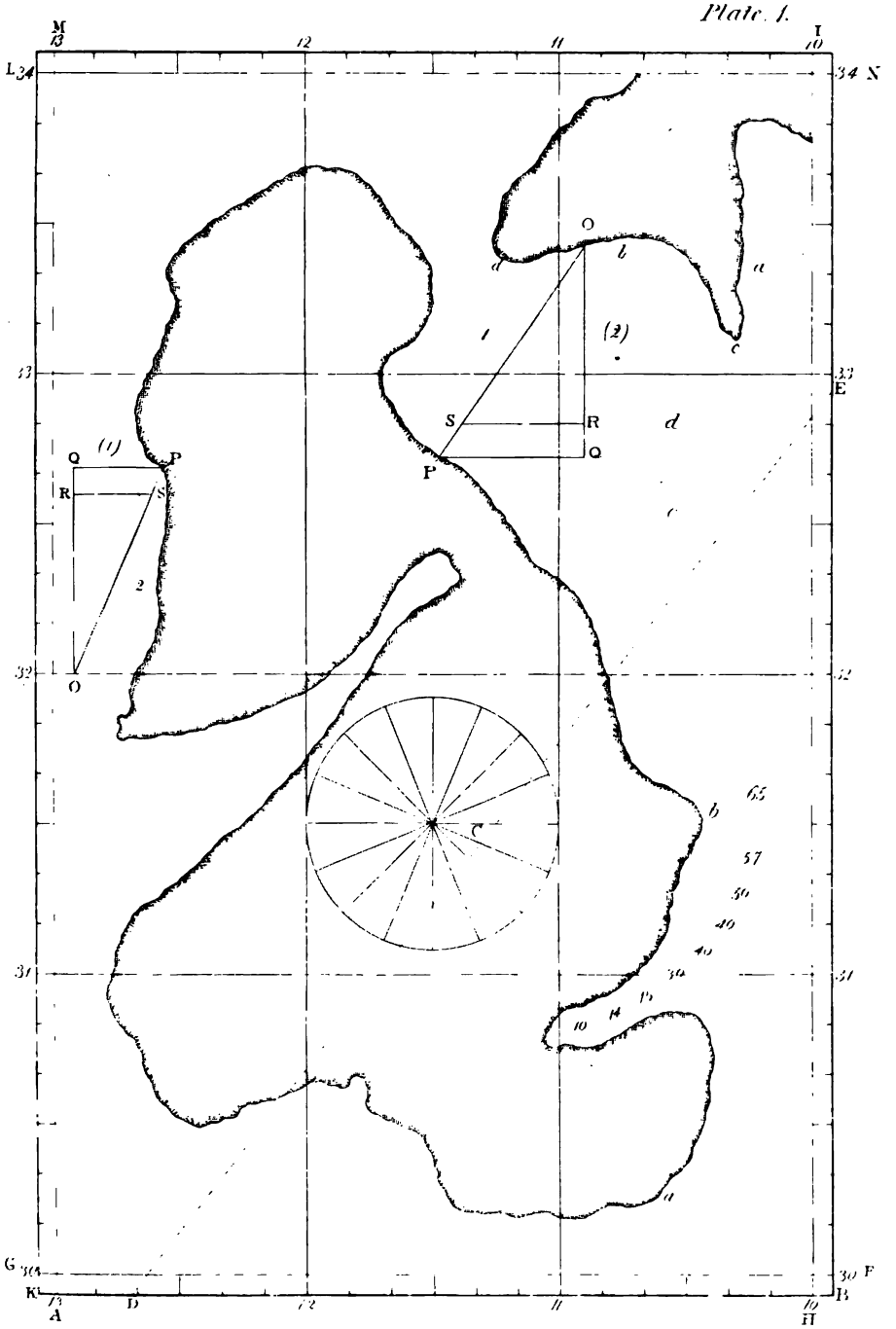
Plate. I.
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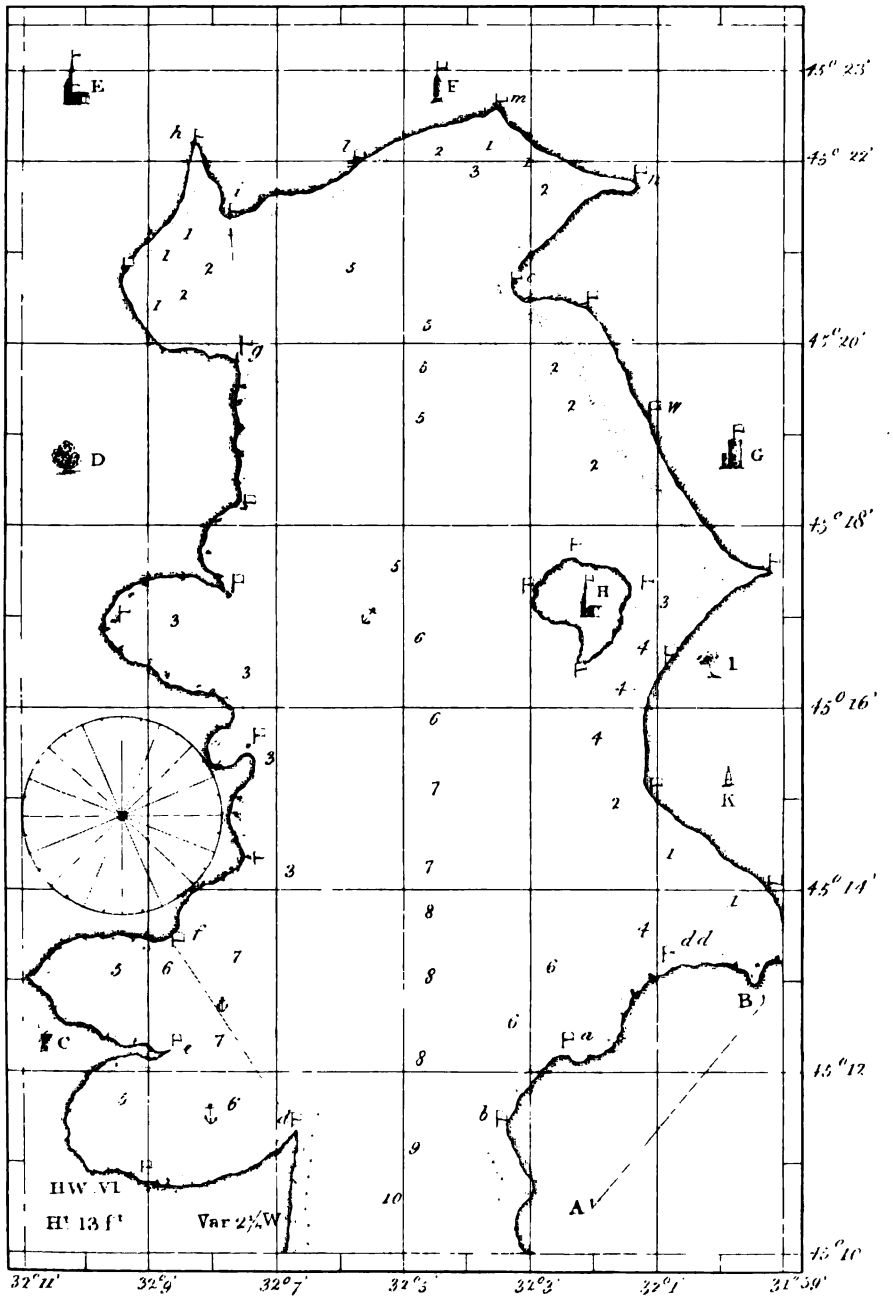
*Plate 2*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HW VI
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Var 2¼W
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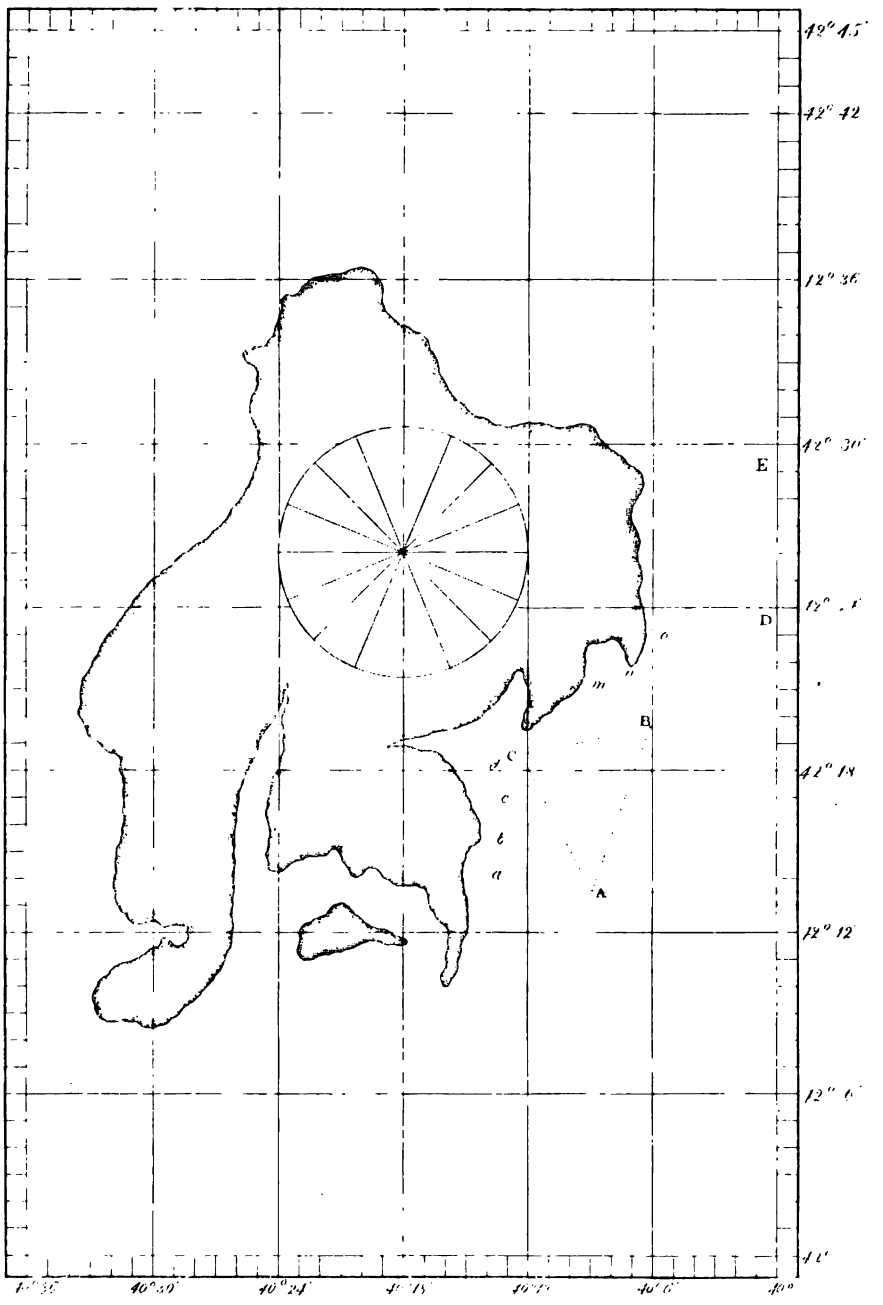
45° 22'
45° 20'
45° 18'
45° 16'
45° 14'
45° 12'
45° 10'
32° 11'
32° 9'
32° 7'
32° 5'
32° 3'
32° 1'
31° 59'

*Plate. 3*


42° 45'
42° 42
42° 36
42° 30
42° 18
42° 12
42° 6
41'
40° 35
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# NAUTICAL TABLES

## DESIGNED FOR THE USE OF BRITISH SEAMEN

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# EXPLANATION AND USE OF TABLES.

Table (a), p. 1.—This table contains the whole correction of the sun's altitude, involving dip, refraction, semidiameter, and parallax. The lower limb is supposed to be observed. When the upper limb is observed proceed as in the Table, and deduct 32′.

Table (b), p. 2. *Parallax in Altitude for Planets.*—Enter with the hor. parallax of a planet (supposed to be known from the Nautical Almanac) at the top, and the app. altitude of planet at the side. Thus will be found the parallax in altitude, to be *added* to the app. alt. to get the true alt. The app. alt. is first supposed to be corrected for refraction, as for a fixed star. See Tab. (n.)

Table (c), p. 2. *Correction of* A *for Planet in Clearing Distance.*—For explanation of this table, see that of Table (w).

Table (cc), p. 2. *Sun's Parallax in Altitude.*—The effect of parallax in alt. for the sun, is included in correction of Table (m): it is put down here, as it is occasionally of use considered separately. (See Navigation on Occultations, p. 180.)

Table (d), p. 3. *Points of Compass, &c.*—This table is of use in turning the points of the compass into degrees, and conversely: also, in finding at once the log. sines of points and quarter points.

Table (e), p. 3. *Dip of the Sea Horizon.*—The altitude of a heavenly body is taken in the open sea with Hadley's quadrant, in doing which the image is brought down to the apparent sea horizon, which is below the level of the eye. The observed altitude is on this account something too great. The necessary correction is put in Table (e), which is entered with the estimated height of the eye above the sea. The correction or dip taken out is *subtractive.**

* In computing this table, it is necessary to consider the effect of horizontal refraction in raising the visible sea horizon, which has been found to be about 8-100ths of the dip independently of this correction. But this effect varies with the state of the air near the sea horizon. Hence the correction applied for dip may frequently be erroneous; and this is one cause why altitudes taken at sea, particularly those taken near the horizon, are not to be depended on where great accuracy is required.

Table (f), p. 3. *Dip of a Shore Horizon.*—Sometimes the observer is obliged to bring the image down to the shore of an island or continent, over which the heavenly body happens to be. In this case the dip is greater than in the open sea. The table is entered with the estimated height of the eye and the estimated distance of the shore; the correction taken out is *subtractive.*

Table (g), p. 4. *Augmentation of the Moon's Semidiameter.*—The semidiameter of the moon put down in the Nautical Almanac is computed on the supposition that the spectator is at the centre of the earth; whereas he is on the surface; and therefore, when the moon is above the horizon, he is nearer to the moon than if he were at the centre. Consequently the apparent semidiameter is something greater than what is taken out of the Nautical Almanac. The No. of seconds to be added is taken from Table (g), which is entered with the moon's apparent altitude at the side, and the semidiameter to the nearest 10″ at the top.

Table (h), p. 4. *Reduction of Horizontal Parallax and Latitude of Place for Figure of Earth.*—The *hor. parallax* of the moon in the Nautical Almanac is put down for a place on the earth's equator. At any other place on the earth it will be something less; since, on account of the compression towards the poles, the earth's semidiameter is there less than at the equator. The seconds to be subtracted are found in this table by entering with hor. par. at the top, and with lat. at the side.

The *latitude* of a place on the earth is the arc between the true zenith and the equator: this is called the latitude on the *spheroid.* It is occasionally necessary to reduce this to the latitude of the same place, on the supposition that the surface of the earth at the same place is exactly *spherical.* The seconds to be subtracted for this purpose are put down in the last column of this table. (See Occultation of Fixed Stars in Navigation.)

Table (i), p. 4. *Reduction of Semidiameter on account of Refraction.*—In correcting a lunar distance it is usual to apply the semidiameter of the moon, as seen from the earth's centre, corrected only for augmentation (Table g); but generally a further correction should be applied for the effect of refraction. The extremities of any diameter of the moon inclined to the horizon, being at different altitudes, are unequally raised by refraction, the lower extremity being the more raised; hence a contraction of the diameter takes place. The necessary correction for the semidiameter, which is always *subtractive,* is found from this table, by entering it with the inclination of the line between the bodies observed, as the moon and a star, and the altitude at the side; the inclination may be estimated by the eye. A similar correction should be applied also to the sun's semidiameter.

Table (k), p. 5. *Correction in finding Moon's Meridian Passage.*—In *west* longitude the moon passes the meridian later, that is, longer after the sun, than at Greenwich; because then her distance from the sun in R. A. (reckoning from W. to E.) is greater than it was at the Greenwich meridian passage. In *east* longitude the meridian passage takes place sooner. The necessary correction of the time of the Greenwich passage is taken from this table, by entering it with the longitude at the top, and at the side the difference between the times of two successive Greenwich passages, one on the given day, the other on the day following, in *west* longitude, but the

difference between the passages on the given day and the day preceding, in east longitude.

Table (l), p. 5. *Correction in finding Time of High Water.*—By the change tide is meant the high water when the moon and sun are in conjunction, or appear from the earth in the same part of the heavens. If the moon and sun always remained in this position, the time of high water would be the same always with the change tide: but as this is not the case, a correction becomes necessary; which is found from this table by entering it with the time of the moon's meridian passage for the place at the side, and the moon's semidiameter (taken by inspection from the Nautical Almanac) at the top.

Table (m), p. 6. *Correction of the Sun's Apparent Altitude.*—The sun's apparent altitude is greater than its true altitude on account of refraction, and less on account of parallax. But since the refraction is greater than the parallax, the necessary correction on the whole, or the difference of refraction and parallax, must be subtractive. To find therefore the true altitude of the sun from its apparent altitude, enter this table with the latter, and take out the corresponding number in the column marked *corr.*, which subtract.

The correction taken from this table, if necessary, should be increased or diminished by the number in Table (z 4), p. 380, Correction of Mean Refraction.

Table (n), p. 8. *Correction of a Star's Apparent Altitude.*—A star has no parallax; hence the only correction is to be applied to its apparent altitude, in order to get the true altitude, is for refraction, which is put down in this table in the column marked *corr.* The table is entered with the star's apparent altitude, and the correction taken out is subtractive.

The refraction put down in this table, and used in the last, is computed from Dr. Young's Table of Refraction (see Nautical Almanac).

Tables (o), p. 10. *Table for finding when the sun is on the prime vertical, and Azimuth Table.*—By these two useful tables, in combination with the Traverse Table, the variation or deviation of the compasses may be found at sea with great facility and sufficient exactness. These operations are rendered the more necessary by the present method of constructing ships of iron.

Table (p), p. 13. *Greenwich Date Logarithm for the Moon.*—By means of this table and the table of proportional logarithms, the proportional part of the moon's declination, right ascension, &c., for any Greenwich date, may be very easily computed as follows. Take from this table the logarithm corresponding to the hours and minutes of the Greenwich date, or if it is greater than 12 hours, with the excess above twelve hours. To this logarithm add the proportional logarithm of the change of the declination, right ascension, &c., in the 12 hours in which the date lies; the sum will be the proportional logarithm of the part required.

If the change of the declination or right ascension be more than 3°, use the proportional logarithm of half the change, and double the proportional part which results. This double will be the part required.

Table (q), p. 14. *Greenwich Date Logarithm for the Sun.*—The proportional part of the sun's declination, right ascension, &c., may be found by

means of this table and the table of proportional logarithms as follows Take from this table the logarithm corresponding to the hours and minutes of the Greenwich date, to which add the proportional logarithm of the change of the sun's declination, right ascension, &c., in the 24 hours in which the date lies. The sum will be the proportional logarithm of the part required.

Table (qq), p. 16. *Proportional Logarithms for Seconds and Tenths of Seconds.*—This table may be of use in finding the proportional part, when the daily or half daily difference is small, and expressed in seconds and tenths of seconds. See explanation of Tables (p), (q), and (r.)

Table (r), p. 13*. *Proportional Logarithms.*—It is frequently necessary to work proportions by logarithms, whereof one of the terms is 3 hours. To do this by common logarithms would be extremely tedious, since it would be necessary to reduce every term into seconds, then to take their logarithms from the tables, and finally to bring the resulting seconds into hours, minutes, and seconds. To shorten such operations, the logarithms of every number of seconds below 3 hours are subtracted from the logarithm of the seconds in 3 hours. The results are arranged in a table, and called proportional logarithms; the corresponding hours and minutes being placed at the top of the page, and the seconds at the side.

Since degrees, minutes, and seconds, have the same proportion to each other as hours, minutes, and seconds, it is manifest that the same numbers will be proportional logarithms of any number of degrees, minutes, and seconds, less than 3°.

If any term of four proportionals be required, each of which terms is less than $3^h$ or 3°, it may be computed by proportional logarithms in the same manner as by common logarithms. If one of the terms be $3^h$ or 3°, its proportional logarithm need not be considered in the operation, since it is equal to 0. Hence appears the use of proportional logarithms in finding Greenwich time from the distance of the moon from the sun or a fixed star. The variation of the distance in $3^h$ is taken from the Nautical Almanac, and the proportional logarithm of this is subtracted from that of a less variation of distance. The result is the proportional logarithm of the time required for the latter variation.

Table (s), p. 32. *Log Sine to Seconds.*—Since the sines of small arcs change not only very rapidly, but also irregularly, the common method of proportioning for seconds is both troublesome and erroneous. On these accounts it was thought proper to put down the log sines of arcs as far as 50′ to seconds; the same numbers are the log cosines of arcs from 90° down to 89° 10′ to seconds. If the *log tangent* of a small arc within the limits of the table be wanted, it may easily be found by subtracting the log cosine (Table t) from the log sine (Table s), adding 10 to the index of the log sine

Table (t), p. 37. *Log Sines, &c.*—An angle is put down in this table at the top and left hand side, if less than half a right angle; and at the bottom and right hand side, if greater than half a right angle; the angles included on the whole being from 0 to a right angle. The angle is put down both in ° ′ ″ and in h. m. s.; the columns of log sines, log cosines, &c., are marked at the top or bottom; the titles at the top must be used, when the angle is less than 45°, or $3^h$; and a the bottom when greater than 45°, or $3^h$.

If an angle be greater than 90°, or 6ʰ, take it from 180°, or 12ʰ, and find the log sine, &c., for the remainder.

This table is useful in turning ° ′ ″ into h. m. s. and conversely. If an angle expressed in ° ′ ″ be greater than 90°; allow 6ʰ for 90°, and look for the excess above 90°. If an angle in time be greater than 6ʰ, allow 90° for 6ʰ, and look for the excess above 6ʰ.

Table (u), p. 217. *Logarithms of Numbers.*—The first two pages of this table contain the logarithms of numbers from one to a thousand; the other pages contain the logarithms of numbers from 1000 to 9999. To find the logarithm of any given number proceed as follows. If the number do not consist of more than four figures, they may all be found in the column of nat. numbers, and opposite them will be found the decimal part of the logarithm. The index of the logarithm is equal to the number of places, which the first left hand significant figure of the natural number is from the place of units; and it will be positive, if the first significant figure be a whole number or integer, and negative, if it be a decimal fraction. Thus the logarithm of 234 is 2.369216, and that of 0.234 is $\bar{1}$.369216. If the number of figures in the given nat. number exceed four, look for the first four figures, and take out the corresponding logarithm; then look for the 5th figure among the last figures, that is, in the unit places of the nat. numbers which lie in the space of the column, wherein the first four figures have been found. Place the opposite figures in the column of prop. parts under the last figures of the logarithm already taken out, the last figures in each under one another. Then look for the second supernumerary figure, if there be one in the given nat. number, and put the corresponding figures in the prop. parts, (carrying them one place to the right) under the last proportional part written down. Again, look for the third supernumerary figure in the given nat. number, if there be one, and put the corresponding part (carrying them still one place farther to the right) under the last prop. parts put down; and thus go on as far as it may be necessary. Lastly, add all the numbers, as they are put down, together; and take the result, to the nearest sixth place, for the logarithm required (see example in next page).

If any of the supernumerary figures be a cipher, pass over this, but take care to carry the next prop. parts put down, *two* places to the right.

To find from the table the nat. number of a given logarithm, proceed as follows. Look for the decimal part of the given logarithm in the column of logarithms. If this be found exactly, take out the corresponding number from the column of the nat. numbers. Then insert the decimal mark, so that the first significant figure may be as many places from the unit's place as there are units in the index of the given logarithm, to the left or right of the units, according as the index is positive or negative.

If there is not a sufficient number of places in the nat. number, when the index is positive, ciphers must be added to the right.

When the index is negative, put a cipher in the unit's place, and then other ciphers in continuation in the first decimal places, so that the first significant figure may be as far from the units, as is denoted by the index.

When the decimal part of the given logarithm cannot be found exactly, in that case, find in the column of logarithms a number next below the decimal of the given logarithm; and take the difference between this and the said decimal. Look in the column of prop. parts, in the space from which the next less logarithm has been taken, for the number next below this difference; the last figure, that is, the figure in the unit's place, of the nat.

number opposite, will be the first figure to be added in continuation to the nat. number corresponding to the next less logarithm.

Take the number in the column of prop. parts next below the aforesaid difference, from the difference itself, and add to the remainder a cipher. With this look again in the column of prop. parts for the number next below it, and the last figure in the nat. number opposite will be the second additional figure.

Thus go on as far as may be necessary, taking the last additional figure to the nearest unit.

If the difference, or remainder with the addition of one cipher, be less than any of the numbers in the column of prop. parts, the corresponding additional figure will be a cipher. Then add another cipher to the remainder, and proceed as above *.

*Ex.* Required the logarithm of 623472 and the nat. number of the logarithm 5.372642.

| | | | |
|---|---|---|---|
| dec. log. of 6234... | .794767 | | 5.372642 |
| p. p. for 7 ..... | 49 | next less..... | .372544..2358 |
| for 2 ..... | 14 | | |
| | | diff..... | 98 |
| decl. reqd. log..... | .794817 | in prop. parts | 92..5 |
| putting the index .... | 5.794817 | | — |
| | | | 60 |
| | | | 55..3 |
| Reqd. nat. number to nearest unit..235853 | | | 50 |

Cologarithms are easily obtained from the table of logarithms *at sight*. Set down the difference of every figure in the logarithm (characteristic as well as mantissa) from 9, proceeding from left to right, until the last significant figure, which subtract from 10. Strike out as many tens from characteristic of the result as cologarithms have been used in the operation.

Table (v), p. 248. *Nat. Versines.*—To find the nat. versine of a given arc from this table, look for the degrees and minutes on the left-hand page, the degrees at the top and the minutes at the side; and take out the corresponding number, observing that where only the last five figures are put down, the preceding ones printed at every third must be added. Then putting the finger on the right-hand page at the nearest half degree to the degrees and minutes just looked out, move it down the corresponding column till it is opposite to the seconds of the given arc, as seen in either side column. The number where the finger is placed will be the parts for the seconds, to be added to the number taken from the left-hand page, the last figure under the last figure.

To find the arc for any given nat. versine, look for the next less in the left-hand page, and take it from the given one. At the same time, take out the degrees and minutes corresponding to the next less. Put your finger on the right-hand page at the nearest half degree to the degrees and minutes just taken out, move it down the corresponding column till you come to the difference between the given versine and the next less as just found, or to

* The index for whole numbers is always *one less* than the No. of integers or whole numbers. When the index is not negative, the No. of integral figures or whole numbers in the nat. number is *one more* than the index denotes.

the nearest number thereto. Then the seconds on either side between which the figure is placed, will be the seconds in the required arc, to be written after the degrees and minutes taken out.

If the minutes of an arc be nearly 15′, or 45′, in that case, where great accuracy is required, the mean of two parts for seconds may be taken, for the next less half degree and the next greater.

The versines of arcs expressed in time as far as $36^m$ are given in the three first pages of the table. This part of the table will be found useful, particularly in computing the latitude by several altitudes of a heavenly body taken near the meridian by the following rule.

Take the time of each observation by a time-keeper, the error of which on apparent time is known, and thence deduce the distance in time between each observation and noon, that is, each hour angle in time; take out the nat. versines of these hour angles, and dividing their sum by their number, get the mean versine. Add the corrected or true altitudes together, and dividing by their number get the mean true altitude, and thence the mean true zenith distance. For a Greenwich date corresponding to noon at the place, take from the Nautical Almanac the sun's declination; with this and the mean true zenith distance, as if it were the meridian zenith distance, find an approximate latitude. Then add together 5·314425, log cosine approximate latitude, log cosine declination, log cosec. mean true zenith distance, and log. of the mean nat. versine (adding 4 to proper index). The sum, rejecting the *tens* from the index, will be the log. of a number of seconds, which find from the tables, and subtract them from the mean true zenith distance (under the pole add); the result will be the true meridian zenith distance, from which and the declination, deduce the true latitude as usual.

The *nat. sine* of any angle may be taken from this table, by finding the nat. vers. of an angle greater than the given one by 90°, rejecting the first figure 1. If the angle be above 90°, take the nat. sin. of its supplement to 180°, in this manner. To find the nat. cosine of an angle, take the nat. sine of what it wants, or is above 90°, in the same manner.

Table (w), p. 284. *The correction of the Moon's Altitude and the Auxiliary Angle A.*—The effect of refraction on the moon's altitude being subtracted from the effect of parallax, the remainder is called the *correction in altitude.* To find it from this table, look for the half page having the degree of apparent altitude at the corner; put your finger at the top on the minutes of the horizontal parallax, and move it down the middle line between the column marked *corr.* and the column marked A with 60° under it, till you come opposite the minute at the side nearest to the minute of the apparent altitude in the proper half page. Take out the number at that point to the left of the aforesaid middle line, that is, in the column marked *Corr.* To this add the parts for the seconds of the horizontal parallax taken from the column marked *corr.* at the right hand side of the page. The result will be the correction in altitude which is required.

Should the horizontal parallax be between 53′ and 54′, then take the correction out for 54′, and subtract the parts for the seconds which the horizontal parallax is below 54′. Thus suppose the horizontal parallax is 53′ 57″, and the moon's apparent altitude is 18° 16′; then the correction corresponding to 54′ of horizontal parallax and the altitude 18° 16′ is 18′ 23″, and the parts for 3″ at the right hand side of the page is 3″: consequently the correction required is 48′ 20″.

This table also contains the auxiliary angle A. which is used in clearing the distance by the method given in p. 129 of Navigation. The minutes and seconds, to be added to the 60° at the top, are taken out of the table at the same time with the correction in altitude, and in a similar manner; being found on the right of the middle line under the minutes of the horizontal parallax, and opposite the minutes of altitude, or the nearest number thereto. Two additions are made to the number so taken out, one taken from the column A opposite to the seconds of the horizontal parallax in the right hand margin, and the other from the small Table at the bottom of the right hand side of the page, for the nearest degree put down there of the sun or star's altitude; from the second or third column, that is, from the column marked ⊙ or ✳, according as the sun or star is observed.

When the moon's distance from a planet is observed, take the second correction of A from the Table (c), p. 2, instead of the column marked ⊙ or ✳.

If the horizontal parallax is below 54′, the value of A corresponding to 54′ and the apparent altitude must first be taken out; then the parts for the seconds which the horizontal parallax is below 54′ must be subtracted; and thirdly, the small correction for the sun or star's altitude must be added.

Table (x), p. 327. *Traverse Table.*—This table is used principally in working a day's work. The distance run is looked for at the top, and the corrected course, either in points or in degrees, at the side; if less than four points, or 45°, at the left hand side; if greater than four points, or 45°, at the right hand side. The *diff. lat.* and *dep.* will be found in the columns so marked, in the former case at the top, in the latter at the bottom.

This table is also frequently used in turning *dep.* into *diff. of long.*, by looking for the *mid. lat.* as a *course*, and the *dep.* as a *diff. lat.*; the *dist.* will then be the *diff. long.*, also conversely; if the *mid. lat.* be looked for as a *course*, and the *diff. long.* in the *dist.* column, the *dep.* will be the corresponding number in the *diff. lat.* column.

Table (y), p. 364. *Meridional Parts.*—At the earth's equator a degree of longitude is equal to a degree of latitude in length; but as we approach the poles the degrees of longitude become less and less, while the degrees of latitude (supposing the earth to be a perfect sphere) remain the same. In a Mercator's chart the degrees, minutes, &c. of longitude are made every where of the same length; hence, to keep up their proper proportion, it is necessary to increase the degrees, minutes, &c. of latitude. A formula is investigated, which gives the value of any latitude properly increased for this purpose; and the miles contained in the latitude so increased are called its *meridional parts.* The meridional parts are taken by inspection from this table for any given latitude, entering with the degrees at the top, and with the minutes at the side. For all the common purposes of navigation it will be sufficient to take out the meridional parts to the nearest unit; that is, to the nearest figure before the decimal mark or dot.

Table (z), p. 373. *Bearing Amplitude and Time Amplitude at the Rising and Setting of the Sun.*—By the bearing amplitude of the sun is meant the arc of the horizon intercepted between the east point and the point where the sun rises, or between the west point and the point where it sets. It is reckoned from the east and west points towards the north or south, according as the declination is north or south.

By the time amplitude is meant the time the sun rises before or after

6 A.M., or sets before or after 6 P.M. When the latitude and declination are both north or both south, the sun rises so much before 6 A.M., and sets so much after 6 P.M. When the latitude and declination are one north and the other south, the sun rises so much after 6 A.M., and sets so much before 6 P.M.

Each of these amplitudes is found by entering the table with the nearest degree to the declination at the top, and the nearest degree to the latitude at the side. This will be sufficient for most of the purposes of the table.

Table (z 1), p. 377. *The Time from Noon, at which the True Bearing of the Sun is E. or W.*—The most advantageous time for taking an altitude of the sun at sea, from which apparent time is to be deduced, is when its true bearing is E. or W., provided its altitude above the horizon is then at least 6 or 7 degrees. This time may be known by inspection from the tables, entering it with the nearest degree to the declination at the top, and the nearest degree to the latitude at the side.

Table (z 2), p. 378. *Equation of Second Differences for* 12 *hours.*—Since the moon's latitude, declination, right ascension, &c. do not vary uniformly for 12 hours, the result of a single proportion will not give the correct change after noon or midnight up to the Greenwich date. The first proportional part therefore is corrected by means of a table of second differences as follows.

To find the moon's correct latitude for any given Greenwich date, take from the Nautical Almanac two latitudes, which immediately precede the given date, and two which immediately follow it; write these in the order of time, under each other, marking each with its proper name N or S. If the second be greater than the first and they have the same name, put down their difference with the name of either; if the second be less than the first, and they have the same name, put down their difference with a name different from that of either; if the two latitudes have different names, put down their sum with the name of the latter. A similar rule must be followed for the second and third latitude, and for the third and fourth. Afterwards take the difference of these first differences in a similar manner, marking the result as directed. Then, if the two results have the same name, take half their sum and give it the name of either; if they have different names, take half their difference, and give it the name of the greater.

Enter the *Table of Second Differences* with the hours and minutes the Greenwich date is after noon or midnight, at the side; and with the mean second difference at the top, first the minutes and then the seconds (see the Table). The sum of the parts taken out will be the *equation of second differences*, to which put a contrary name to that of the mean second difference. Then compute the first proportional part as usual, putting to it the name of the middle first difference; under this put the equation of second differences, and if the names be like, take the sum with the name of either; if the names be unlike, take the difference with the name of the greater; the result will be the correct proportional part to be applied to the second latitude.

The declination of the moon is taken out in a similar manner.

The right ascension of the moon may also be taken out thus: putting to each right ascension the sign + instead of the name N or S as used above and the sign — when the name is changed as above.

This observation applies also to the longitude of the moon

*Ex.* Required the moon's latitude at Greenwich on May 18, $4^h\ 20^m$.

| | Lattude. | First Diff. | Second Diff. | M. Second Diff |
|---|---|---|---|---|
| 17 Midn. . . . | 4° 59′ 49″ S | | | |
| 18 Noon . . . | 5 0 29 S | 0′ 40″ S | | |
| 18 Midn. . . . | 4 57 32 S | 2 57 N | 3′ 37″ N | |
| 19 Noon . . . | 4 50 46 S | 6 46 N | 3 49 N | 3′ 43″ S |
| (*p*) | .44236 | | 1′ 3″.8 N | |
| | 1.78545 | | 0 25 .7 S | |
| | 2.22781 | | 0 38 .1 N | |
| | | | 5 0 29 S | |
| | | Lat. | 4 59 50 .9 S | |

Table (z 3), p. 379. ***Mean Motion of the Sun in Right Ascension for Sidereal Hours.***—This table contains the difference between any interval as expressed in sidereal time, and the same interval as expressed in mean solar time. It is particularly useful in turning sidereal time into mean solar time as follows. From sidereal time, increased if necessary by 24 hours, subtract the right ascension of the sun at the preceding apparent noon. The remainder will be the interval between apparent noon and the given instant, as shewn by a sidereal clock. From this subtract the mean increase of the sun's right ascension in that interval so expressed, which increase is taken from this table. The remainder will then be the distance from apparent noon as shewn by a mean solar clock. To this apply the equation of time at the preceding noon with its proper sign as in the Nautical Almanac, and the result will be the distance of the given instant from mean noon, as shewn by a mean solar clock, or it will be mean time.

Table (z 4), p. 379. *Correction of Mean Refraction.*—The amount of refraction depends on the weight and temperature of the air. The barometer at the surface of the sea is supposed to stand at 30 inches and the thermometer at 50°, when the air is at its mean state in both respects. On this supposition the tables of correction for refraction and parallax, pp. 6, 7, 8, 9, and p. 284 to 326, are formed. If the barometer and thermometer do not stand so, the corrections taken from those tables must be increased or diminished by the numbers taken from Table (z 4). When the quicksilver in the barometer is higher than 30 inches, or that in the thermometer is higher than 50°, the number of seconds taken from Table (z 4) must be applied with the signs at the head of the columns, for the sun or a star; when the quicksilver stands below these heights in either, they must be applied with the signs at the bottom, for the sun or a star. But to the correction of the moon's altitude, as put down in Table (w), these numbers must be applied with contrary signs to those found in this manner.

Table (o) 1, p. 12. An imaginary sun moving in right ascension with the mean motion of the true sun, or 3′ 56″.556 in 24 mean solar hours, is called the *mean sun*. When such a supposed sun is on the meridian of any place, its right ascension is the same there as *sidereal time* (see Navigation); under which heading it is put down in the Nautical Almanac for every mean noon at Greenwich.

For any other Greenwich date the numbers taken from this Table—first, for the hours; secondly, for the minutes; and, thirdly, for the seconds—are added to the right ascension (or sidereal time) at the preceding noon. The result is the right ascension of the mean sun for the Greenwich date.

Table (o) 2, p. 12. A diameter of the earth being supposed to be produced outside the earth's surface to any height as $h$, and a tangent as $t$ to be drawn from the extremity of $h$ to the surface of the sea: then, from the properties of the circle, $t^2 = h \times (\text{diameter} + h)$: or, taking the diameter 41796480 feet, $\log. t = \frac{1}{2}\{\log. h + \log. (41796480 + h)\}$. From this formula $t$ is computed for different heights $h$, and put down in this Table. It is evidently the distance at which a high object, as the top of a mountain whose height is $h$, might be seen by an eye supposed to be placed on the surface of the sea. If $t$ be supposed to be produced beyond the point where it touches the sea, so as to reach any elevated spot where the eye may actually be placed, as the mast-head of a ship, whose height is $h'$, the distance it is thus produced, as $t'$, may evidently be found from the Table by entering it with $h'$; and then, adding $t'$ to $t$, the sum will be the whole distance of the eye from the object whose height is $h$.

Table (o) 3, p. 12. If $\delta$ (computed as in p. xi.) denote the 2nd difference of any quantities put down for every $1^h$ or $3^h$, as the moon's R. A. in the Nautical Almanac or the lunar distances, then the *equation of 2nd diff.* is $\delta . x . \frac{x-1}{2}$, $x$ being the fractional part of $1^h$ or $3^h$, which the Greenwich date is beyond the preceding $1^h$ or $3^h$. In Table (o) 3 the value of $x . \frac{x-1}{2}$ is put down, so that, if $\delta$ in seconds be multiplied by the number found from this Table, the result will be the *equation of 2nd diff.*, by which an element to be computed for any Greenwich date may be corrected, in the manner directed in p. xi., where the interval is $12^h$.

When the Greenwich date is required to be found from the given element, this is first computed, as usual, on the supposition of uniform motion for $1^h$ or $3^h$; the *equation of 2nd diff.* is then computed in the manner pointed out in p. xi. Then subtracting from the *prop. log.* of this equation the *prop. log.* of the excess of the Greenwich date first got above the preceding $1^h$ or $3^h$, the result will be the *prop. log.* of the required correction on account of variable motion. This correction being found, it must be added when the change of the element is accelerated, that is, when the differences of theelement in question for $1^h$ or $3^h$ increase; otherwise it must be subtracted.

But this correction is most easily taken from a Table in the Nautical Almanac, p. 484.

Table (o) 4, p. 12. If $x$ be the true lunar distance, $d$ the apparent dis-

tance, A and A′ the true altitudes, and $a$ and $a'$ the apparent altitudes; then *vers.* $x$ = *vers.* (A − A′) + *vers.* $\theta$, where log. *havers* $\theta = \frac{1}{2}$ log. *havers* $(d+\overline{a-a'})+\frac{1}{2}$ log. *havers* $(d-\overline{a-a'})+$ { log. *sec.* $a$ + log. *cos.* A—20 } + { log. *sec.* $a'$ + log. *cos.* A′ − 20. } Table (o) 4 contains each expression between the brackets, supposing the body, as a fixed star, to be affected only by refraction (see Navigation, Lunar Observations, when spheroidal figure of earth is considered). And the column for the sun contains the expression for the sun as affected both by parallax and refraction.

*Table of Logistic Logarithms* (o) 5. If there be a proportion consisting of four terms, two of which are expressed in time and two in degrees, or all are expressed in time or in degrees, one of the terms being $1^h$ or 1°, and none of them being greater than $1^h$ or 1°; then, any one unknown and required term may be easily found by means of this Table. Thus, let $1^h : a :: b : c$ be the proportion; then the Table contains what the log. of seconds in each term wants of the log. of 3600, the number of seconds in $1^h$ or 1°, and this is called the *logistic logarith.* (*log°. log.*) of that term. The log$^{c.}$ log. of $1^h$ or 1° is therefore 0, and in the proportion just stated, any one of the three terms, $a$, $b$, $c$, may be found by adding or subtracting the *log$^{a.}$ log$^{a.}$* of the two others supposed known: if the required term be an extreme term, as $c$, by adding: if a mean or middle term, as $b$ or $a$, by subtracting. The result will be the *log$^{c.}$ log.* of the required term, which may be taken, therefore, from the Table.

*Table of Prop. Parts*, p. 216. A principal use of this Table is to take out log. *sin.*, log. *cos.*, &c., for seconds of arc. To do this, take out of the Table of log. *sin.*, log. *cos.*, &c., the difference for 15″ of arc. Look for this *diff.* in the left marginal column of this Table of Prop. Parts, under 15; then the *diff.* for any odd seconds above the next less 15″, for which the log. *sin.*, log. *cos.*, &c., is given, will be found in the same horizontal line, and under the said odd seconds in the extreme heading in a line with 15. In using this Table it must be particularly noticed that some of the last figures, under the heading 15, may be considered as decimal fractions, in which case, the same number of decimal fractions must be supposed in the number taken out. Let the log. *sin.* of 12° 33′ 23″ be required. The log. *sin.* of 12° 33′ 15″ is 9.337185: the *diff.* for 15″ is 141, the nearest to which under 15 is 140, the last 0 in 1400 being considered a decimal fraction. The corresponding number under 8 (which 23″ is above 15″) is 74.7, where the last figure is supposed a decimal fraction. Adding, therefore, 74.7 or 75 to 9.337185, we have the required log. *sin.*, namely, 9.337260.....The mode of finding an arc to the nearest second, by means of this Table, will be apparent from the following example. Let the arc be required corresponding to log. *sin.* 9.337260. The next in the Table of log. *sines* is 9.337185, which is less than the given log. *sine* by 75. Looking for the nearest to 75 in the same horizontal line with the *diff.* for 15″ or 141, considering in both cases the last figure as a decimal fraction, we find 8 at the top. Consequently, the required arc is 12° 33′ 15″+8″, or 12° 33′ 23″.

This Table may be used also in a similar manner, when the prop. part is given for $1^h$ or $60^m$; or for $12^s$ ($^*12^*$), as in the case of the moon's hor parallax and semidiameter.

*Tables* (Aa Bb) *of Logarithmic Differences*, p. 382–4.

The altitude and horizontal parallax of the moon and the alt. of the sun or a star given, to find the log. difference.

Take out the log. diff. corresponding to moon's app. alt. either in the left or right side column and under the hor. parallax at the top, and write down in a corner of the paper or elsewhere, the diff. of 1° of ☾'s alt., and the diff. of 1′ of parallax,* then turn to table (Bb), and take out the proportionate parts for the minutes of alt., and for the seconds of parallax, and also the sun's or a star's correction from the bottom of table (Aa); and add the sum of these three quantities to the log. difference taken out, and you have the log. difference required.

*Note.*—Should the moon's alt. be to the degree, add the diff. of 1° of alt. to the log. difference; and when the hor. par. is only to the minute, add in the same manner the diff. of 1′ of parallax.

*Ex.* 1. ☾ app. alt. 16° 10′, hor. par. 57′ 28″, and ☉ alt 68°: find the log. difference.

| | | diff. 1° alt. | diff. 1′ par. |
|---|---|---|---|
| Log. Diff. ..... | 6·299046 | 123 | 39 |
| p. p. for 10′ of ☾ alt. ..... | 102½ | | |
| p. p. for 28″ of par.* ..... | 20½ | | |
| ☉'s correction ..... | 13 | | |
| Log. Difference required ..... | 6·299182 | | |

*Ex.* 2. ☾ alt. 32° 0′, hor. par. 55′ 25″, a star's alt. 12°: find the log. difference.

| | | | |
|---|---|---|---|
| Log. Diff. ..... | 6·297336 | 104 | 71 |
| diff 1° alt. ..... | 104 | | |
| p. p. for 25″ of par.* ..... | 39 | | |
| star's correction ..... | 27 | | |
| Log. Difference required ..... | 6·297506 | | |

*Ex.* 3. ☾ alt. 25° 42′, hor. par. 56′ 0″, ✳'s alt. 40°: find the log. difference.

| | | | |
|---|---|---|---|
| Log. Diff. ..... | 6·298031 | 114 | 58 |
| p. p. for 42′ of ☾ alt..... | 34 | | |
| diff. 1′ par. ..... | 58 | | |
| ✳ correction ..... | 30 | | |
| Log. Difference required ..... | 6·298153 | | |

*Rule for clearing Lunar Distance.*

(1) Under the difference of apparent altitudes (both to the nearest minute), write the apparent distance, omitting the seconds, to be added afterwards; and take their sum and difference.

(2) Add together the half log. haversines of the sum and difference, and the logarithmic difference (see the preceding problem), and the sum is the logarithm of a number.

(3) To the number, add the nat. versine of the difference of true altitudes, and the sum is the nat. versine of an arc, which, on being increased by the "seconds" omitted, becomes the true distance.

* The "diff. 1′ par.*" is found in the last column but one, to the right.

*Note.*—The difference of true altitudes may be found thus:—add together the moon's app. alt. (to the nearest minute) and the corrections of alts. of both objects, and the difference between the sum and the sun's or star's app. alt. is the difference of true altitudes.

Tables Cc, Dd, p. 385.—These tables are for the correction of the log. difference in the case of a planet, and for exceptional conditions of the thermometer and barometer. They are easily understood by inspection.

*Example of Lunar worked by means of the Log. Difference.*

| | | | | | |
|---|---|---|---|---|---|
| ☾ app. alt. | 32° 49′ | Hor. par. | 54′ 20″ | | |
| ⊙ „ | 37 23 | | | | |
| Diff. | 4 34 | | | | |
| App. dist. | 106 28 27″ | | | | |
| Sum | 111 2 | ½ log. hav. | 4.916081 | | |
| Diff. | 101 54 | ½ log. hav. | 4.890195 | | |
| | | Log. difference | 6.297407 | | |
| ☾ diff. 1° = 103, par. diff. 1′ = 71 | | | 84* | | |
| pp. for 49′ = 19 | | Log. | 6.103767 | | |
| 20″ = 47 * | | | | | |
| ⊙ corr. = 18 | | | | | |
| | | No. | 1269890 | | |
| Diff. true alts. | 3° 48′ 47″ | Vers. | 2198 | | |
| | | | 16 | | |
| | 105° 47′ 22″ | Vers. | 1272104 | | |
| Seconds omitted | 27 | | | | |
| True dist. | 105 47 49 | | | | |

Nota.—It may be often convenient to use the apparent distance to the nearest *even* minute, observing to subtract the *seconds* at the conclusion, if taken in *excess*.

For instance—let the app. distance 60° 53′ 50″ be given; the seaman would use 60° 54′, and at the conclusion of his work *subtract* 10″, the *excess*, from the computed distance, to get the true distance.

Table (a). Correction of ⊙'s Altitude (involving Dip, Refraction, Semidiameter, and Parallax).

| ⊙ Obs. Alt. | *Add* the Correction to the Altitude of the *Lower Limb.* Height of the Eye in Feet. | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 8 | 10 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 |
| ° ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ |
| 5 0 | 3.8 | 3.4 | 3.1 | 2.8 | 2.6 | 2·5 | 2·3 | 2.2 | 2.1 | 2.0 | 1.8 | 1.6 | 1.4 | 1.2 | 1.0 | 0.8 | 0.6 |
| 10 | 4.0 | 3.7 | 3.3 | 3.1 | 2.9 | 2.8 | 2.6 | 2.5 | 2.4 | 2.3 | 2.1 | 1.8 | 1.6 | 1.5 | 1.3 | 1.1 | 0.9 |
| 20 | 4.3 | 3.9 | 3.6 | 3.3 | 3.2 | 3.0 | 2.9 | 2.8 | 2.7 | 2.5 | 2.3 | 2.1 | 1.9 | 1.7 | 1.5 | 1.3 | 1.1 |
| 30 | 4.5 | 4.2 | 3.9 | 3.6 | 3.4 | 3.3 | 3.1 | 3.0 | 2.9 | 2.8 | 2.6 | 2.4 | 2.2 | 2.0 | 1.8 | 1.6 | 1.4 |
| 40 | 4.8 | 4.4 | 4.1 | 3.8 | 3.7 | 3.5 | 3.4 | 3.3 | 3.2 | 3.0 | 2.9 | 2.6 | 2.4 | 2.2 | 2.0 | 1.8 | 1.7 |
| 50 | 5.0 | 4.6 | 4.3 | 4.0 | 3.9 | 3.7 | 3.6 | 3.5 | 3.4 | 3.3 | 3.0 | 2.8 | 2.6 | 2.4 | 2.2 | 2.0 | 1.9 |
| 6 0 | 5.2 | 4.9 | 4.5 | 4.2 | 4.1 | 4.0 | 3.8 | 3.7 | 3.6 | 3.5 | 3.3 | 3.0 | 2.8 | 2.6 | 2.4 | 2.3 | 2.1 |
| 10 | 5.4 | 5.1 | 4.7 | 4.4 | 4.3 | 4.2 | 4.0 | 3.9 | 3.8 | 3.7 | 3.5 | 3.2 | 3.0 | 2.8 | 2.7 | 2.5 | 2.3 |
| 20 | 5.6 | 5.2 | 4.9 | 4.6 | 4.5 | 4.3 | 4.2 | 4.1 | 4.0 | 3.9 | 3.7 | 3.5 | 3.2 | 3.0 | 2.8 | 2.7 | 2.5 |
| 30 | 5.8 | 5.4 | 5.1 | 4.8 | 4.7 | 4.5 | 4.4 | 4.3 | 4.2 | 4.0 | 3.8 | 3.6 | 3.4 | 3.2 | 3.0 | 2.9 | 2.7 |
| 40 | 5.9 | 5.6 | 5.3 | 5.0 | 4.9 | 4.7 | 4.6 | 4.5 | 4.3 | 4.2 | 4.0 | 3.9 | 3.6 | 3.4 | 3.2 | 3.0 | 2.9 |
| 50 | 6.1 | 5.8 | 5.5 | 5.2 | 5.0 | 4.9 | 4.8 | 4.6 | 4.5 | 4.4 | 4.2 | 4.0 | 3.8 | 3.6 | 3.4 | 3.2 | 3.0 |
| 7 0 | 6.3 | 5.9 | 5.6 | 5.3 | 5.2 | 5.1 | 4.9 | 4.8 | 4.7 | 4.6 | 4.3 | 4.2 | 3.9 | 3.7 | 3.6 | 3.4 | 3.2 |
| 20 | 6.6 | 6.2 | 5.9 | 5.6 | 5.4 | 5.3 | 5.2 | 5.1 | 4.9 | 4.8 | 4.6 | 4.4 | 4.2 | 4.0 | 3.8 | 3.6 | 3.5 |
| 40 | 6.9 | 6.5 | 6.2 | 5.9 | 5.7 | 5.6 | 5.5 | 5.3 | 5.2 | 5.1 | 4.9 | 4.7 | 4.4 | 4.2 | 4.1 | 3.9 | 3.8 |
| 8 0 | 7.1 | 6.8 | 6.4 | 6.1 | 6.0 | 5.9 | 5.7 | 5.6 | 5.5 | 5.4 | 5.1 | 4.9 | 4.7 | 4.5 | 4.3 | 4.1 | 4.0 |
| 20 | 7.4 | 7.0 | 6.7 | 6.4 | 6.2 | 6.1 | 6.0 | 5.8 | 5.7 | 5.6 | 5.4 | 5.1 | 4.9 | 4.7 | 4.6 | 4.4 | 4.3 |
| 40 | 7.6 | 7.2 | 6.9 | 6.6 | 6.5 | 6.3 | 6.2 | 6.1 | 5.9 | 5.8 | 5.6 | 5.4 | 5.2 | 5.0 | 4.8 | 4.6 | 4.5 |
| 9 0 | 7.8 | 7.4 | 7.1 | 6.8 | 6.7 | 6.5 | 6.4 | 6.3 | 6.2 | 6.0 | 5.8 | 5.6 | 5.4 | 5.2 | 5.0 | 4.8 | 4.7 |
| 20 | 8.0 | 7.6 | 7.3 | 7.0 | 6.9 | 6.7 | 6.6 | 6.5 | 6 4 | 6.2 | 6.0 | 5.8 | 5.6 | 5.4 | 5.2 | 5.0 | 4.9 |
| 40 | 8.2 | 7.8 | 7.5 | 7.2 | 7.1 | 6.9 | 6.8 | 6.7 | 6.6 | 6.4 | 6.2 | 6.0 | 5.8 | 5.6 | 5.4 | 5.2 | 5.1 |
| 10 0 | 8.4 | 8.0 | 7.7 | 7.4 | 7.2 | 7.1 | 7.0 | 6.9 | 6.7 | 6.6 | 6.4 | 6.2 | 6.0 | 5.8 | 5.6 | 5.4 | 5.3 |
| 30 | 8.6 | 8.3 | 7.9 | 7.6 | 7.5 | 7.3 | 7.2 | 7.1 | 7.0 | 6.9 | 6.6 | 6.4 | 6.2 | 6.0 | 5.8 | 5.6 | 5.5 |
| 11 0 | 8.9 | 8.5 | 8.2 | 7.9 | 7.7 | 7.6 | 7.5 | 7.3 | 7.2 | 7.1 | 6.8 | 6.6 | 6.4 | 6.2 | 6.1 | 5.9 | 5.7 |
| 11 30 | 9.1 | 8.7 | 8.4 | 8.1 | 7.9 | 7.8 | 7.7 | 7.5 | 7·4 | 7.3 | 7.1 | 6.8 | 6.6 | 6.4 | 6.3 | 6.1 | 5.9 |
| 12 | 9.3 | 8.9 | 8.6 | 8.2 | 8.1 | 8.0 | 7.9 | 7.7 | 7.6 | 7.5 | 7.3 | 7.0 | 6.8 | 6.6 | 6.5 | 6.3 | 6.2 |
| 13 | 9.6 | 9.2 | 8.9 | 8.6 | 8.5 | 8.3 | 8.2 | 8.1 | 7.9 | 7.8 | 7.6 | 7.4 | 7.2 | 7.0 | 6.8 | 6.6 | 6.5 |
| 14 | 9.9 | 9.5 | 9.2 | 8.9 | 8.8 | 8.6 | 8.5 | 8.4 | 8.2 | 8.1 | 7.9 | 7.7 | 7.5 | 7.3 | 7.1 | 6.9 | 6.8 |
| 15 | 10.2 | 9.8 | 9.5 | 9.2 | 9.0 | 8.9 | 8.8 | 8.6 | 8.5 | 8.4 | 8.2 | 7.9 | 7.7 | 7.5 | 7.4 | 7.2 | 7.0 |
| 16 | 10.4 | 10.0 | 9.7 | 9.4 | 9.2 | 9.1 | 9.0 | 8.9 | 8.7 | 8.6 | 8.4 | 8.2 | 8.0 | 7.8 | 7.6 | 7.4 | 7.2 |
| 17 | 10.6 | 10.2 | 9.9 | 9.6 | 9.4 | 9.3 | 9.2 | 9.1 | 8.9 | 8.8 | 8.6 | 8.4 | 8.2 | 8.0 | 7.8 | 7.6 | 7.4 |
| 18 | 10.8 | 10.4 | 10.1 | 9.8 | 9.6 | 9.5 | 9.4 | 9.2 | 9.1 | 9.0 | 8.8 | 8.6 | 8.4 | 8.2 | 8.0 | 7.8 | 7.6 |
| 19 | 10.9 | 10.6 | 10.2 | 9.9 | 9.8 | 9.7 | 9.5 | 9.4 | 9.3 | 9.2 | 8.9 | 8.7 | 8.5 | 8.3 | 8.1 | 8.0 | 7.8 |
| 20 | 11.1 | 10.7 | 10.4 | 10.1 | 9.9 | 9.8 | 9.7 | 9.6 | 9.4 | 9.3 | 9.1 | 8.9 | 8.7 | 8.5 | 8.3 | 8.1 | 7.9 |
| 22 | 11.3 | 11.0 | 10.6 | 10.3 | 10.2 | 10.1 | 9.9 | 9.8 | 9.7 | 9.6 | 9.4 | 9.1 | 8.9 | 8.7 | 8.5 | 8.4 | 8.2 |
| 24 | 11.6 | 11.2 | 10.9 | 10.6 | 10.4 | 10.3 | 10.2 | 10.0 | 9.9 | 9.8 | 9.6 | 9.4 | 9.1 | 9.0 | 8.8 | 8.6 | 8.4 |
| 26 | 11.7 | 11.4 | 11.0 | 10.7 | 10.6 | 10.5 | 10.3 | 10.2 | 10.1 | 10.0 | 9.8 | 9.5 | 9.3 | 9.1 | 8.9 | 8.8 | 8.6 |
| 28 | 11.9 | 11.5 | 11.2 | 10.9 | 10.8 | 10.6 | 10.5 | 10.4 | 10.3 | 10.2 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 | 8.9 | 8.7 |
| 30 | 12.0 | 11.7 | 11.3 | 11.0 | 10.9 | 10.8 | 10.6 | 10.5 | 10.4 | 10.3 | 10.1 | 9.8 | 9.6 | 9.4 | 9.3 | 9.1 | 8.9 |
| 34 | 12.3 | 11.9 | 11.6 | 11.3 | 11.1 | 11.0 | 10.9 | 10.7 | 10.6 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.5 | 9.3 | 9.1 |
| 38 | 12.5 | 12.1 | 11.8 | 11.5 | 11.3 | 11.2 | 11.1 | 10.9 | 10.8 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 | 9.5 | 9.3 |
| 42 | 12.6 | 12.3 | 11.9 | 11.6 | 11.5 | 11.4 | 11.2 | 11.1 | 11.0 | 10.9 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.7 | 9.4 |
| 46 | 12.8 | 12.4 | 12.1 | 11.8 | 11.6 | 11.5 | 11.4 | 11.2 | 11.1 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 | 9.6 |
| 50 | 12.9 | 12.5 | 12.2 | 11.9 | 11.7 | 11.6 | 11.5 | 11.4 | 11.2 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 | 9.7 |
| 55 | 13.0 | 12.6 | 12.3 | 12.0 | 11.9 | 11.7 | 11.6 | 11.5 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 | 10.2 | 10.0 | 9.8 |
| 60 | 13.1 | 12.7 | 12.4 | 12.1 | 12.0 | 11.8 | 11.7 | 11.6 | 11.5 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 | 9.9 |
| 70 | 13.3 | 12.9 | 12.6 | 12.3 | 12.2 | 12.0 | 11.9 | 11.8 | 11.7 | 11.5 | 11.3 | 11.1 | 10.9 | 10.7 | 10.5 | 10.3 | 10.1 |
| 80 | 13.4 | 13.1 | 12.8 | 12.5 | 12.3 | 12.2 | 12.1 | 11.9 | 11.8 | 11.7 | 11.5 | 11.3 | 11.0 | 10.9 | 10.7 | 10.5 | 10.3 |
| 90 | 13.5 | 13.2 | 12.9 | 12.6 | 12.5 | 12.3 | 12.2 | 12.1 | 12.0 | 11.8 | 11.6 | 11.4 | 11.2 | 11.0 | 10.8 | 10.6 | 10.4 |

| Month. | Jan. | Feb. | March. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ |
| 1st day . . | +0.3 | +0.2 | +0.2 | −0.0 | −0.1 | −0.2 | −0.2 | −0.2 | −0.1 | +0.0 | +0.1 | +0.2 |
| 16th day . . | +0.3 | +0.2 | +0.1 | −0.1 | −0.2 | −0.2 | −0.2 | −0.2 | −0.1 | +0.1 | +0.2 | +0.3 |

* When the upper limb of the Sun has been observed, proceed as above, and deduct 32′.

## (b) Parallax in Altitude for Planets.

| App. Alt. | Horizontal Parallax. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2″ | 4″ | 6″ | 8″ | 10″ | 12″ | 14″ | 16″ | 18″ | 20″ | 22″ | 24″ | 26″ | 28″ | 30″ | 32″ |
| | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| ° | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| 0 | 2.0 | 4.0 | 6.0 | 8.0 | 10.0 | 12.0 | 14.0 | 16.0 | 18.0 | 20.0 | 22.0 | 24.0 | 26.0 | 28.0 | 30.0 | 32.0 |
| 3 | 2.0 | 4.0 | 6.0 | 8.0 | 10.0 | 12.0 | 14.0 | 16.0 | 18.0 | 20.0 | 22.0 | 24.0 | 26.0 | 28.0 | 30.0 | 32.0 |
| 6 | 2.0 | 3.9 | 5.9 | 7.9 | 9.9 | 11.9 | 13.9 | 15.9 | 17.9 | 19.9 | 21.9 | 23.9 | 25.9 | 27.9 | 29.8 | 31.8 |
| 9 | 2.0 | 3.9 | 5.9 | 7.9 | 9.9 | 11.9 | 13.8 | 15.8 | 17.8 | 19.8 | 21.7 | 23.7 | 25.7 | 27.6 | 29.6 | 31.6 |
| 12 | 1.9 | 3.9 | 5.9 | 7.8 | 9.8 | 11.7 | 13.7 | 15.6 | 17.6 | 19.6 | 21.5 | 23.5 | 25.4 | 27.4 | 29.3 | 31.3 |
| 15 | 1.9 | 3.8 | 5.8 | 7.7 | 9.6 | 11.6 | 13.5 | 15.5 | 17.3 | 19.3 | 21.3 | 23.2 | 25.1 | 27.1 | 29.0 | 30.9 |
| 18 | 1.9 | 3.8 | 5.7 | 7.6 | 9.5 | 11.4 | 13.3 | 15.2 | 17.1 | 19.0 | 20.9 | 22.8 | 24.7 | 26.6 | 28.5 | 30 4 |
| 21 | 1.9 | 3.7 | 5.6 | 7.5 | 9.4 | 11.2 | 13.0 | 14.9 | 16.8 | 18.7 | 20.5 | 22.4 | 24.2 | 26.1 | 28.0 | 29.9 |
| 24 | 1.8 | 3.6 | 5.5 | 7.3 | 9.1 | 11.0 | 12.8 | 14.6 | 16.4 | 18.2 | 20.0 | 21.9 | 23.7 | 25.5 | 27.4 | 29.2 |
| 27 | 1.8 | 3.6 | 5.3 | 7.1 | 8.9 | 10.7 | 12.5 | 14.2 | 16.0 | 17.8 | 19.6 | 21.4 | 23.1 | 24.9 | 26.7 | 28.5 |
| 30 | 1.7 | 3.4 | 5.1 | 6.9 | 8.7 | 10.4 | 12.1 | 13.8 | 15.6 | 17.3 | 19.0 | 20.8 | 22.5 | 24.2 | 26.0 | 27.7 |
| 33 | 1.7 | 3.3 | 5.0 | 6.7 | 8.4 | 10.0 | 11.7 | 13.4 | 15.0 | 16.8 | 18.4 | 20.1 | 21.8 | 23.5 | 25.1 | 26.8 |
| 36 | 1.6 | 3.2 | 4.8 | 6.4 | 8.0 | 9.7 | 11.3 | 12.9 | 14.6 | 16.2 | 17.8 | 19.4 | 21.0 | 22.6 | 24.2 | 25.9 |
| 39 | 1.5 | 3.1 | 4.6 | 6.2 | 7.8 | 9.3 | 10.8 | 12.4 | 14.0 | 15.5 | 17.0 | 18.6 | 20.2 | 21.7 | 23.3 | 24.9 |
| 42 | 1.5 | 3.0 | 4.5 | 5.9 | 7.4 | 8.9 | 10.4 | 11.9 | 13.4 | 14.9 | 16.3 | 17.8 | 19.3 | 20.8 | 22.3 | 23.8 |
| 45 | 1.4 | 2.8 | 4.2 | 5.6 | 7.1 | 8.5 | 9.9 | 11.3 | 12.7 | 14.1 | 15.6 | 16.9 | 18.4 | 19.8 | 21.2 | 22.6 |
| 48 | 1.3 | 2.7 | 4.0 | 5.3 | 6.7 | 8.0 | 9.3 | 10.7 | 12.0 | 13.4 | 14.7 | 16.1 | 17.4 | 18.7 | 20.1 | 21.4 |
| 51 | 1.2 | 2.5 | 3.8 | 5.0 | 6.3 | 7.6 | 8.8 | 10.1 | 11.3 | 12.6 | 13.8 | 15.1 | 16.4 | 17.6 | 18.9 | 20.1 |
| 54 | 1.1 | 2.3 | 3.5 | 4.7 | 5.9 | 7.1 | 8.2 | 9.4 | 10.5 | 11.7 | 12.9 | 14.1 | 15.3 | 16.4 | 17.6 | 18.8 |
| 57 | 1.1 | 2.1 | 3.3 | 4.3 | 5.4 | 6.5 | 7.6 | 8.7 | 9.8 | 10.9 | 12.0 | 13.1 | 14.1 | 15.2 | 16.3 | 17.4 |
| 60 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 6.0 | 7.0 | 8.0 | 9.0 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 | 16.0 |
| 65 | 0.8 | 1.7 | 2.5 | 3.4 | 4.2 | 5.1 | 5.9 | 6.7 | 7.6 | 8.4 | 9.3 | 10.1 | 11.0 | 11.8 | 12.7 | 13.5 |
| 70 | 0 7 | 1.4 | 2.1 | 2.7 | 3.4 | 4.1 | 4.8 | 5.5 | 6.1 | 6.8 | 7.5 | 8.2 | 8.9 | 9.6 | 10.3 | 10.9 |
| 75 | 0 5 | 1.0 | 1.5 | 2.1 | 2.6 | 3.1 | 3.6 | 4.1 | 4.6 | 5.1 | 5.7 | 6.2 | 6.7 | 7.2 | 7.8 | 8.3 |
| 80 | 0.3 | 0.7 | 1.0 | 1.4 | 1.7 | 2.1 | 2.4 | 2.8 | 3.1 | 3.5 | 3.8 | 4.2 | 4.5 | 4.8 | 5.2 | 5.5 |
| 85 | 0.2 | 0.3 | 0.5 | 0.7 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.7 | 1.9 | 2.1 | 2.3 | 2.4 | 2.6 | 2.8 |
| 90 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

## (c) Correction of A. for Planet in clearing Distance.

| App. Alt. | Parallax in Altitude. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0″ | 2″ | 4″ | 8″ | 12″ | 16″ | 20″ | 24″ | 28″ | 32″ |
| | + | + | + | + | + | + | + | + | + | + |
| ° | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| 3 | 8.0 | 8.0 | 8.1 | 8.2 | 8.3 | 8.4 | 8.6 | 8.7 | 8.8 | 8.9 |
| 4 | 5.4 | 5.5 | 5.6 | 5.7 | 5.9 | 6.0 | 6.2 | 6.3 | 6.5 | 6.7 |
| 5 | 3.8 | 3.9 | 4.0 | 4.1 | 4.3 | 4.5 | 4.7 | 4.9 | 5.1 | 5.3 |
| 6 | 2.8 | 2.9 | 3.0 | 3.2 | 3.5 | 3.7 | 3.9 | 4.2 | 4.4 | 4.7 |
| 7 | 2.1 | 2.2 | 2.4 | 2.6 | 2.9 | 3.2 | 3.5 | 3.7 | 4.0 | 4.3 |
| 8 | 1.7 | 1.8 | 2.0 | 2.3 | 2.6 | 2.9 | 3.3 | 3.6 | 3.9 | 4.2 |
| 9 | 1.3 | 1.5 | 1.7 | 2.0 | 2.4 | 2.8 | 3.1 | 3.5 | 3.8 | 4.2 |
| 10 | 1.1 | 1.3 | 1.5 | 1.9 | 2.3 | 2.7 | 3.1 | 3.5 | 3.9 | 4.3 |
| 20 | 0.0 | 0.5 | 0.9 | 1.8 | 2.7 | 3.5 | 4.3 | 5.1 | 6.0 | 6.8 |
| 30 | 0.0 | 0.8 | 1.5 | 2.8 | 4.1 | 5.5 | 6.8 | 8.1 | 9.4 | 10.7 |
| 40 | 0.0 | 0.1 | 2.0 | 3.9 | 5.9 | 7.7 | 9.7 | 11.6 | 13.5 | |
| 50 | 0 0 | 1.1 | 2.5 | 5.2 | 8.0 | 10.7 | 13.4 | 16.1 | | |
| 60 | 0.0 | 1.5 | 3.5 | 7.4 | 11.4 | 15.3 | 19.3 | | | |
| 70 | 0.0 | 3.0 | 6.5 | 12.8 | 19.0 | | | | | |
| 75 | 0.0 | 4 4 | 8.6 | 17.2 | | | | | | |
| 80 | 0.0 | 6.6 | 13.1 | 26.0 | | | | | | |
| 85 | 0.0 | 13.4 | 26.0 | | | | | | | |
| 88 | 0.0 | 33.2 | 65.8 | | | | | | | |

Sun's Par. in Alt. (cc)

| Alt. | Par. |
|---|---|
| | + |
| ° | ″ |
| 0 | 8.8 |
| 12 | 8.6 |
| 18 | 8.4 |
| 21 | 8.2 |
| 24 | 8.0 |
| 27 | 7.8 |
| 30 | 7.6 |
| 33 | 7.4 |
| 36 | 7.1 |
| 39 | 6.8 |
| 42 | 6.5 |
| 45 | 6.2 |
| 48 | 5 9 |
| 51 | 5.5 |
| 54 | 5.2 |
| 57 | 4.8 |
| 60 | 4.4 |
| 63 | 4.0 |
| 66 | 3.6 |
| 69 | 3.1 |
| 72 | 2 7 |
| 75 | 2.3 |
| 78 | 1.8 |
| 81 | 1.4 |
| 84 | 0 9 |
| 87 | 0.4 |

| Name of Point. | | Points. | In Degrees | | | Log. Sine. | Name of Point. (d) | |
|---|---|---|---|---|---|---|---|---|
| North. | | | ° | ′ | ″ | | South. | |
| N. ¼ E | N. ¼ W. | ¼ | 2 | 48 | 45 | 8.690796 | S. ¼ E. | S. ¼ W. |
| N. ½ E. | N. ½ W | ½ | 5 | 37 | 30 | 8.991302 | S. ½ E. | S. ½ W. |
| N. ¾ E. | N. ¾ W. | ¾ | 8 | 26 | 15 | 9.166520 | S. ¾ E. | S. ¾ W. |
| N. by E. | N. by W. | 1 | 11 | 15 | 0 | 9.290236 | S. by E. | S. by W. |
| N. by E. ¼ E. | N. by W. ¼ W. | 1 ¼ | 14 | 3 | 45 | 9.385571 | S. by E. ¼ E. | S. by W. ¼ W. |
| N. by E. ½ E. | N. by W. ½ W. | 1 ½ | 16 | 52 | 30 | 9.462824 | S. by E. ½ E. | S. by W. ½ W. |
| N. by E. ¾ E. | N. by W. ¾ W. | 1 ¾ | 19 | 41 | 15 | 9.527488 | S. by E. ¾ E. | S. by W. ¾ W. |
| N.N.E. | N.N.W. | 2 | 22 | 30 | 0 | 9.582840 | S.S.E. | S.S.W. |
| N.N.E. ¼ E. | N.N.W. ¼ W. | 2 ¼ | 25 | 18 | 45 | 9.630992 | S.S.E. ¼ E. | S.S.W ¼ W |
| N.N.E. ½ E. | N.N.W. ½ W. | 2 ½ | 28 | 7 | 30 | 9.673387 | S.S.E. ½ E. | S.S.W ½ W. |
| N.N.E. ¾ E. | N.N.W. ¾ W. | 2 ¾ | 30 | 56 | 15 | 9.711050 | S.S.E. ¾ E. | S.S.W. ¾ W |
| N.E. by N. | N.W. by N. | 3 | 33 | 45 | 0 | 9.744739 | S.E. by S. | S.W. by S. |
| N.E. by N. ¼ E. | N.W. b. N. ¼ W. | 3 ¼ | 36 | 33 | 45 | 9.775027 | S.E. by S. ¼ E. | S.W. by S. ¼ W. |
| N.E. by N. ½ E. | N.W. b. N. ½ W. | 3 ½ | 39 | 22 | 30 | 9.802359 | S.E. by S. ½ E. | S.W. by S. ½ W. |
| N.E. by N. ¾ E. | N.W. b. N. ¾ W. | 3 ¾ | 42 | 11 | 15 | 9.827084 | S.E. by S. ¾ E. | S.W. by S. ¾ W. |
| N.E. | N.W. | 4 | 45 | 0 | 0 | 9.849485 | S.E. | S.W. |
| N.E. ¼ E. | N.W. ¼ W. | 4 ¼ | 47 | 48 | 45 | 9.869790 | S.E. ¼ E. | S.W. ¼ W. |
| N.E. ½ E. | N.W. ½ W. | 4 ½ | 50 | 37 | 30 | 9.888185 | S.E. ½ E. | S.W. ½ W. |
| N.E. ¾ E. | N.W. ¾ W. | 4 ¾ | 53 | 26 | 15 | 9.904828 | S.E. ¾ E. | S.W. ¾ W. |
| N.E. by E. | N.W. by W. | 5 | 56 | 15 | 0 | 9.919846 | S.E. by E. | S.W. by W. |
| N.E. by E. ¼ E. | N.W.b.W. ¼ W. | 5 ¼ | 59 | 3 | 45 | 9.933350 | S.E. by E. ¼ E. | S.W. by W. ¼ W. |
| N.E. by E. ½ E. | N.W.b.W. ½ W. | 5 ½ | 61 | 52 | 30 | 9.945430 | S.E. by E. ½ E. | S.W. by W. ½ W. |
| N.E. by E. ¾ E. | N.W.b.W. ¾ W. | 5 ¾ | 64 | 41 | 15 | 9.956163 | S.E. by E. ¾ E. | S.W. by W. ¾ W. |
| E.N.E. | W.N.W. | 6 | 67 | 30 | 0 | 9.965615 | E.S.E. | W.S.W. |
| E. by N. ¾ N. | W. by N. ¾ N. | 6 ¼ | 70 | 18 | 45 | 9.973841 | E. by S. ¾ S. | W. by S. ¼ S. |
| E. by N. ½ N. | W. by N. ½ N. | 6 ½ | 73 | 7 | 30 | 9.980885 | E. by S. ½ S. | W. by S. ½ S. |
| E. by N. ¼ N. | W. by N. ¼ N. | 6 ¾ | 75 | 56 | 15 | 9.986786 | E. by S. ¼ S. | W. by S. ¼ S. |
| E. by N. | W. by N. | 7 | 78 | 45 | 0 | 9.991574 | E. by S. | W. by S. |
| E. ¾ N. | W. ¾ N. | 7 ¼ | 81 | 33 | 45 | 9.995274 | E. ¾ S. | W. ¾ S. |
| E. ½ N. | W. ½ N. | 7 ½ | 84 | 22 | 30 | 9.997904 | E. ½ S. | W. ½ S. |
| E. ¼ N. | W. ¼ N. | 7 ¾ | 87 | 11 | 15 | 9.999477 | E. ¼ S. | W. ¼ S. |

(e) Dip of the Sea Horizon.

| Height of eye. | Dip. | Height of eye. | Dip. | Height of eye. | Dip. | Height of eye. | Dip. | Height of eye. | Dip. |
|---|---|---|---|---|---|---|---|---|---|
| ft. | ′ ″ | ft. | ′ ″ | ft. | ′ ″ | ft. | ′ ″ | ft. | ′ ″ |
| 1 | 0 59 | 15 | 3 49 | 29 | 5 18 | 59 | 7 34 | 110 | 10 19 |
| 2 | 1 24 | 16 | 3 56 | 30 | 5 24 | 62 | 7 45 | 120 | 10 47 |
| 3 | 1 42 | 17 | 4 4 | 31 | 5 29 | 65 | 7 56 | 130 | 11 14 |
| 4 | 1 58 | 18 | 4 11 | 32 | 5 34 | 68 | 8 7 | 140 | 11 39 |
| 5 | 2 12 | 19 | 4 17 | 33 | 5 39 | 71 | 8 18 | 150 | 12 3 |
| 6 | 2 25 | 20 | 4 24 | 34 | 5 44 | 74 | 8 28 | 160 | 12 27 |
| 7 | 2 36 | 21 | 4 31 | 35 | 5 49 | 77 | 8 38 | 170 | 12 50 |
| 8 | 2 47 | 22 | 4 37 | 38 | 6 4 | 80 | 8 48 | 180 | 13 12 |
| 9 | 2 57 | 23 | 4 43 | 41 | 6 18 | 83 | 8 58 | 190 | 13 33 |
| 10 | 3 7 | 24 | 4 49 | 44 | 6 32 | 86 | 9 8 | 200 | 13 55 |
| 11 | 3 16 | 25 | 4 55 | 47 | 6 45 | 89 | 9 17 | 210 | 14 16 |
| 12 | 3 25 | 26 | 5 1 | 50 | 6 58 | 92 | 9 26 | 220 | 14 36 |
| 13 | 3 33 | 27 | 5 7 | 53 | 7 10 | 95 | 9 36 | 230 | 14 56 |
| 14 | 3 41 | 28 | 5 13 | 56 | 7 22 | 98 | 9 45 | 240 | 15 15 |

Dip of a Shore Horizon. (f)

| Distance of the Shore. | Height of the eye above the Sea in feet. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 |
| Miles | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ |
| ¼ | 11 | 22 | 34 | 45 | 56 | 68 | 79 | 90 |
| ½ | 6 | 11 | 17 | 22 | 28 | 34 | 39 | 45 |
| ¾ | 4 | 8 | 12 | 15 | 19 | 23 | 27 | 30 |
| 1 | 4 | 6 | 9 | 12 | 15 | 17 | 20 | 23 |
| 1¼ | 3 | 5 | 7 | 9 | 12 | 14 | 16 | 19 |
| 1½ | 3 | 4 | 6 | 8 | 10 | 12 | 14 | 15 |
| 2 | 2 | 3 | 5 | 6 | 8 | 10 | 11 | 12 |
| 2¼ | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 |
| 3 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 |
| 3¼ | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 7 |
| 4 | 2 | 3 | 4 | 4 | 5 | 6 | 7 | 7 |
| 5 | 2 | 3 | 4 | 4 | 5 | 5 | 6 | 6 |
| 6 | 2 | 3 | 4 | 4 | 5 | 5 | 6 | 6 |

## (g) Augmentation of the Moon's Hor. Semidiameter.

| App. Alt. | ′ ″ 14 40 | ′ ″ 15 0 | ′ ″ 15 20 | ′ ″ 15 40 | ′ ″ 16 0 | ′ ″ 16 20 | ′ ″ 16 40 |
|---|---|---|---|---|---|---|---|
| ° | ′ | ″ | ″ | ″ | ″ | ″ | ″ |
| 0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 |
| 6 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.0 |
| 8 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.5 | 2.6 |
| 10 | 2.6 | 2.7 | 2.8 | 2.9 | 3.0 | 3.1 | 3.3 |
| 12 | 3.2 | 3.3 | 3.3 | 3.4 | 3.6 | 3.7 | 3.9 |
| 14 | 3.5 | 3.6 | 3.8 | 3.9 | 4.1 | 4.3 | 4.5 |
| 16 | 3.9 | 4.1 | 4.3 | 4.5 | 4.7 | 4.9 | 5.1 |
| 18 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 | 5.4 | 5.6 |
| 20 | 4.8 | 5.0 | 5.3 | 5.6 | 5.8 | 6.0 | 6.2 |
| 22 | 5.2 | 5.5 | 5.8 | 6.1 | 6.3 | 6.6 | 6.8 |
| 24 | 5.7 | 6.0 | 6.3 | 6.6 | 6.8 | 7.1 | 7.4 |
| 26 | 6.1 | 6.4 | 6.8 | 7.1 | 7.4 | 7.7 | 8.0 |
| 28 | 6.6 | 3.9 | 7.2 | 7.6 | 7.9 | 8.2 | 8.5 |
| 30 | 7.1 | 7.4 | 7.7 | 8.0 | 8.4 | 8.7 | 9.0 |
| 32 | 7.5 | 7.8 | 8.2 | 8.5 | 8.9 | 9.2 | 9.6 |
| 34 | 7.8 | 8.2 | 8.6 | 9.0 | 9.3 | 9.7 | 10.1 |
| 36 | 8.2 | 8.6 | 9.0 | 9.4 | 9.9 | 10.2 | 10.6 |
| 38 | 8.6 | 9.0 | 9.4 | 9.9 | 10.3 | 10.7 | 11.1 |
| 40 | 9.0 | 9.4 | 9.8 | 10.3 | 10.7 | 11.1 | 11.6 |
| 42 | 9.4 | 9.8 | 10.2 | 10.7 | 11.2 | 11.6 | 12.1 |
| 44 | 9.8 | 10.2 | 10.6 | 11.1 | 11.6 | 12.0 | 12.6 |
| 46 | 10.0 | 10.5 | 11.0 | 11.5 | 12.0 | 12.5 | 13.0 |
| 48 | 10.4 | 10.9 | 11.4 | 11.9 | 12.4 | 12.9 | 13.4 |
| 50 | 10.7 | 11.2 | 11.7 | 12.2 | 12.8 | 13.3 | 13.8 |
| 52 | 11.0 | 11.5 | 12.0 | 12.6 | 13.1 | 13.7 | 14.2 |
| 54 | 11.3 | 11.8 | 12.4 | 12.9 | 13.5 | 14.1 | 14.6 |
| 56 | 11.6 | 12.1 | 12.7 | 13.2 | 13.8 | 14.4 | 14.9 |
| 58 | 11.8 | 12.4 | 12.9 | 13.6 | 14.2 | 14.7 | 15.3 |
| 60 | 12.1 | 12.7 | 13.2 | 13.8 | 14.5 | 15.0 | 15.6 |
| 62 | 12.3 | 12.9 | 13.5 | 14.1 | 14.7 | 15.3 | 15.9 |
| 64 | 12.5 | 13.1 | 13.7 | 14.3 | 15.0 | 15.6 | 16.2 |
| 66 | 12.8 | 13.4 | 13.9 | 14.6 | 15.2 | 15.8 | 16.5 |
| 68 | 12.9 | 13.5 | 14.2 | 14.8 | 15.4 | 16.1 | 16.7 |
| 70 | 13.1 | 13.7 | 14.4 | 15.0 | 15.7 | 16.3 | 16.9 |
| 72 | 13.3 | 13.9 | 14.5 | 15.2 | 15.8 | 16.5 | 17.2 |
| 74 | 13.4 | 14.0 | 14.7 | 15.3 | 16.0 | 16.7 | 17.4 |
| 76 | 13.5 | 14.1 | 14.8 | 15.5 | 16.2 | 16.8 | 17.5 |
| 78 | 13.7 | 14.3 | 14.9 | 15.6 | 16.3 | 16.9 | 17.6 |
| 80 | 13.8 | 14.4 | 15.0 | 15.7 | 16.4 | 17.1 | 17.8 |
| 82 | 13.8 | 14.4 | 15.1 | 15.8 | 16.5 | 17.2 | 17.8 |
| 84 | 13.9 | 14.5 | 15.2 | 15.9 | 16.5 | 17.2 | 17.9 |
| 86 | 13.9 | 14.5 | 15.2 | 15.9 | 16.6 | 17.3 | 18.0 |
| 88 | 14.0 | 14.6 | 15.3 | 15.9 | 16.6 | 17.3 | 18.0 |
| 90 | 14.0 | 14.6 | 15.3 | 16.0 | 16.7 | 17.3 | 18.0 |

## (h) Reduction of Hor. Par., and Lat. of Place, for Figure of Earth; both subtractive.

| Lat. | 54′ | 56′ | 58′ | 60′ | 62′ | Red. of Lat. |
|---|---|---|---|---|---|---|
| ° | ″ | ″ | ″ | ″ | ″ | ′ ″ |
| 6 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 2 15 |
| 12 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 4 24 |
| 18 | 0.9 | 1.0 | 1.0 | 1.1 | 1.1 | 6 22 |
| 24 | 1.6 | 1.7 | 1.8 | 1.9 | 1.9 | 8 3 |
| 30 | 2.5 | 2.6 | 2.7 | 2.8 | 2.9 | 9 23 |
| 36 | 3.5 | 3.6 | 3.7 | 3.9 | 4.0 | 10 19 |
| 42 | 4.5 | 4.7 | 4.9 | 5.1 | 5.2 | 10 48 |
| 48 | 5.6 | 5.8 | 6.0 | 6.2 | 6.4 | 10 48 |
| 54 | 6.6 | 6.9 | 7.1 | 7.4 | 7.6 | 10 20 |
| 60 | 7.6 | 7.9 | 8.2 | 8.5 | 8.7 | 9 25 |
| 66 | 8.5 | 8.8 | 9.1 | 9.4 | 9.7 | 8 5 |
| 72 | 9.2 | 9.5 | 9.9 | 10.2 | 10.6 | 6 24 |
| 78 | 9.7 | 10.1 | 10.5 | 10.8 | 11.2 | 4 26 |
| 84 | 10.1 | 10.4 | 10.8 | 11.2 | 11.6 | 2 16 |
| 90 | 10.2 | 10.6 | 11.0 | 11.3 | 11.7 | 0 0 |

## (i) Reduction of Semid. on account of Refraction.

| Alt. | Inclination to the Horizon. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° 0 | ° 12 | ° 24 | ° 36 | ° 48 | ° 54 | ° 60 | ° 66 | ° 72 | ° 78 | ° 84 | ° 90 |
| ° | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| 5 | 0 | 1 | 4 | 9 | 14 | 16 | 19 | 21 | 23 | 24 | 25 | 25 |
| 6 | 0 | 1 | 3 | 7 | 10 | 12 | 14 | 16 | 17 | 18 | 19 | 19 |
| 7 | 0 | 1 | 2 | 5 | 8 | 9 | 11 | 12 | 13 | 14 | 14 | 14 |
| 8 | 0 | 0 | 2 | 4 | 6 | 7 | 8 | 9 | 10 | 11 | 11 | 11 |
| 9 | 0 | 0 | 1 | 3 | 5 | 6 | 7 | 8 | 8 | 9 | 9 | 9 |
| 10 | 0 | 0 | 1 | 3 | 4 | 5 | 6 | 6 | 7 | 7 | 8 | 8 |
| 12 | 0 | 0 | 1 | 2 | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 |
| 14 | 0 | 0 | 1 | 1 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 |
| 16 | 0 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |
| 20 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| 30 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Correction in finding Moon's Meridian Passage. (k)

| Diff. Moon's Mer. Pass. | Long. (W. add)—(E. Subtract.) | | |

(Ther. 50.)
(Bar. 30.)

## Correction of the SUN's App. Alt. *(subtr.)* ⊙

(m) (or Refraction — Parallax.)

| AA | Corr. — | Diff. for 10′ | AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ |
| 0 0 | 33 42 | 117 | 5 0 | 9 49 | 6 0 | 8 23 | 7 0 | 7 18 | 8 0 | 6 26 | 9 0 | 5 45 |
| 0 5 | 32 44 | 113 | 5 1 | 9 48 | 6 1 | 8 22 | 7 1 | 7 17 | 8 1 | 6 25 | 9 2 | 5 44 |
| 0 10 | 31 48 | 109 | 5 2 | 9 46 | 6 2 | 8 21 | 7 2 | 7 16 | 8 2 | 6 25 | 9 4 | 5 42 |
| 0 15 | 30 56 | 105 | 5 3 | 9 44 | 6 3 | 8 20 | 7 3 | 7 15 | 8 3 | 6 24 | 9 6 | 5 41 |
| 0 20 | 30 4 | 101 | 5 4 | 9 43 | 6 4 | 8 18 | 7 4 | 7 14 | 8 4 | 6 23 | 9 8 | 5 40 |
| 0 25 | 29 15 | 97 | 5 5 | 9 41 | 6 5 | 8 17 | 7 5 | 7 13 | 8 5 | 6 23 | 9 10 | 5 38 |
| 0 30 | 28 28 | 94 | 5 6 | 9 40 | 6 6 | 8 16 | 7 6 | 7 12 | 8 6 | 6 22 | 9 12 | 5 37 |
| 0 35 | 27 42 | 90 | 5 7 | 9 38 | 6 7 | 8 15 | 7 7 | 7 11 | 8 7 | 6 21 | 9 14 | 5 36 |
| 0 40 | 26 57 | 87 | 5 8 | 9 36 | 6 8 | 8 14 | 7 8 | 7 10 | 8 8 | 6 21 | 9 16 | 5 35 |
| 0 45 | 26 15 | 84 | 5 9 | 9 35 | 6 9 | 8 13 | 7 9 | 7 9 | 8 9 | 6 20 | 9 18 | 5 33 |
| 0 50 | 25 34 | 80 | 5 10 | 9 33 | 6 10 | 8 11 | 7 10 | 7 8 | 8 10 | 6 19 | 9 20 | 5 32 |
| 0 55 | 24 54 | 77 | 5 11 | 9 32 | 6 11 | 8 10 | 7 11 | 7 7 | 8 11 | 6 19 | 9 22 | 5 31 |
| 1 0 | 24 16 | 74 | 5 12 | 9 31 | 6 12 | 8 9 | 7 12 | 7 6 | 8 12 | 6 18 | 9 24 | 5 30 |
| 1 5 | 23 39 | 71 | 5 13 | 9 29 | 6 13 | 8 8 | 7 13 | 7 6 | 8 13 | 6 17 | 9 26 | 5 29 |
| 1 10 | 23 4 | 69 | 5 14 | 9 27 | 6 14 | 8 7 | 7 14 | 7 5 | 8 14 | 6 16 | 9 28 | 5 28 |
| 1 15 | 22 31 | 66 | 5 15 | 9 26 | 6 15 | 8 6 | 7 15 | 7 4 | 8 15 | 6 16 | 9 30 | 5 27 |
| 1 20 | 21 59 | 63 | 5 16 | 9 24 | 6 16 | 8 5 | 7 16 | 7 3 | 8 16 | 6 15 | 9 32 | 5 26 |
| 1 25 | 21 28 | 61 | 5 17 | 9 23 | 6 17 | 8 4 | 7 17 | 7 2 | 8 17 | 6 14 | 9 34 | 5 25 |
| 1 30 | 20 58 | 59 | 5 18 | 9 21 | 6 18 | 8 2 | 7 18 | 7 1 | 8 18 | 6 14 | 9 36 | 5 24 |
| 1 35 | 20 29 | 57 | 5 19 | 9 20 | 6 19 | 8 1 | 7 19 | 7 0 | 8 19 | 6 13 | 9 38 | 5 22 |
| 1 40 | 20 1 | 55 | 5 20 | 9 18 | 6 20 | 8 0 | 7 20 | 6 59 | 8 20 | 6 12 | 9 40 | 5 21 |
| 1 45 | 19 34 | 53 | 5 21 | 9 17 | 6 21 | 7 59 | 7 21 | 6 58 | 8 21 | 6 12 | 9 42 | 5 20 |
| 1 50 | 19 8 | 51 | 5 22 | 9 15 | 6 22 | 7 58 | 7 22 | 6 57 | 8 22 | 6 11 | 9 44 | 5 19 |
| 1 55 | 18 43 | 49 | 5 23 | 9 13 | 6 23 | 7 57 | 7 23 | 6 57 | 8 23 | 6 10 | 9 46 | 5 18 |
| 2 0 | 18 20 | 48 | 5 24 | 9 12 | 6 24 | 7 56 | 7 24 | 6 56 | 8 24 | 6 9 | 9 48 | 5 17 |
| 2 5 | 17 56 | 46 | 5 25 | 9 10 | 6 25 | 7 55 | 7 25 | 6 55 | 8 25 | 6 9 | 9 50 | 5 16 |
| 2 10 | 17 34 | 44 | 5 26 | 9 9 | 6 26 | 7 54 | 7 26 | 6 54 | 8 26 | 6 8 | 9 52 | 5 15 |
| 2 15 | 17 12 | 43 | 5 27 | 9 7 | 6 27 | 7 53 | 7 27 | 6 53 | 8 27 | 6 7 | 9 54 | 5 14 |
| 2 20 | 16 51 | 41 | 5 28 | 9 5 | 6 28 | 7 51 | 7 28 | 6 52 | 8 28 | 6 7 | 9 56 | 5 13 |
| 2 25 | 16 31 | 40 | 5 29 | 9 4 | 6 29 | 7 50 | 7 29 | 6 51 | 8 29 | 6 6 | 9 58 | 5 12 |
| 2 30 | 16 12 | 39 | 5 30 | 9 2 | 6 30 | 7 49 | 7 30 | 6 50 | 8 30 | 6 5 | 10 0 | 5 11 |
| 2 35 | 15 53 | 37 | 5 31 | 9 1 | 6 31 | 7 48 | 7 31 | 6 49 | 8 31 | 6 5 | 10 2 | 5 10 |
| 2 40 | 15 34 | 36 | 5 32 | 9 0 | 6 32 | 7 47 | 7 32 | 6 49 | 8 32 | 6 4 | 10 4 | 5 9 |
| 2 45 | 15 16 | 35 | 5 33 | 8 58 | 6 33 | 7 46 | 7 33 | 6 48 | 8 33 | 6 3 | 10 6 | 5 8 |
| 2 50 | 14 59 | 34 | 5 34 | 8 57 | 6 34 | 7 45 | 7 34 | 6 47 | 8 34 | 6 2 | 10 8 | 5 7 |
| 2 55 | 14 42 | 33 | 5 35 | 8 56 | 6 35 | 7 44 | 7 35 | 6 46 | 8 35 | 6 2 | 10 10 | 5 6 |
| 3 0 | 14 26 | 32 | 5 36 | 8 54 | 6 36 | 7 43 | 7 36 | 6 45 | 8 36 | 6 1 | 10 12 | 5 5 |
| 3 5 | 14 10 | 31 | 5 37 | 8 53 | 6 37 | 7 42 | 7 37 | 6 45 | 8 37 | 6 0 | 10 14 | 5 4 |
| 3 10 | 13 55 | 30 | 5 38 | 8 52 | 6 38 | 7 40 | 7 38 | 6 44 | 8 38 | 6 0 | 10 16 | 5 3 |
| 3 15 | 13 41 | 29 | 5 39 | 8 51 | 6 39 | 7 39 | 7 39 | 6 43 | 8 39 | 5 59 | 10 18 | 5 2 |
| 3 20 | 13 26 | 28 | 5 40 | 8 49 | 6 40 | 7 38 | 7 40 | 6 42 | 8 40 | 5 58 | 10 20 | 5 1 |
| 3 25 | 13 12 | 27 | 5 41 | 8 48 | 6 41 | 7 37 | 7 41 | 6 41 | 8 41 | 5 58 | 10 22 | 5 0 |
| 3 30 | 12 58 | 27 | 5 42 | 8 47 | 6 42 | 7 36 | 7 42 | 6 41 | 8 42 | 5 57 | 10 24 | 4 59 |
| 3 35 | 12 44 | 26 | 5 43 | 8 45 | 6 43 | 7 35 | 7 43 | 6 40 | 8 43 | 5 56 | 10 26 | 4 58 |
| 3 40 | 12 32 | 25 | 5 44 | 8 44 | 6 44 | 7 34 | 7 44 | 6 39 | 8 44 | 5 55 | 10 28 | 4 57 |
| 3 45 | 12 19 | 24 | 5 45 | 8 43 | 6 45 | 7 33 | 7 45 | 6 38 | 8 45 | 5 55 | 10 30 | 4 56 |
| 3 50 | 12 7 | 24 | 5 46 | 8 41 | 6 46 | 7 32 | 7 46 | 6 37 | 8 46 | 5 54 | 10 32 | 4 55 |
| 3 55 | 11 54 | 23 | 5 47 | 8 40 | 6 47 | 7 31 | 7 47 | 6 37 | 8 47 | 5 53 | 10 34 | 4 54 |
| 4 0 | 11 43 | 22 | 5 48 | 8 39 | 6 48 | 7 30 | 7 48 | 6 36 | 8 48 | 5 53 | 10 36 | 4 53 |
| 4 5 | 11 37 | 21 | 5 49 | 8 38 | 6 49 | 7 29 | 7 49 | 6 35 | 8 49 | 5 52 | 10 38 | 4 52 |
| 4 10 | 11 21 | 20 | 5 50 | 8 36 | 6 50 | 7 28 | 7 50 | 6 34 | 8 50 | 5 51 | 10 40 | 4 51 |
| 4 15 | 11 11 | 20 | 5 51 | 8 35 | 6 51 | 7 27 | 7 51 | 6 33 | 8 51 | 5 51 | 10 42 | 4 50 |
| 4 20 | 11 1 | 20 | 5 52 | 8 34 | 6 52 | 7 26 | 7 52 | 6 33 | 8 52 | 5 50 | 10 44 | 4 50 |
| 4 25 | 10 51 | 19 | 5 53 | 8 32 | 6 53 | 7 25 | 7 53 | 6 32 | 8 53 | 5 49 | 10 46 | 4 49 |
| 4 30 | 10 41 | 18 | 5 54 | 8 31 | 6 54 | 7 24 | 7 54 | 6 31 | 8 54 | 5 49 | 10 48 | 4 48 |
| 4 35 | 10 32 | 18 | 5 55 | 8 30 | 6 55 | 7 23 | 7 55 | 6 30 | 8 55 | 5 48 | 10 50 | 4 47 |
| 4 40 | 10 23 | 17 | 5 56 | 8 28 | 6 56 | 7 22 | 7 56 | 6 29 | 8 56 | 5 48 | 10 52 | 4 46 |
| 4 45 | 10 15 | 17 | 5 57 | 8 27 | 6 57 | 7 21 | 7 57 | 6 29 | 8 57 | 5 47 | 10 54 | 4 45 |
| 4 50 | 10 6 | 17 | 5 58 | 8 26 | 6 58 | 7 20 | 7 58 | 6 28 | 8 58 | 5 46 | 10 56 | 4 44 |
| 4 55 | 9 58 | 16 | 5 59 | 8 25 | 6 59 | 7 19 | 7 59 | 6 27 | 8 59 | 5 46 | 10 58 | 4 43 |

(Ther. 50.)
Bar 30.)

## ⊙ Correction of the Sun's App. Alt. *(subtr.)*

(or Refraction — Parallax.) (m)

| AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ |
| 11 0 | 4 42 | 13 0 | 3 59 | 15 0 | 3 26 | 20 0 | 2 30 | 30 0 | 1 33 | 50 0 | 0 43 |
| 11 2 | 4 42 | 13 2 | 3 58 | 15 5 | 3 25 | 20 10 | 2 29 | 30 20 | 1 32 | 50 30 | 0 42 |
| 11 4 | 4 41 | 13 4 | 3 58 | 15 10 | 3 23 | 20 20 | 2 28 | 30 40 | 1 30 | 51 0 | 0 42 |
| 11 6 | 4 40 | 13 6 | 3 57 | 15 15 | 3 22 | 20 30 | 2 26 | 31 0 | 1 29 | 51 30 | 0 41 |
| 11 8 | 4 39 | 13 8 | 3 56 | 15 20 | 3 21 | 20 40 | 2 25 | 31 20 | 1 28 | 52 0 | 0 40 |
| 11 10 | 4 38 | 13 10 | 3 56 | 15 25 | 3 20 | 20 50 | 2 23 | 31 40 | 1 27 | 52 30 | 0 39 |
| 11 12 | 4 38 | 13 12 | 3 55 | 15 30 | 3 19 | 21 0 | 2 22 | 32 0 | 1 25 | 53 0 | 0 38 |
| 11 14 | 4 37 | 13 14 | 3 55 | 15 35 | 3 18 | 21 10 | 2 21 | 32 20 | 1 24 | 53 30 | 0 38 |
| 11 16 | 4 36 | 13 16 | 3 54 | 15 40 | 3 17 | 21 20 | 2 20 | 32 40 | 1 23 | 54 0 | 0 37 |
| 11 18 | 4 35 | 13 18 | 3 53 | 15 45 | 3 15 | 21 30 | 2 19 | 33 0 | 1 22 | 54 30 | 0 36 |
| 11 20 | 4 34 | 13 20 | 3 53 | 15 50 | 3 14 | 21 40 | 2 17 | 33 20 | 1 21 | 55 0 | 0 36 |
| 11 22 | 4 34 | 13 22 | 3 52 | 15 55 | 3 13 | 21 50 | 2 16 | 33 40 | 1 20 | 55 30 | 0 35 |
| 11 24 | 4 33 | 13 24 | 3 52 | 16 0 | 3 12 | 22 0 | 2 15 | 34 0 | 1 19 | 56 0 | 0 34 |
| 11 26 | 4 32 | 13 26 | 3 51 | 16 5 | 3 11 | 22 10 | 2 14 | 34 20 | 1 18 | 56 30 | 0 33 |
| 11 28 | 4 31 | 13 28 | 3 50 | 16 10 | 3 10 | 22 20 | 2 13 | 34 40 | 1 17 | 57 0 | 0 33 |
| 11 30 | 4 30 | 13 30 | 3 50 | 16 15 | 3 9 | 22 30 | 2 12 | 35 0 | 1 16 | 57 30 | 0 32 |
| 11 32 | 4 30 | 13 32 | 3 49 | 16 20 | 3 8 | 22 40 | 2 11 | 35 20 | 1 15 | 58 0 | 0 32 |
| 11 34 | 4 29 | 13 34 | 3 49 | 16 25 | 3 7 | 22 50 | 2 9 | 35 40 | 1 14 | 58 30 | 0 31 |
| 11 36 | 4 28 | 13 36 | 3 48 | 16 30 | 3 6 | 23 0 | 2 8 | 36 0 | 1 13 | 59 0 | 0 30 |
| 11 38 | 4 27 | 13 38 | 3 48 | 16 35 | 3 5 | 23 10 | 2 7 | 36 20 | 1 12 | 59 30 | 0 30 |
| 11 40 | 4 26 | 13 40 | 3 47 | 16 40 | 3 4 | 23 20 | 2 6 | 36 40 | 1 11 | 60 0 | 0 29 |
| 11 42 | 4 26 | 13 42 | 3 46 | 16 45 | 3 3 | 23 30 | 2 5 | 37 0 | 1 10 | 60 30 | 0 28 |
| 11 44 | 4 25 | 13 44 | 3 46 | 16 50 | 3 2 | 23 40 | 2 4 | 37 20 | 1 9 | 61 0 | 0 28 |
| 11 46 | 4 24 | 13 46 | 3 45 | 16 55 | 3 1 | 23 50 | 2 3 | 37 40 | 1 8 | 61 30 | 0 27 |
| 11 48 | 4 23 | 13 48 | 3 45 | 17 0 | 3 0 | 24 0 | 2 2 | 38 0 | 1 7 | 62 0 | 0 27 |
| 11 50 | 4 22 | 13 50 | 3 44 | 17 5 | 2 59 | 24 10 | 2 1 | 38 20 | 1 7 | 62 30 | 0 26 |
| 11 52 | 4 22 | 13 52 | 3 44 | 17 10 | 2 58 | 24 20 | 2 0 | 38 40 | 1 6 | 63 0 | 0 26 |
| 11 54 | 4 21 | 13 54 | 3 43 | 17 15 | 2 57 | 24 30 | 1 59 | 39 0 | 1 5 | 63 30 | 0 25 |
| 11 56 | 4 21 | 13 56 | 3 42 | 17 20 | 2 56 | 24 40 | 1 58 | 39 20 | 1 4 | 64 0 | 0 24 |
| 11 58 | 4 20 | 13 58 | 3 42 | 17 25 | 2 55 | 24 50 | 1 57 | 39 40 | 1 3 | 64 30 | 0 24 |
| 12 0 | 4 19 | 14 0 | 3 41 | 17 30 | 2 54 | 25 0 | 1 56 | 40 0 | 1 3 | 65 0 | 0 23 |
| 12 2 | 4 19 | 14 2 | 3 41 | 17 35 | 2 54 | 25 10 | 1 55 | 40 20 | 1 2 | 65 30 | 0 23 |
| 12 4 | 4 18 | 14 4 | 3 40 | 17 40 | 2 53 | 25 20 | 1 54 | 40 40 | 1 1 | 66 0 | 0 22 |
| 12 6 | 4 17 | 14 6 | 3 40 | 17 45 | 2 52 | 25 30 | 1 54 | 41 0 | 1 0 | 66 30 | 0 22 |
| 12 8 | 4 16 | 14 8 | 3 39 | 17 50 | 2 51 | 25 40 | 1 53 | 41 20 | 0 59 | 67 0 | 0 21 |
| 12 10 | 4 16 | 14 10 | 3 39 | 17 55 | 2 50 | 25 50 | 1 52 | 41 40 | 0 59 | 67 30 | 0 21 |
| 12 12 | 4 15 | 14 12 | 3 38 | 18 0 | 2 49 | 26 0 | 1 51 | 42 0 | 0 58 | 68 0 | 0 20 |
| 12 14 | 4 14 | 14 14 | 3 38 | 18 5 | 2 48 | 26 10 | 1 50 | 42 20 | 0 57 | 69 0 | 0 19 |
| 12 16 | 4 14 | 14 16 | 3 37 | 18 10 | 2 47 | 26 20 | 1 49 | 42 40 | 0 57 | 70 0 | 0 18 |
| 12 18 | 4 13 | 14 18 | 3 36 | 18 15 | 2 47 | 26 30 | 1 48 | 43 0 | 0 56 | 71 0 | 0 17 |
| 12 20 | 4 12 | 14 20 | 3 36 | 18 20 | 2 46 | 26 40 | 1 48 | 43 20 | 0 55 | 72 0 | 0 16 |
| 12 22 | 4 11 | 14 22 | 3 35 | 18 25 | 2 45 | 26 50 | 1 47 | 43 40 | 0 55 | 73 0 | 0 15 |
| 12 24 | 4 11 | 14 24 | 3 35 | 18 30 | 2 44 | 27 0 | 1 46 | 44 0 | 0 54 | 74 0 | 0 14 |
| 12 26 | 4 10 | 14 26 | 3 34 | 18 35 | 2 43 | 27 10 | 1 45 | 44 20 | 0 53 | 75 0 | 0 13 |
| 12 28 | 4 9 | 14 28 | 3 34 | 18 40 | 2 43 | 27 20 | 1 44 | 44 40 | 0 53 | 76 0 | 0 12 |
| 12 30 | 4 9 | 14 30 | 3 33 | 18 45 | 2 42 | 27 30 | 1 44 | 45 0 | 0 52 | 77 0 | 0 11 |
| 12 32 | 4 8 | 14 32 | 3 33 | 18 50 | 2 41 | 27 40 | 1 43 | 45 20 | 0 51 | 78 0 | 0 10 |
| 12 34 | 4 7 | 14 34 | 3 32 | 18 55 | 2 40 | 27 50 | 1 42 | 45 40 | 0 51 | 79 0 | 0 9 |
| 12 36 | 4 7 | 14 36 | 3 32 | 19 0 | 2 39 | 28 0 | 1 41 | 46 0 | 0 50 | 80 0 | 0 9 |
| 12 38 | 4 6 | 14 38 | 3 31 | 19 5 | 2 39 | 28 10 | 1 41 | 46 20 | 0 49 | 81 0 | 0 8 |
| 12 40 | 4 5 | 14 40 | 3 31 | 19 10 | 2 38 | 28 20 | 1 40 | 46 40 | 0 49 | 82 0 | 0 7 |
| 12 42 | 4 5 | 14 42 | 3 30 | 19 15 | 2 37 | 28 30 | 1 39 | 47 0 | 0 48 | 83 0 | 0 6 |
| 12 44 | 4 4 | 14 44 | 3 30 | 19 20 | 2 36 | 28 40 | 1 38 | 47 20 | 0 47 | 84 0 | 0 5 |
| 12 46 | 4 3 | 14 46 | 3 29 | 19 25 | 2 36 | 28 50 | 1 38 | 47 40 | 0 47 | 85 0 | 0 4 |
| 12 48 | 4 3 | 14 48 | 3 29 | 19 30 | 2 35 | 29 0 | 1 37 | 48 0 | 0 46 | 86 0 | 0 4 |
| 12 50 | 4 2 | 14 50 | 3 28 | 19 35 | 2 34 | 29 10 | 1 36 | 48 20 | 0 46 | 87 0 | 0 3 |
| 12 52 | 4 1 | 14 52 | 3 28 | 19 40 | 2 33 | 29 20 | 1 36 | 48 40 | 0 45 | 88 0 | 0 2 |
| 12 54 | 4 1 | 14 54 | 3 27 | 19 45 | 2 33 | 29 30 | 1 35 | 49 0 | 0 45 | 89 0 | 0 1 |
| 12 56 | 4 0 | 14 56 | 3 27 | 19 50 | 2 32 | 29 40 | 1 34 | 49 20 | 0 44 | 90 0 | 0 0 |
| 12 58 | 3 59 | 14 58 | 3 26 | 19 55 | 2 31 | 29 50 | 1 33 | 49 40 | 0 44 | | |

(Ther. 50.)
(Bar. 30.)

## Correction of a STAR's App. Alt. *(subtr.)* ✳

(n) (or Refraction in Alt.)

| AA | Corr. — | Diff. for 10′ | AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — | AA | Corr. — |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ |
| 0 0 | 33 51 | 117 | 5 0 | 9 58 | 6 0 | 8 32 | 7 0 | 7 27 | 8 0 | 6 35 | 9 0 | 5 54 |
| 0 5 | 32 53 | 113 | 5 1 | 9 56 | 6 1 | 8 31 | 7 1 | 7 26 | 8 1 | 6 34 | 9 2 | 5 53 |
| 0 10 | 31 58 | 109 | 5 2 | 9 55 | 6 2 | 8 30 | 7 2 | 7 25 | 8 2 | 6 34 | 9 4 | 5 51 |
| 0 15 | 31 5 | 105 | 5 3 | 9 53 | 6 3 | 8 28 | 7 3 | 7 24 | 8 3 | 6 33 | 9 6 | 5 50 |
| 0 20 | 30 13 | 101 | 5 4 | 9 52 | 6 4 | 8 27 | 7 4 | 7 23 | 8 4 | 6 32 | 9 8 | 5 48 |
| 0 25 | 29 24 | 97 | 5 5 | 9 50 | 6 5 | 8 26 | 7 5 | 7 22 | 8 5 | 6 31 | 9 10 | 5 47 |
| 0 30 | 28 37 | 94 | 5 6 | 9 48 | 6 6 | 8 25 | 7 6 | 7 21 | 8 6 | 6 31 | 9 12 | 5 46 |
| 0 35 | 27 51 | 90 | 5 7 | 9 47 | 6 7 | 8 24 | 7 7 | 7 20 | 8 7 | 6 30 | 9 14 | 5 45 |
| 0 40 | 27 6 | 87 | 5 8 | 9 45 | 6 8 | 8 22 | 7 8 | 7 19 | 8 8 | 6 29 | 9 16 | 5 43 |
| 0 45 | 26 24 | 84 | 5 9 | 9 44 | 6 9 | 8 21 | 7 9 | 7 18 | 8 9 | 6 29 | 9 18 | 5 42 |
| 0 50 | 25 43 | 80 | 5 10 | 9 42 | 6 10 | 8 20 | 7 10 | 7 17 | 8 10 | 6 28 | 9 20 | 5 41 |
| 0 55 | 25 3 | 77 | 5 11 | 9 40 | 6 11 | 8 19 | 7 11 | 7 16 | 8 11 | 6 27 | 9 22 | 5 40 |
| 1 0 | 24 25 | 74 | 5 12 | 9 39 | 6 12 | 8 18 | 7 12 | 7 15 | 8 12 | 6 27 | 9 24 | 5 39 |
| 1 5 | 23 48 | 71 | 5 13 | 9 37 | 6 13 | 8 17 | 7 13 | 7 14 | 8 13 | 6 26 | 9 26 | 5 38 |
| 1 10 | 23 13 | 69 | 5 14 | 9 36 | 6 14 | 8 16 | 7 14 | 7 13 | 8 14 | 6 25 | 9 28 | 5 37 |
| 1 15 | 22 40 | 66 | 5 15 | 9 34 | 6 15 | 8 14 | 7 15 | 7 12 | 8 15 | 6 24 | 9 30 | 5 36 |
| 1 20 | 22 8 | 63 | 5 16 | 9 33 | 6 16 | 8 13 | 7 16 | 7 12 | 8 16 | 6 24 | 9 32 | 5 35 |
| 1 25 | 21 37 | 61 | 5 17 | 9 31 | 6 17 | 8 12 | 7 17 | 7 11 | 8 17 | 6 23 | 9 34 | 5 34 |
| 1 30 | 21 7 | 59 | 5 18 | 9 30 | 6 18 | 8 11 | 7 18 | 7 10 | 8 18 | 6 22 | 9 36 | 5 32 |
| 1 35 | 20 38 | 57 | 5 19 | 9 28 | 6 19 | 8 10 | 7 19 | 7 9 | 8 19 | 6 22 | 9 38 | 5 31 |
| 1 40 | 20 10 | 55 | 5 20 | 9 27 | 6 20 | 8 9 | 7 20 | 7 8 | 8 20 | 6 21 | 9 40 | 5 30 |
| 1 45 | 19 43 | 53 | 5 21 | 9 25 | 6 21 | 8 8 | 7 21 | 7 7 | 8 21 | 6 20 | 9 42 | 5 29 |
| 1 50 | 19 17 | 51 | 5 22 | 9 24 | 6 22 | 8 7 | 7 22 | 7 6 | 8 22 | 6 20 | 9 44 | 5 28 |
| 1 55 | 18 52 | 49 | 5 23 | 9 22 | 6 23 | 8 6 | 7 23 | 7 5 | 8 23 | 6 19 | 9 46 | 5 27 |
| 2 0 | 18 29 | 48 | 5 24 | 9 21 | 6 24 | 8 5 | 7 24 | 7 4 | 8 24 | 6 18 | 9 48 | 5 26 |
| 2 5 | 18 5 | 46 | 5 25 | 9 19 | 6 25 | 8 3 | 7 25 | 7 3 | 8 25 | 6 17 | 9 50 | 5 25 |
| 2 10 | 17 43 | 44 | 5 26 | 9 17 | 6 26 | 8 2 | 7 26 | 7 3 | 8 26 | 6 17 | 9 52 | 5 24 |
| 2 15 | 17 21 | 43 | 5 27 | 9 16 | 6 27 | 8 1 | 7 27 | 7 2 | 8 27 | 6 16 | 9 54 | 5 23 |
| 2 20 | 17 0 | 41 | 5 28 | 9 14 | 6 28 | 8 0 | 7 28 | 7 1 | 8 28 | 6 15 | 9 56 | 5 22 |
| 2 25 | 16 40 | 40 | 5 29 | 9 13 | 6 29 | 7 59 | 7 29 | 7 0 | 8 29 | 6 15 | 9 58 | 5 21 |
| 2 30 | 16 21 | 39 | 5 30 | 9 11 | 6 30 | 7 58 | 7 30 | 6 59 | 8 30 | 6 14 | 10 0 | 5 20 |
| 2 35 | 16 2 | 37 | 5 31 | 9 10 | 6 31 | 7 57 | 7 31 | 6 58 | 8 31 | 6 13 | 10 2 | 5 19 |
| 2 40 | 15 43 | 36 | 5 32 | 9 8 | 6 32 | 7 56 | 7 32 | 6 57 | 8 32 | 6 13 | 10 4 | 5 18 |
| 2 45 | 15 25 | 35 | 5 33 | 9 7 | 6 33 | 7 55 | 7 33 | 6 57 | 8 33 | 6 12 | 10 6 | 5 17 |
| 2 50 | 15 8 | 34 | 5 34 | 9 6 | 6 34 | 7 54 | 7 34 | 6 56 | 8 34 | 6 11 | 10 8 | 5 16 |
| 2 55 | 14 51 | 33 | 5 35 | 9 4 | 6 35 | 7 52 | 7 35 | 6 55 | 8 35 | 6 10 | 10 10 | 5 15 |
| 3 0 | 14 35 | 32 | 5 36 | 9 3 | 6 36 | 7 51 | 7 36 | 6 54 | 8 36 | 6 10 | 10 12 | 5 14 |
| 3 5 | 14 19 | 31 | 5 37 | 9 2 | 6 37 | 7 50 | 7 37 | 6 53 | 8 37 | 6 9 | 10 14 | 5 13 |
| 3 10 | 14 4 | 30 | 5 38 | 9 1 | 6 38 | 7 49 | 7 38 | 6 53 | 8 38 | 6 8 | 10 16 | 5 12 |
| 3 15 | 13 50 | 29 | 5 39 | 8 59 | 6 39 | 7 48 | 7 39 | 6 52 | 8 39 | 6 8 | 10 18 | 5 11 |
| 3 20 | 13 35 | 28 | 5 40 | 8 58 | 6 40 | 7 47 | 7 40 | 6 51 | 8 40 | 6 7 | 10 20 | 5 10 |
| 3 25 | 13 21 | 27 | 5 41 | 8 57 | 6 41 | 7 46 | 7 41 | 6 50 | 8 41 | 6 6 | 10 22 | 5 9 |
| 3 30 | 13 7 | 27 | 5 42 | 8 55 | 6 42 | 7 45 | 7 42 | 6 49 | 8 42 | 6 6 | 10 24 | 5 8 |
| 3 35 | 12 53 | 26 | 5 43 | 8 54 | 6 43 | 7 44 | 7 43 | 6 49 | 8 43 | 6 5 | 10 26 | 5 7 |
| 3 40 | 12 41 | 25 | 5 44 | 8 53 | 6 44 | 7 43 | 7 44 | 6 48 | 8 44 | 6 4 | 10 28 | 5 6 |
| 3 45 | 12 28 | 24 | 5 45 | 8 51 | 6 45 | 7 42 | 7 45 | 6 47 | 8 45 | 6 3 | 10 30 | 5 5 |
| 3 50 | 12 16 | 24 | 5 46 | 8 50 | 6 46 | 7 41 | 7 46 | 6 46 | 8 46 | 6 3 | 10 32 | 5 4 |
| 3 55 | 12 3 | 23 | 5 47 | 8 49 | 6 47 | 7 40 | 7 47 | 6 45 | 8 47 | 6 2 | 10 34 | 5 3 |
| 4 0 | 11 52 | 22 | 5 48 | 8 48 | 6 48 | 7 39 | 7 48 | 6 45 | 8 48 | 6 1 | 10 36 | 5 2 |
| 4 5 | 11 41 | 21 | 5 49 | 8 46 | 6 49 | 7 38 | 7 49 | 6 44 | 8 49 | 6 1 | 10 38 | 5 1 |
| 4 10 | 11 30 | 20 | 5 50 | 8 45 | 6 50 | 7 37 | 7 50 | 6 43 | 8 50 | 6 0 | 10 40 | 5 0 |
| 4 15 | 11 20 | 20 | 5 51 | 8 44 | 6 51 | 7 36 | 7 51 | 6 42 | 8 51 | 5 59 | 10 42 | 4 59 |
| 4 20 | 11 10 | 20 | 5 52 | 8 42 | 6 52 | 7 35 | 7 52 | 6 41 | 8 52 | 5 59 | 10 44 | 4 58 |
| 4 25 | 11 0 | 19 | 5 53 | 8 41 | 6 53 | 7 34 | 7 53 | 6 41 | 8 53 | 5 58 | 10 46 | 4 58 |
| 4 30 | 10 50 | 18 | 5 54 | 8 40 | 6 54 | 7 33 | 7 54 | 6 40 | 8 54 | 5 58 | 10 48 | 4 57 |
| 4 35 | 10 41 | 18 | 5 55 | 8 38 | 6 55 | 7 32 | 7 55 | 6 39 | 8 55 | 5 57 | 10 50 | 4 56 |
| 4 40 | 10 32 | 17 | 5 56 | 8 37 | 6 56 | 7 31 | 7 56 | 6 38 | 8 56 | 5 56 | 10 52 | 4 55 |
| 4 45 | 10 23 | 17 | 5 57 | 8 36 | 6 57 | 7 30 | 7 57 | 6 37 | 8 57 | 5 56 | 10 54 | 4 54 |
| 4 50 | 10 15 | 17 | 5 58 | 8 35 | 6 58 | 7 29 | 7 58 | 6 37 | 8 58 | 5 55 | 10 56 | 4 53 |
| 4 55 | 10 7 | 16 | 5 59 | 8 33 | 6 59 | 7 28 | 7 59 | 6 36 | 8 59 | 5 55 | 10 58 | 4 52 |

(Ther. 50.)
(Bar. 30.)

* Correction of a STAR's App. Alt. *(subtr.)*
(or Refraction in Alt.) (n)

| AA | Corr. | AA | Corr. | AA | Corr. | AA | Corr. | AA | Corr. | AA | Corr. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ | ° ′ | ′ ″ |
| 11 0 | 4 51 | 13 0 | 4 7 | 15 0 | 3 34 | 20 0 | 2 39 | 30 0 | 1 40 | 50 0 | 0 49 |
| 11 2 | 4 50 | 13 2 | 4 7 | 15 5 | 3 33 | 20 10 | 2 37 | 30 20 | 1 39 | 50 30 | 0 48 |
| 11 4 | 4 49 | 13 4 | 4 6 | 15 10 | 3 32 | 20 20 | 2 36 | 30 40 | 1 38 | 51 0 | 0 47 |
| 11 6 | 4 49 | 13 6 | 4 6 | 15 15 | 3 31 | 20 30 | 2 35 | 31 0 | 1 37 | 51 30 | 0 46 |
| 11 8 | 4 48 | 13 8 | 4 5 | 15 20 | 3 30 | 20 40 | 2 33 | 31 20 | 1 35 | 52 0 | 0 45 |
| 11 10 | 4 47 | 13 10 | 4 4 | 15 25 | 3 28 | 20 50 | 2 32 | 31 40 | 1 34 | 52 30 | 0 45 |
| 11 12 | 4 46 | 13 12 | 4 4 | 15 30 | 3 27 | 21 0 | 2 30 | 32 0 | 1 33 | 53 0 | 0 44 |
| 11 14 | 4 45 | 13 14 | 4 3 | 15 35 | 3 26 | 21 10 | 2 29 | 32 20 | 1 32 | 53 30 | 0 43 |
| 11 16 | 4 45 | 13 16 | 4 3 | 15 40 | 3 25 | 21 20 | 2 28 | 32 40 | 1 31 | 54 0 | 0 42 |
| 11 18 | 4 44 | 13 18 | 4 2 | 15 45 | 3 24 | 21 30 | 2 27 | 33 0 | 1 29 | 54 30 | 0 41 |
| 11 20 | 4 43 | 13 20 | 4 1 | 15 50 | 3 23 | 21 40 | 2 26 | 33 20 | 1 28 | 55 0 | 0 41 |
| 11 22 | 4 42 | 13 22 | 4 1 | 15 55 | 3 22 | 21 50 | 2 24 | 33 40 | 1 27 | 55 30 | 0 40 |
| 11 24 | 4 41 | 13 24 | 4 0 | 16 0 | 3 21 | 22 0 | 2 23 | 34 0 | 1 26 | 56 0 | 0 39 |
| 11 26 | 4 41 | 13 26 | 4 0 | 16 5 | 3 20 | 22 10 | 2 22 | 34 20 | 1 25 | 56 30 | 0 38 |
| 11 28 | 4 40 | 13 28 | 3 59 | 16 10 | 3 18 | 22 20 | 2 21 | 34 40 | 1 24 | 57 0 | 0 38 |
| 11 30 | 4 39 | 13 30 | 3 58 | 16 15 | 3 17 | 22 30 | 2 20 | 35 0 | 1 23 | 57 30 | 0 37 |
| 11 32 | 4 38 | 13 32 | 3 58 | 16 20 | 3 16 | 22 40 | 2 19 | 35 20 | 1 22 | 58 0 | 0 36 |
| 11 34 | 4 37 | 13 34 | 3 57 | 16 25 | 3 15 | 22 50 | 2 18 | 35 40 | 1 21 | 58 30 | 0 36 |
| 11 36 | 4 37 | 13 36 | 3 57 | 16 30 | 3 14 | 23 0 | 2 16 | 36 0 | 1 20 | 59 0 | 0 35 |
| 11 38 | 4 36 | 13 38 | 3 56 | 16 35 | 3 13 | 23 10 | 2 15 | 36 20 | 1 19 | 59 30 | 0 34 |
| 11 40 | 4 35 | 13 40 | 3 55 | 16 40 | 3 12 | 23 20 | 2 14 | 36 40 | 1 18 | 60 0 | 0 34 |
| 11 42 | 4 34 | 13 42 | 3 55 | 16 45 | 3 11 | 23 30 | 2 13 | 37 0 | 1 17 | 60 30 | 0 33 |
| 11 44 | 4 33 | 13 44 | 3 54 | 16 50 | 3 10 | 23 40 | 2 12 | 37 20 | 1 16 | 61 0 | 0 32 |
| 11 46 | 4 33 | 13 46 | 3 54 | 16 55 | 3 9 | 23 50 | 2 11 | 37 40 | 1 15 | 61 30 | 0 32 |
| 11 48 | 4 32 | 13 48 | 3 53 | 17 0 | 3 8 | 24 0 | 2 10 | 38 0 | 1 14 | 62 0 | 0 31 |
| 11 50 | 4 31 | 13 50 | 3 53 | 17 5 | 3 7 | 24 10 | 2 9 | 38 20 | 1 13 | 62 30 | 0 30 |
| 11 52 | 4 30 | 13 52 | 3 52 | 17 10 | 3 7 | 24 20 | 2 8 | 38 40 | 1 13 | 63 0 | 0 30 |
| 11 54 | 4 30 | 13 54 | 3 51 | 17 15 | 3 6 | 24 30 | 2 7 | 39 0 | 1 12 | 63 30 | 0 29 |
| 11 56 | 4 29 | 13 56 | 3 51 | 17 20 | 3 5 | 24 40 | 2 6 | 39 20 | 1 11 | 64 0 | 0 28 |
| 11 58 | 4 29 | 13 58 | 3 50 | 17 25 | 3 4 | 24 50 | 2 5 | 39 40 | 1 10 | 64 30 | 0 28 |
| 12 0 | 4 28 | 14 0 | 3 50 | 17 30 | 3 3 | 25 0 | 2 4 | 40 0 | 1 9 | 65 0 | 0 27 |
| 12 2 | 4 27 | 14 2 | 3 49 | 17 35 | 3 2 | 25 10 | 2 3 | 40 20 | 1 8 | 65 30 | 0 26 |
| 12 4 | 4 27 | 14 4 | 3 49 | 17 40 | 3 1 | 25 20 | 2 2 | 40 40 | 1 8 | 66 0 | 0 26 |
| 12 6 | 4 26 | 14 6 | 3 48 | 17 45 | 3 0 | 25 30 | 2 1 | 41 0 | 1 7 | 66 30 | 0 25 |
| 12 8 | 4 25 | 14 8 | 3 48 | 17 50 | 2 59 | 25 40 | 2 1 | 41 20 | 1 6 | 67 0 | 0 25 |
| 12 10 | 4 24 | 14 10 | 3 47 | 17 55 | 2 58 | 25 50 | 2 0 | 41 40 | 1 5 | 67 30 | 0 24 |
| 12 12 | 4 24 | 14 12 | 3 47 | 18 0 | 2 58 | 26 0 | 1 59 | 42 0 | 1 5 | 68 0 | 0 23 |
| 12 14 | 4 23 | 14 14 | 3 46 | 18 5 | 2 57 | 26 10 | 1 58 | 42 20 | 1 4 | 69 0 | 0 22 |
| 12 16 | 4 22 | 14 16 | 3 45 | 18 10 | 2 56 | 26 20 | 1 57 | 42 40 | 1 3 | 70 0 | 0 21 |
| 12 18 | 4 21 | 14 18 | 3 45 | 18 15 | 2 55 | 26 30 | 1 56 | 43 0 | 1 2 | 71 0 | 0 20 |
| 12 20 | 4 21 | 14 20 | 3 44 | 18 20 | 2 54 | 26 40 | 1 55 | 43 20 | 1 2 | 72 0 | 0 19 |
| 12 22 | 4 20 | 14 22 | 3 44 | 18 25 | 2 53 | 26 50 | 1 55 | 43 40 | 1 1 | 73 0 | 0 18 |
| 12 24 | 4 19 | 14 24 | 3 43 | 18 30 | 2 53 | 27 0 | 1 54 | 44 0 | 1 0 | 74 0 | 0 17 |
| 12 26 | 4 19 | 14 26 | 3 43 | 18 35 | 2 52 | 27 10 | 1 53 | 44 20 | 1 0 | 75 0 | 0 15 |
| 12 28 | 4 18 | 14 28 | 3 42 | 18 40 | 2 51 | 27 20 | 1 52 | 44 40 | 0 59 | 76 0 | 0 14 |
| 12 30 | 4 17 | 14 30 | 3 42 | 18 45 | 2 50 | 27 30 | 1 51 | 45 0 | 0 58 | 77 0 | 0 13 |
| 12 32 | 4 17 | 14 32 | 3 41 | 18 50 | 2 49 | 27 40 | 1 51 | 45 20 | 0 57 | 78 0 | 0 12 |
| 12 34 | 4 16 | 14 34 | 3 41 | 18 55 | 2 48 | 27 50 | 1 50 | 45 40 | 0 57 | 79 0 | 0 11 |
| 12 36 | 4 15 | 14 36 | 3 40 | 19 0 | 2 48 | 28 0 | 1 49 | 46 0 | 0 56 | 80 0 | 0 10 |
| 12 38 | 4 15 | 14 38 | 3 40 | 19 5 | 2 47 | 28 10 | 1 48 | 46 20 | 0 55 | 81 0 | 0 9 |
| 12 40 | 4 14 | 14 40 | 3 39 | 19 10 | 2 46 | 28 20 | 1 48 | 46 40 | 0 55 | 82 0 | 0 8 |
| 12 42 | 4 13 | 14 42 | 3 39 | 19 15 | 2 45 | 28 30 | 1 47 | 47 0 | 0 54 | 83 0 | 0 7 |
| 12 44 | 4 13 | 14 44 | 3 38 | 19 20 | 2 45 | 28 40 | 1 46 | 47 20 | 0 53 | 84 0 | 0 6 |
| 12 46 | 4 12 | 14 46 | 3 38 | 19 25 | 2 44 | 28 50 | 1 45 | 47 40 | 0 53 | 85 0 | 0 5 |
| 12 48 | 4 11 | 14 48 | 3 37 | 19 30 | 2 43 | 29 0 | 1 45 | 48 0 | 0 52 | 86 0 | 0 4 |
| 12 50 | 4 11 | 14 50 | 3 37 | 19 35 | 2 42 | 29 10 | 1 44 | 48 20 | 0 52 | 87 0 | 0 3 |
| 12 52 | 4 10 | 14 52 | 3 36 | 19 40 | 2 42 | 29 20 | 1 43 | 48 40 | 0 51 | 88 0 | 0 2 |
| 12 54 | 4 9 | 14 54 | 3 36 | 19 45 | 2 41 | 29 30 | 1 43 | 49 0 | 0 50 | 89 0 | 0 1 |
| 12 56 | 4 9 | 14 56 | 3 35 | 19 50 | 2 40 | 29 40 | 1 42 | 49 20 | 0 50 | 90 0 | 0 0 |
| 12 58 | 4 8 | 14 58 | 3 35 | 19 55 | 2 39 | 29 50 | 1 41 | 49 40 | 0 49 | | |

## Table (o). For finding at what time the Sun passes the Prime Vertical.

| Lat. | Dist. | Lat. | Dist. | Lat. | Dist. | Lat. | Dist. | Lat. | Dist. | Lat. | Dist. | Lat. | Dist. | Lat. | Dist. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| o | | o | | o | | o | | o | | o | | o | | o | |
| 1 | 1.7 | 9 | 15.8 | 17 | 30.5 | 25 | 46.6 | 33 | 64.9 | 41 | 86.9 | 49 | 115.0 | 57 | 154.0 |
| 2 | 3.5 | 10 | 17.6 | 18 | 32.4 | 26 | 48.7 | 34 | 67.4 | 42 | 90.0 | 50 | 119.2 | 58 | 160.1 |
| 3 | 5.2 | 11 | 19.4 | 19 | 34.4 | 27 | 50.9 | 35 | 70.0 | 43 | 93.2 | 51 | 123.5 | 59 | 166.5 |
| 4 | 7.0 | 12 | 21.2 | 20 | 36.4 | 28 | 53.1 | 36 | 72.6 | 44 | 96.5 | 52 | 128.0 | 60 | 173.2 |
| 5 | 8.7 | 13 | 23.0 | 21 | 38.4 | 29 | 55.4 | 37 | 75.3 | 45 | 100.0 | 53 | 132.7 | 61 | 180.4 |
| 6 | 10.5 | 14 | 24.9 | 22 | 40.4 | 30 | 57.7 | 38 | 78.1 | 46 | 103.6 | 54 | 137.6 | 62 | 188.1 |
| 7 | 12.2 | 15 | 26.8 | 23 | 42.4 | 31 | 60.0 | 39 | 80.9 | 47 | 107.3 | 55 | 142.8 | 63 | 196.2 |
| 8 | 14.0 | 16 | 28.6 | 24 | 44.5 | 32 | 62.4 | 40 | 83.9 | 48 | 111.0 | 56 | 148.3 | 64 | 205.0 |
| Dec. | Dep. | Dec. | Dep. | Dec. | Dep. | Dec. | Dep. | Dec. | Dep. | Dec. | Dep. | Dec. | Dep. | Dec. | Dep. |

(I.) With Lat. and Dec. take out Dist. and Dep. (II.) From Travers. Table take corresponding Course. (III.) The Time will be found in Azimuth Table, opposite the Degrees of this Course.

N.B. From the above Table and the Azimuth Table can be determined with sufficient accuracy the Variation or Deviation at sea.

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## Azimuth Table.

| App. T. from Noon. | N. | Deg. | App. T. from Noon. | N. | Deg. | App. T. from Noon. | N. | Deg. | App. T. from Noon. | N. | Deg. | App. T. from Noon. | N. | Deg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| h. m. | | | h. m. | | | h. m. | | | h. m. | | | h. m. | | |
| 0 0 | 0.0 | 90 | 1 12 | 77.3 | 72 | 2 24 | 146.9 | 54 | 3 36 | 202.3 | 36 | 4 48 | 237.8 | 18 |
| 4 | 4.4 | 89 | 16 | 81.4 | 71 | 28 | 150.5 | 53 | 40 | 204.8 | 35 | 52 | 239.1 | 17 |
| 8 | 8.7 | 88 | 20 | 85.5 | 70 | 32 | 153.9 | 52 | 44 | 207.3 | 34 | 56 | 240.3 | 16 |
| 12 | 13.1 | 87 | 24 | 89.6 | 69 | 36 | 157.3 | 51 | 48 | 209.7 | 33 | 5 0 | 241.5 | 15 |
| 16 | 17.4 | 86 | 28 | 93.7 | 68 | 40 | 160.7 | 50 | 52 | 212.0 | 32 | 4 | 242.6 | 14 |
| 20 | 21.8 | 85 | 32 | 97.7 | 67 | 44 | 164.0 | 49 | 56 | 214.3 | 31 | 8 | 243.6 | 13 |
| 24 | 26.1 | 84 | 36 | 101.7 | 66 | 48 | 167.3 | 48 | 4 0 | 216.5 | 30 | 12 | 244.5 | 12 |
| 28 | 30.5 | 83 | 40 | 105.7 | 65 | 52 | 170.5 | 47 | 4 | 218.7 | 29 | 16 | 245.4 | 11 |
| 32 | 34.8 | 82 | 44 | 109.6 | 64 | 56 | 173.7 | 46 | 8 | 220.7 | 28 | 20 | 246.2 | 10 |
| 36 | 39.1 | 81 | 48 | 113.5 | 63 | 8 0 | 176.8 | 45 | 12 | 222.8 | 27 | 24 | 246.9 | 9 |
| 40 | 43.4 | 80 | 52 | 117.4 | 62 | 4 | 179.8 | 44 | 16 | 224.7 | 26 | 28 | 247.6 | 8 |
| 44 | 47.7 | 79 | 56 | 121.2 | 61 | 8 | 182.8 | 43 | 20 | 226.6 | 25 | 32 | 248.1 | 7 |
| 48 | 52.0 | 78 | 2 0 | 125.0 | 60 | 12 | 185.8 | 42 | 24 | 228.4 | 24 | 36 | 248.6 | 6 |
| 52 | 56.2 | 77 | 4 | 128.8 | 59 | 16 | 188.7 | 41 | 28 | 230.1 | 23 | 40 | 249.0 | 5 |
| 56 | 60.5 | 76 | 8 | 132.5 | 58 | 20 | 191.5 | 40 | 32 | 231.8 | 22 | 44 | 249.4 | 4 |
| 1 0 | 64.7 | 75 | 12 | 136.2 | 57 | 24 | 194.3 | 39 | 36 | 233.4 | 21 | 48 | 249.7 | 3 |
| 4 | 68.9 | 74 | 16 | 139.8 | 56 | 28 | 197.0 | 38 | 40 | 234.9 | 20 | 52 | 249.8 | 2 |
| 8 | 73.1 | 73 | 20 | 143.4 | 55 | 32 | 199.7 | 37 | 44 | 236.4 | 19 | 56 | 249·9 | 1 |
| | | | | | | | | | | | | 6 0 | 250.0 | 0 |
| | Dist. | Alt. | | Dist. | Alt. | | Dist. | Alt. | | Dist. | Alt. | | Dist. | Alt. |

(I.) For Appt. Time from Noon take out N. (II.) With N. as dist. and codeclin. as course, find dep. (Trav. Table). (III.) For Altitude take out dist. The course corresponding to this dist. and the above dep. will be Azimuth, which mark N. or S., according as Sun is N. or S. of Prime Vertical, and E. or W. as the time is A.M. or P.M.

(o)1.

Increase of R. A. of Mean Sun, or of Sid. Time at Mean Noon, for Hours, Minutes, and Seconds of Mean Time.

| | For Hours. | For Minutes | For Seconds. |
|---|---|---|---|
| | m | Sec. | Sec. |
| 1 | 0 9.8565 | 0.164 | 0.003 |
| 2 | 0 19.713 | 0.329 | 0.006 |
| 3 | 0 29.569 | 0.493 | 0.008 |
| 4 | 0 39.426 | 0.658 | 0.011 |
| 5 | 0 49.282 | 0.822 | 0.014 |
| 6 | 0 59.139 | 0.986 | 0.017 |
| 7 | 1 8.995 | 1.150 | 0.019 |
| 8 | 1 18.852 | 1.315 | 0.022 |
| 9 | 1 28.708 | 1.479 | 0.025 |
| 10 | 1 38.565 | 1.643 | 0.027 |
| 11 | 1 48.421 | 1.807 | 0.030 |
| 12 | 1 58.278 | 1.972 | 0.033 |
| 13 | 2 8.134 | 2.136 | 0.036 |
| 14 | 2 17.991 | 2.300 | 0.038 |
| 15 | 2 27.847 | 2.464 | 0.041 |
| 16 | 2 37.704 | 2.629 | 0.044 |
| 17 | 2 47.560 | 2 793 | 0.047 |
| 18 | 2 57.417 | 2.957 | 0.050 |
| 19 | 3 7.273 | 3.121 | 0.053 |
| 20 | 3 17.130 | 3.286 | 0.055 |
| 21 | 3 26.987 | 3.450 | 0.058 |
| 22 | 3 36.844 | 3.614 | 0.061 |
| 23 | 3 46.700 | 3.779 | 0.064 |
| 24 | 3 56.556 | 3.943 | 0.066 |
| 25 | | 4.108 | 0.069 |
| 26 | | 4.272 | 0.072 |
| 27 | | 4.436 | 0.075 |
| 28 | | 4.600 | 0.077 |
| 29 | | 4.764 | 0.080 |
| 30 | | 4.928 | 0.082 |
| 31 | | 5.092 | 0.085 |
| 32 | | 5.257 | 0.088 |
| 33 | | 5.421 | 0.091 |
| 34 | | 5.585 | 0.094 |
| 35 | | 5.750 | 0.097 |
| 36 | | 5.914 | 0.100 |
| 37 | | 6.078 | 0.103 |
| 38 | | 6.242 | 0.106 |
| 39 | | 6.407 | 0.108 |
| 40 | | 6.571 | 0.111 |
| 41 | | 6.735 | 0.114 |
| 42 | | 6.900 | 0.116 |
| 43 | | 7.064 | 0.119 |
| 44 | | 7.228 | 0.122 |
| 45 | | 7.393 | 0.125 |
| 46 | | 7.557 | 0.128 |
| 47 | | 7.722 | 0.131 |
| 48 | | 7.886 | 0.133 |
| 49 | | 8.050 | 0.136 |
| 50 | | 8.214 | 0.138 |
| 51 | | 8.378 | 0.141 |
| 52 | | 8.543 | 0.144 |
| 53 | | 8.707 | 0.147 |
| 54 | | 8.872 | 0.150 |
| 55 | | 9.036 | 0.152 |
| 56 | | 9.200 | 0.155 |
| 57 | | 9.364 | 0.157 |
| 58 | | 9.528 | 0.159 |
| 59 | | 9.692 | 0.162 |

(o)2

Distance of objects first seen at sea when eye on sea: if eye at known distance above sea, add distance for that height.

| Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. | Height. Ft. | Distance. Naut. Miles. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.15 | 22 | 5.40 | 43 | 7.54 | 120 | 12.60 | 300 | 19.91 | 520 | 26.22 | 940 | 35.25 | 2800 | 60.8 |
| 2 | 1.63 | 23 | 5.51 | 44 | 7.62 | 125 | 12.85 | 310 | 20.24 | 540 | 26.71 | 960 | 35.62 | 2900 | 61.9 |
| 3 | 1.99 | 24 | 5.63 | 45 | 7.70 | 130 | 13.11 | 320 | 20.57 | 560 | 27.21 | 980 | 35.99 | 3000 | 63.0 |
| 4 | 2.31 | 25 | 5.75 | 46 | 7.79 | 135 | 13.36 | 330 | 20.88 | 580 | 27.69 | 1000 | 36.40 | 3100 | 64.1 |
| 5 | 2.58 | 26 | 5.87 | 47 | 7.88 | 140 | 13.60 | 340 | 21.20 | 600 | 28.17 | 1100 | 38.10 | 3200 | 65.0 |
| 6 | 2.82 | 27 | 5.98 | 48 | 7.97 | 145 | 13.84 | 350 | 21.51 | 620 | 28.62 | 1200 | 39.90 | 3300 | 66.0 |
| 7 | 3.04 | 28 | 6.08 | 49 | 8.05 | 150 | 14.08 | 360 | 21.81 | 640 | 29.09 | 1300 | 41.40 | 3400 | 67.0 |
| 8 | 3.25 | 29 | 6.19 | 50 | 8.12 | 160 | 14.54 | 370 | 22.12 | 660 | 29.54 | 1400 | 43.00 | 3500 | 68.0 |
| 9 | 3.45 | 30 | 6.30 | 55 | 8.52 | 170 | 14.99 | 380 | 22.41 | 680 | 29.98 | 1500 | 44.50 | 3600 | 69.0 |
| 10 | 3.64 | 31 | 6.41 | 60 | 8.91 | 180 | 15.43 | 390 | 22.71 | 700 | 30.42 | 1600 | 46.00 | 3700 | 69.9 |
| 11 | 3.81 | 32 | 6.50 | 65 | 9.27 | 190 | 15.85 | 400 | 22.99 | 720 | 30.85 | 1700 | 47.40 | 3800 | 70.9 |
| 12 | 3.99 | 33 | 6.60 | 70 | 9.62 | 200 | 16.26 | 410 | 23.28 | 740 | 31.28 | 1800 | 48.80 | 3900 | 71.8 |
| 13 | 4.14 | 34 | 6.70 | 75 | 9.96 | 210 | 16.66 | 420 | 23.56 | 760 | 31.70 | 1900 | 50.20 | 4000 | 72.7 |
| 14 | 4.30 | 35 | 6.80 | 80 | 10.28 | 220 | 17.05 | 430 | 23.84 | 780 | 32.11 | 2000 | 51.50 | 4100 | 73.6 |
| 15 | 4.45 | 36 | 6.90 | 85 | 10.60 | 230 | 17.43 | 440 | 24.12 | 800 | 32.52 | 2100 | 52.70 | 4200 | 74.5 |
| 16 | 4.60 | 37 | 6.99 | 90 | 10.90 | 240 | 17.81 | 450 | 24.39 | 820 | 32.92 | 2200 | 54.00 | 4300 | 75.4 |
| 17 | 4.74 | 38 | 7.09 | 95 | 11.20 | 250 | 18.16 | 460 | 24.65 | 840 | 33.32 | 2300 | 55.10 | 4400 | 76.2 |
| 18 | 4.88 | 39 | 7.18 | 100 | 11.50 | 260 | 18.54 | 470 | 24.93 | 860 | 33.72 | 2400 | 56.30 | 4500 | 77.0 |
| 19 | 5.02 | 40 | 7.27 | 105 | 11.79 | 270 | 18.90 | 480 | 25.18 | 880 | 34.11 | 2500 | 57.50 | 4600 | 77.9 |
| 20 | 5.15 | 41 | 7.36 | 110 | 12.06 | 280 | 19.24 | 490 | 25.45 | 900 | 34.49 | 2600 | 58.70 | 4700 | 78.8 |
| 21 | 5.27 | 42 | 7.45 | 115 | 12.34 | 290 | 19.58 | 500 | 25.70 | 920 | 34.88 | 2700 | 59.80 | 1mile | 83.5 |

(o)3

Equation of 2nd Differences. (Multiply Tab. Nr. by Second Difference.)

| For Period 1h. | | Tab. Number. | For Period 3h. | |
|---|---|---|---|---|
| m | m | | h m | h m |
| 0 | 60 | 0.00000 | 0 0 | 3 0 |
| 1 | 59 | 0.00819 | 0 3 | 2 57 |
| 2 | 58 | 0.01611 | 0 6 | 2 54 |
| 3 | 57 | 0.02375 | 0 9 | 2 51 |
| 4 | 56 | 0.03111 | 0 12 | 2 48 |
| 5 | 55 | 0.03819 | 0 15 | 2 45 |
| 6 | 54 | 0.04500 | 0 18 | 2 42 |
| 7 | 53 | 0.05153 | 0 21 | 2 39 |
| 8 | 52 | 0.05778 | 0 24 | 2 36 |
| 9 | 51 | 0.06375 | 0 27 | 2 33 |
| 10 | 50 | 0.06944 | 0 30 | 2 30 |
| 11 | 49 | 0 07486 | 0 33 | 2 27 |
| 12 | 48 | 0.08000 | 0 36 | 2 24 |
| 13 | 47 | 0.08486 | 0 39 | 2 21 |
| 14 | 46 | 0.08944 | 0 42 | 2 18 |
| 15 | 45 | 0.09375 | 0 45 | 2 15 |
| 16 | 44 | 0.09778 | 0 48 | 2 12 |
| 17 | 43 | 0.10153 | 0 51 | 2 9 |
| 18 | 42 | 0.10500 | 0 54 | 2 6 |
| 19 | 41 | 0.10819 | 0 57 | 2 3 |
| 20 | 40 | 0.11111 | 1 0 | 2 0 |
| 21 | 39 | 0.11375 | 1 3 | 1 57 |
| 22 | 38 | 0.11611 | 1 6 | 1 54 |
| 23 | 37 | 0.11819 | 1 9 | 1 51 |
| 24 | 36 | 0.12000 | 1 12 | 1 48 |
| 25 | 35 | 0.12153 | 1 15 | 1 45 |
| 26 | 34 | 0.12278 | 1 18 | 1 42 |
| 27 | 33 | 0.12375 | 1 21 | 1 39 |
| 28 | 32 | 0.12444 | 1 24 | 1 36 |
| 29 | 31 | 0.12486 | 1 27 | 1 33 |
| 30 | 30 | 0.12500 | 1 30 | 1 30 |

(o)4

Logarithms for clearing Distance.

| Alt. | For Sun. | For Star. | Alt. | For Sun. | For Star. |
|---|---|---|---|---|---|
| 3 | .000092 | .000093 | 37 | .000108 | .000120 |
| 4 | .000101 | .000102 | 38 | .000108 | .000120 |
| 5 | .000106 | .000107 | 39 | .000108 | .000120 |
| 6 | .000109 | .000111 | 40 | .000108 | .000120 |
| 7 | .000111 | .000113 | 41 | .000107 | .000120 |
| 8 | .000112 | .000114 | 42 | .000107 | .000120 |
| 9 | .000113 | .000115 | 43 | .000107 | .000120 |
| 10 | .000113 | .000116 | 44 | .000107 | .000120 |
| 11 | .000113 | .000117 | 45 | .000107 | .000120 |
| 12 | .000113 | .000117 | 46 | .000107 | .000120 |
| 13 | .000113 | .000118 | 47 | .000106 | .000120 |
| 14 | .000113 | .000118 | 48 | .000106 | .000120 |
| 15 | .000113 | .000119 | 49 | .000106 | .000120 |
| 16 | .000113 | .000119 | 50 | .000105 | 000120 |
| 17 | .000113 | .000119 | 51 | .000105 | .000120 |
| 18 | .000113 | .000119 | 52 | .000105 | .000120 |
| 19 | .000113 | .000119 | 53 | .000105 | .000120 |
| 20 | .000113 | .000119 | 54 | .000105 | .000120 |
| 21 | .000112 | .000119 | 55 | .000104 | .000120 |
| 22 | .000112 | .000119 | 56 | .000104 | .000120 |
| 23 | .000112 | .000119 | 57 | .000104 | .000120 |
| 24 | .000112 | .000119 | 58 | .000104 | .000120 |
| 25 | .000112 | .000119 | 59 | .000104 | .000120 |
| 26 | .000111 | .000119 | 60 | 000104 | .000120 |
| 27 | .000111 | 000120 | 61 | .000104 | .000120 |
| 28 | .000111 | .000120 | 62 | .000104 | .000120 |
| 29 | .000111 | .000120 | 63 | .000103 | .000120 |
| 30 | .000110 | 000120 | 64 | .000103 | .000120 |
| 31 | .000110 | .000120 | 65 | 000103 | .000120 |
| 32 | .000110 | .000120 | 66 | .000103 | 000120 |
| 33 | .000109 | .000120 | 67 | .000103 | .000120 |
| 34 | .000109 | .000120 | 68 | .000103 | .000120 |
| 35 | .000109 | .000120 | 69 | .000102 | .000120 |
| 36 | .000109 | .000120 | 90 | .000102 | .000120 |

(o)5 LOGISTIC LOGARITHMS.

| Sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 1.77815 | 1.47712 | 1.30103 | 1.17609 | 1.07918 | 1.00000 | .93305 | .87506 | .82391 |
| 2 | 3.25527 | 1.76391 | 1.46994 | 1.29623 | 1.17249 | 1.07630 | .99760 | .93099 | .87326 | .82230 |
| 4 | 2.95424 | 1.75012 | 1.46288 | 1.29149 | 1.16891 | 1.07343 | .99520 | .92894 | .87146 | .82070 |
| 6 | 2.77815 | 1.73676 | 1.45593 | 1.28679 | 1.16537 | 1.07058 | .99282 | .92689 | .86967 | .81911 |
| 8 | 2.65321 | 1.72379 | 1.44909 | 1.28215 | 1.16185 | 1.06775 | .99046 | .92486 | .86788 | .81752 |
| 10 | 2.55630 | 1.71121 | 1.44236 | 1.27755 | 1.15836 | 1.06494 | .98810 | .92284 | .86611 | .81594 |
| 12 | 2.47712 | 1.69897 | 1.43573 | 1.27300 | 1.15490 | 1.06216 | .98576 | .92082 | .86433 | .81436 |
| 14 | 2.41018 | 1.68707 | 1.42920 | 1.26850 | 1.15147 | 1.05937 | .98343 | .91881 | .86258 | .81279 |
| 16 | 2.35218 | 1.67549 | 1.42276 | 1.26405 | 1.14806 | 1.05662 | .98112 | .91682 | .86082 | .81123 |
| 18 | 2.30103 | 1.66421 | 1.41642 | 1.25964 | 1.14468 | 1.05388 | .97881 | .91483 | .85907 | .80967 |
| 20 | 2.25527 | 1.65321 | 1.41018 | 1.25527 | 1.14133 | 1.05115 | .97652 | .91285 | .85733 | .80812 |
| 22 | 2.21388 | 1.64249 | 1.40402 | 1.25095 | 1.13800 | 1.04845 | .97424 | .91088 | .85560 | .80657 |
| 24 | 2.17609 | 1.63202 | 1.39794 | 1.24667 | 1.13470 | 1.04576 | .97197 | .90892 | .85387 | .80503 |
| 26 | 2.14133 | 1.62181 | 1.39195 | 1.24244 | 1.13142 | 1.04309 | .96972 | .90697 | .85215 | .80349 |
| 28 | 2.10915 | 1.61182 | 1.38604 | 1.23824 | 1.12817 | 1.04043 | .96747 | .90503 | .85044 | .80196 |
| 30 | 2.07918 | 1.60206 | 1.38021 | 1.23408 | 1.12494 | 1.03779 | .96524 | .90309 | .84873 | .80043 |
| 32 | 2.05115 | 1.59252 | 1.37446 | 1.22997 | 1.12173 | 1.03517 | .96302 | .90117 | .84703 | .79891 |
| 34 | 2.02482 | 1.58318 | 1.36878 | 1.22590 | 1.11855 | 1.03256 | .96081 | .89925 | .84534 | .79740 |
| 36 | 2.00000 | 1.57403 | 1.36318 | 1.22185 | 1.11540 | 1.02996 | .95861 | .89734 | .84365 | .79588 |
| 38 | 1.97652 | 1.56508 | 1.35765 | 1.21785 | 1.11226 | 1.02739 | .95642 | .89544 | .84197 | .79438 |
| 40 | 1.95424 | 1.55630 | 1.35218 | 1.21388 | 1.10915 | 1.02482 | .95424 | .89355 | .84030 | .79288 |
| 42 | 1.93305 | 1.54770 | 1.34679 | 1.20995 | 1.10605 | 1.02228 | .95208 | .89166 | .83863 | .79138 |
| 44 | 1.91285 | 1.53927 | 1.34146 | 1.20606 | 1.10300 | 1.01975 | .94992 | .88980 | .83697 | .78990 |
| 46 | 1.89355 | 1.53100 | 1.33620 | 1.20220 | 1.09994 | 1.01723 | .94778 | .88792 | .83532 | .78841 |
| 48 | 1.87506 | 1.52288 | 1.33100 | 1.19837 | 1.09691 | 1.01472 | .94564 | .88606 | .83367 | .78693 |
| 50 | 1.85733 | 1.51491 | 1.32585 | 1.19458 | 1.09391 | 1.01224 | .94352 | .88421 | .83203 | .78545 |
| 52 | 1.84030 | 1.50709 | 1.32078 | 1.19082 | 1.09092 | 1.00976 | .94141 | .88236 | .83040 | .78398 |
| 54 | 1.82391 | 1.49940 | 1.31575 | 1.18710 | 1.08796 | 1.00730 | .93930 | .88053 | .82876 | .78252 |
| 56 | 1.80812 | 1.49185 | 1.31079 | 1.18340 | 1.08501 | 1.00485 | .93721 | .87870 | .82714 | .78106 |
| 58 | 1.79288 | 1.48442 | 1.30588 | 1.17973 | 1.08210 | 1.00242 | .93513 | .87688 | .82552 | .77960 |
| 60 | 1.77815 | 1.47712 | 1.30103 | 1.17610 | 1.07918 | 1.00000 | .93305 | .87506 | .82391 | .77815 |

| Sec. | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .77815 | .73676 | .69897 | .66421 | .63202 | .60206 | .57403 | .54770 | .52288 | .49940 |
| 2 | .77671 | .73545 | .69777 | .66310 | .63099 | .60110 | .57313 | .54685 | .52208 | .49864 |
| 4 | .77527 | .73414 | .69657 | .66199 | .62996 | .60014 | .57223 | .54600 | .52127 | .49788 |
| 6 | .77383 | .73283 | .69537 | .66088 | .62893 | .59918 | .57133 | .54516 | .52047 | .49712 |
| 8 | .77240 | .73153 | .69417 | .65978 | .62791 | .59822 | .57043 | .54431 | .51967 | .49636 |
| 10 | .77097 | .73023 | .69298 | .65868 | .62688 | .59726 | .56953 | .54347 | .51888 | .49561 |
| 12 | .76955 | .72893 | .69179 | .65758 | .62586 | .59631 | .56864 | .54262 | .51808 | .49485 |
| 14 | .76814 | .72764 | .69061 | .65648 | .62485 | .59536 | .56774 | .54178 | .51729 | .49410 |
| 16 | .76672 | .72636 | .68943 | .65539 | .62383 | .59441 | .56685 | .54094 | .51649 | .49335 |
| 18 | .76532 | .72507 | .68825 | .65430 | .62282 | .59346 | .56596 | .54011 | .51570 | .49260 |
| 20 | .76391 | .72379 | .68707 | .65321 | .62181 | .59252 | 56508 | .53927 | .51491 | .49185 |
| 22 | .76251 | .72252 | .68590 | .65213 | .62080 | .59157 | .56419 | .53844 | .51412 | .49110 |
| 24 | .76112 | .72125 | .68473 | .65105 | .61979 | .59063 | .56331 | .53760 | .51333 | .49035 |
| 26 | .75973 | .71998 | .68356 | .64997 | .61879 | .58969 | .56243 | .53677 | .51255 | .48961 |
| 28 | .75834 | .71872 | .68240 | .64889 | .61778 | .58876 | .56155 | .53594 | .51176 | .48886 |
| 30 | .75696 | .71745 | .68124 | .64782 | .61678 | .58782 | .56067 | .53511 | .51098 | .48812 |
| 32 | .75559 | .71620 | .68009 | .64675 | .61579 | .58689 | .55979 | .53429 | .51020 | .48738 |
| 34 | .75421 | .71494 | .67893 | .64568 | .61479 | .58596 | .55892 | .53346 | .50942 | .48663 |
| 36 | .75285 | .71369 | .67778 | .64461 | .61380 | .58503 | .55804 | .53264 | .50864 | .48590 |
| 38 | .75148 | .71245 | .67663 | .64355 | .61281 | .58410 | .55717 | .53182 | .50786 | .48516 |
| 40 | .75012 | .71121 | .67549 | .64249 | .61182 | .58318 | .55630 | .53100 | .50709 | .48443 |
| 42 | .74877 | .70997 | .67435 | .64143 | .61084 | .58225 | .55544 | .53018 | .50631 | .48369 |
| 44 | .74742 | .70873 | .67321 | .64038 | .60985 | .58133 | .55457 | .52936 | .50554 | .48295 |
| 46 | .74607 | .70750 | .67207 | .63932 | .60887 | .58041 | .55371 | .52855 | .50477 | .48222 |
| 48 | .74473 | .70627 | .67094 | .63827 | .60789 | .57950 | .55284 | .52773 | .50399 | .48149 |
| 50 | .74339 | .70505 | .66981 | .63723 | .60691 | .57858 | .55198 | .52692 | .50323 | .48076 |
| 52 | .74206 | .70382 | .66869 | .63618 | .60594 | .57767 | .55112 | .52611 | .50246 | .48003 |
| 54 | .74073 | .70261 | .66756 | .63514 | .60497 | .57676 | .55027 | .52530 | .50169 | .47930 |
| 56 | .73940 | .70139 | .66644 | .63410 | .60400 | .57585 | .54941 | .52449 | .50093 | .47857 |
| 58 | .73808 | .70018 | .66532 | .63306 | .60303 | .57494 | .54856 | .52368 | .50016 | .47785 |
| 60 | .73676 | .69897 | .66421 | .63202 | .60206 | .57403 | .54770 | .52288 | .49940 | .47712 |

(o)5 LOGISTIC LOGARITHMS.

| Sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .47712 | .45593 | .43573 | .41642 | .39794 | .38021 | .36318 | .34679 | .33099 | .31575 |
| 2 | .47640 | .45524 | .43507 | .41580 | .39734 | .37963 | .36262 | .34625 | .33048 | .31526 |
| 4 | .47568 | .45456 | .43442 | .41517 | .39674 | .37906 | .36207 | .34572 | .32996 | .31476 |
| 6 | .47496 | .45387 | .43376 | .41454 | .39614 | .37848 | .36151 | .34518 | .32945 | .31426 |
| 8 | .47424 | .45318 | .43311 | .41391 | .39554 | .37790 | .36096 | .34465 | .32893 | .31376 |
| 10 | .47352 | .45250 | .43245 | .41329 | .39494 | .37733 | .36040 | .34412 | .32842 | .31327 |
| 12 | .47280 | .45182 | .43180 | .41266 | .39434 | .37675 | .35985 | .34358 | .32790 | .31277 |
| 14 | .47209 | .45113 | .43115 | .41204 | .39374 | .37618 | .35930 | .34305 | .32739 | .31227 |
| 16 | .47137 | .45045 | .43050 | .41142 | .39314 | .37560 | .35875 | .34252 | .32688 | .31178 |
| 18 | .47066 | .44977 | .42985 | .41080 | .39255 | .37503 | .35820 | .34199 | .32637 | .31126 |
| 20 | .46994 | .44909 | .42920 | .41018 | .39195 | .37446 | .35765 | .34146 | .32585 | .31079 |
| 22 | .46923 | .44842 | .42855 | .40956 | .39136 | .37389 | .35710 | .34093 | .32534 | .31030 |
| 24 | .46852 | .44774 | .42790 | .40894 | .39076 | .37332 | .35655 | .34040 | .32483 | .30981 |
| 26 | .46781 | .44706 | .42726 | .40832 | .39017 | .37275 | .35600 | .33987 | .32432 | .30931 |
| 28 | .46711 | .44639 | .42661 | .40770 | .38958 | .37218 | .35545 | .33935 | .32382 | .30882 |
| 30 | .46640 | .44571 | .42597 | .40708 | .38899 | .37161 | .35491 | .33882 | .32331 | .30833 |
| 32 | .46569 | .44504 | .42533 | .40647 | .38840 | .37104 | .35436 | .33829 | .32280 | .30784 |
| 34 | .46499 | .44437 | .42469 | .40585 | .38781 | .37048 | .35382 | .33777 | .32229 | .30735 |
| 36 | .46429 | .44370 | .42404 | .40524 | .38722 | .36991 | .35327 | .33724 | .32179 | .30686 |
| 38 | .46358 | .44303 | .42340 | .40463 | .38663 | .36935 | .35273 | .33672 | .32128 | .30637 |
| 40 | .46288 | .44236 | .42276 | .40402 | .38604 | .36878 | .35218 | .33620 | .32078 | .30588 |
| 42 | .46218 | .44169 | .42213 | .40340 | .38546 | .36822 | .35164 | .33567 | .32027 | .30540 |
| 44 | .46148 | .44103 | .42149 | .40279 | .38487 | .36766 | .35110 | .33515 | .31977 | .30491 |
| 46 | .46079 | .44036 | .42085 | .40218 | .38428 | .36709 | .35056 | .33463 | .31926 | .30442 |
| 48 | .46009 | .43970 | .42022 | .40158 | .38370 | .36653 | .35002 | .33411 | .31876 | .30394 |
| 50 | .45939 | .43903 | .41958 | .40097 | .38312 | .36597 | .34948 | .33359 | .31826 | .30345 |
| 52 | .45870 | .43837 | .41895 | .40036 | .38253 | .36541 | .34894 | .33307 | .31776 | .30297 |
| 54 | .45801 | .43771 | .41832 | .39975 | .38195 | .36485 | .34840 | .33255 | .31725 | .30248 |
| 56 | .45731 | .43705 | .41769 | .39915 | .38137 | .36429 | .34786 | .33203 | .31675 | .30200 |
| 58 | .45662 | .43639 | .41705 | .39854 | .38079 | .36374 | .34733 | .33151 | .31625 | .30151 |
| 60 | .45593 | .43573 | .41642 | .39794 | .38021 | .36318 | .34679 | .33099 | .31575 | .30103 |

| Sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .30103 | .28679 | .27300 | .25964 | .24667 | .23408 | .22185 | .20995 | .19837 | .18709 |
| 2 | .30055 | .28632 | .27255 | .25920 | .24625 | .23367 | .22145 | .20956 | .19799 | .18672 |
| 4 | .30007 | .28586 | .27210 | .25876 | .24582 | .23326 | .22105 | .20917 | .19761 | .18635 |
| 6 | .29959 | .28539 | .27165 | .25832 | .24540 | .23285 | .22065 | .20878 | .19723 | .18598 |
| 8 | .29911 | .28493 | .27120 | .25789 | .24497 | .23243 | .22024 | .20839 | .19685 | .18561 |
| 10 | .29863 | .28446 | .27075 | .25745 | .24455 | .23202 | .21984 | .20800 | .19647 | .18524 |
| 12 | .29815 | .28400 | .27030 | .25701 | .24413 | .23161 | .21944 | .20761 | .19609 | .18487 |
| 14 | .29767 | .28353 | .26985 | .25658 | .24370 | .23120 | .21904 | .20722 | .19571 | .18450 |
| 16 | .29719 | .28307 | .26940 | .25614 | .24328 | .23079 | .21864 | .20683 | .19533 | .18413 |
| 18 | .29671 | .28261 | .26895 | .25571 | .24286 | .23038 | .21825 | .20644 | .19495 | .18376 |
| 20 | .29623 | .28215 | .26850 | .25527 | .24244 | .22997 | .21785 | .20606 | .19458 | .18339 |
| 22 | .29576 | .28168 | .26805 | .25484 | .24202 | .22956 | .21745 | .20567 | .19420 | .18302 |
| 24 | .29528 | .28122 | .26761 | .25441 | .24159 | .22915 | .21705 | .20528 | .19382 | .18266 |
| 26 | .29480 | .28076 | .26716 | .25397 | .24117 | .22874 | .21665 | .20489 | .19344 | .18229 |
| 28 | .29433 | .28030 | .26671 | .25354 | .24075 | .22833 | .21626 | .20451 | .19307 | .18192 |
| 30 | .29385 | .27984 | .26627 | .25311 | .24033 | .22792 | .21586 | .20412 | .19269 | .18156 |
| 32 | .29338 | .27938 | .26582 | .25268 | .23991 | .22752 | .21546 | .20374 | .19232 | .18119 |
| 34 | .29290 | .27892 | .26538 | .25224 | .23949 | .22711 | .21507 | .20335 | .19194 | .18082 |
| 36 | .29243 | .27847 | .26493 | .25181 | .23908 | .22670 | .21467 | .20297 | .19157 | .18046 |
| 38 | .29196 | .27801 | .26449 | .25138 | .23866 | .22630 | .21428 | .20258 | .19119 | .18009 |
| 40 | .29149 | .27755 | .26405 | .25095 | .23824 | .22589 | .21388 | .20220 | .19082 | .17973 |
| 42 | .29101 | .27709 | .26360 | .25052 | .23782 | .22548 | .21349 | .20181 | .19044 | .17936 |
| 44 | .29054 | .27664 | .26316 | .25009 | .23741 | .22508 | .21309 | .20143 | .19007 | .17900 |
| 46 | .29007 | .27618 | .26272 | .24966 | .23699 | .22467 | .21270 | .20104 | .18969 | .17863 |
| 48 | .28960 | .27573 | .26228 | .24924 | .23657 | .22427 | .21230 | .20066 | .18932 | .17827 |
| 50 | .28913 | .27527 | .26184 | .24881 | .23616 | .22387 | .21191 | .20028 | .18895 | .17791 |
| 52 | .28866 | .27492 | .26140 | .24838 | .23574 | .22346 | .21152 | .19990 | .18858 | .17754 |
| 54 | .28819 | .27436 | .26096 | .24795 | .23533 | .22306 | .21113 | .19951 | .18820 | .17718 |
| 56 | .28773 | .27391 | .26052 | .24753 | .23491 | .22265 | .21073 | .19913 | .18783 | .17682 |
| 58 | .28726 | .27346 | .26008 | .24710 | .23450 | .22225 | .21034 | .19875 | .18746 | .17645 |
| 60 | .28679 | .27300 | .25964 | .24667 | .23408 | .22185 | .20995 | .19837 | .18709 | .17609 |

LOGISTIC LOGARITHMS.

| Sec. | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .17609 | .16537 | .15490 | .14468 | .13470 | .12494 | .11539 | .10605 | .09691 | .08796 |
| 2 | .17573 | .16502 | .15456 | .14435 | .13437 | .12462 | .11508 | .10575 | .09661 | .08766 |
| 4 | .17537 | .16466 | .15421 | .14401 | .13404 | .12430 | .11477 | .10544 | .09631 | .08737 |
| 6 | .17501 | .16431 | .15387 | .14368 | .13371 | .12398 | .11445 | .10513 | .09601 | .08707 |
| 8 | .17465 | .16396 | .15353 | .14334 | .13339 | .12366 | .11414 | .10482 | .09571 | .08678 |
| 10 | .17429 | .16361 | .15318 | .14300 | .13306 | .12333 | .11382 | .10452 | .09541 | .08648 |
| 12 | .17393 | .16326 | .15284 | .14267 | .13273 | .12301 | .11351 | .10421 | .09511 | .08619 |
| 14 | .17357 | .16290 | .15250 | .14233 | .13240 | .12269 | .11320 | .10390 | .09481 | .08589 |
| 16 | .17321 | .16255 | .15215 | .14200 | .13208 | .12237 | .11288 | .10360 | .09451 | .08560 |
| 18 | .17286 | .16220 | .15181 | .14166 | .13175 | .12205 | .11257 | .10329 | .09421 | .08531 |
| 20 | .17249 | .16185 | .15147 | .14133 | .13142 | .12173 | .11226 | .10299 | .09391 | .08501 |
| 22 | .17213 | .16150 | .15113 | .14100 | .13110 | .12142 | .11195 | .10268 | .09361 | .08472 |
| 24 | .17177 | .16115 | .15079 | .14066 | .13077 | .12110 | .11163 | .10237 | .09331 | .08443 |
| 26 | .17141 | .16080 | .15045 | .14033 | .13044 | .12078 | .11132 | .10207 | .09301 | .08413 |
| 28 | .17106 | .16045 | .15010 | .14000 | .13012 | .12046 | .11101 | .10176 | .09271 | .08384 |
| 30 | .17070 | .16010 | .14976 | .13966 | .12979 | .12014 | .11070 | .10146 | .09241 | .08355 |
| 32 | .17034 | .15976 | .14942 | .13933 | .12947 | .11982 | .11039 | .10115 | .09211 | .08325 |
| 34 | .16998 | .15941 | .14908 | .13900 | .12914 | .11951 | .11008 | .10085 | .09181 | .08296 |
| 36 | .16963 | .15906 | .14874 | .13867 | .12882 | .11919 | .10977 | .10055 | .09152 | .08267 |
| 38 | .16927 | .15871 | .14840 | .13833 | .12849 | .11887 | .10946 | .10024 | .09122 | .08238 |
| 40 | .16891 | .15836 | .14806 | .13800 | .12817 | .11855 | .10915 | .09994 | .09092 | .08209 |
| 42 | .16856 | .15802 | .14773 | .13767 | .12784 | .11824 | .10884 | .09963 | .09062 | .08180 |
| 44 | .16820 | .15767 | .14739 | .13734 | .12752 | .11792 | .10853 | .09933 | .09033 | .08150 |
| 46 | .16785 | .15732 | .14705 | .13701 | .12720 | .11760 | .10822 | .09903 | .09003 | .08121 |
| 48 | .16749 | .15698 | .14671 | .13668 | .12687 | .11729 | .10791 | .09872 | .08973 | .08092 |
| 50 | .16714 | .15663 | .14637 | .13635 | .12655 | .11697 | .10760 | .09842 | .08944 | .08063 |
| 52 | .16678 | .15628 | .14603 | .13602 | .12623 | .11666 | .10729 | .09812 | .08914 | .08034 |
| 54 | .16643 | .15594 | .14570 | .13569 | .12591 | .11634 | .10698 | .09782 | .08884 | .08005 |
| 56 | .16608 | .15559 | .14536 | .13536 | .12558 | .11602 | .10667 | .09751 | .08855 | .07976 |
| 58 | .16572 | .15525 | .14502 | .13503 | .12526 | .11571 | .10636 | .09721 | .08825 | .07947 |
| 60 | .16537 | .15490 | .14468 | .13470 | .12494 | .11539 | .10605 | .09691 | .08796 | .07918 |

| Sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .07918 | .07058 | .06215 | .05388 | .04576 | .03779 | .02996 | .02228 | .01472 | .00730 |
| 2 | .07889 | .07030 | .06187 | .05360 | .04549 | .03753 | .02971 | .02202 | .01447 | .00706 |
| 4 | .07860 | .07002 | .06159 | .05333 | .04522 | .03726 | .02945 | .02177 | .01423 | .00681 |
| 6 | .07831 | .06973 | .06131 | .05306 | .04496 | .03700 | .02919 | .02152 | .01398 | .00657 |
| 8 | .07803 | .06945 | .06104 | .05279 | .04469 | .03674 | .02893 | .02126 | .01373 | .00632 |
| 10 | .07774 | .06917 | .06076 | .05251 | .04442 | .03648 | .02867 | .02101 | .01348 | .00608 |
| 12 | .07745 | .06888 | .06048 | .05224 | .04415 | .03621 | .02842 | .02076 | .01323 | .00583 |
| 14 | .07716 | .06860 | .06020 | .05197 | .04389 | .03595 | .02816 | .02050 | .01298 | .00559 |
| 16 | .07687 | .06832 | .05993 | .05170 | .04362 | .03569 | .02790 | .02025 | .01273 | .00534 |
| 18 | .07658 | .06804 | .05965 | .05143 | .04335 | .03543 | .02764 | .02000 | .01248 | .00510 |
| 20 | .07630 | .06775 | .05937 | .05115 | .04309 | .03517 | .02739 | .01975 | .01224 | .00485 |
| 22 | .07601 | .06747 | .05910 | .05088 | .04282 | .03490 | .02713 | .01949 | .01199 | .00461 |
| 24 | .07572 | .06719 | .05882 | .05061 | .04255 | .03464 | .02687 | .01924 | .01174 | .00437 |
| 26 | .07543 | .06691 | .05855 | .05034 | .04229 | .03438 | .02662 | .01899 | .01149 | .00412 |
| 28 | .07515 | .06663 | .05827 | .05007 | .04202 | .03412 | .02636 | .01874 | .01124 | .00388 |
| 30 | .07486 | .06635 | .05799 | .04980 | .04176 | .03386 | .02610 | .01848 | .01100 | .00364 |
| 32 | .07457 | .06606 | .05772 | .04953 | .04150 | .03360 | .02585 | .01823 | .01075 | .00339 |
| 34 | .07429 | .06578 | .05744 | .04926 | .04123 | .03334 | .02559 | .01798 | .01050 | .00315 |
| 36 | .07400 | .06550 | .05717 | .04899 | .04096 | .03308 | .02534 | .01773 | .01025 | .00291 |
| 38 | .07372 | .06522 | .05689 | .04872 | .04069 | .03282 | .02508 | .01748 | .01001 | .00266 |
| 40 | .07343 | .06494 | .05662 | .04845 | .04043 | .03256 | .02482 | .01723 | .00976 | .00242 |
| 42 | .07314 | .06466 | .05634 | .04818 | .04017 | .03230 | .02457 | .01698 | .00951 | .00218 |
| 44 | .07286 | .06438 | .05607 | .04791 | .03990 | .03204 | .02431 | .01673 | .00927 | .00194 |
| 46 | .07257 | .06410 | .05579 | .04764 | .03964 | .03178 | .02406 | .01648 | .00902 | .00169 |
| 48 | .07229 | .06382 | .05552 | .04737 | .03937 | .03152 | .02380 | .01622 | .00878 | .00145 |
| 50 | .07200 | .06354 | .05524 | .04710 | .03911 | .03126 | .02355 | .01597 | .00853 | .00121 |
| 52 | .07172 | .06326 | .05497 | .04683 | .03884 | .03100 | .02329 | .01572 | .00828 | .00097 |
| 54 | .07143 | .06300 | .05470 | .04656 | .03858 | .03074 | .02304 | .01547 | .00804 | .00073 |
| 56 | .07115 | .06271 | .05442 | .04630 | .03832 | .03048 | .02279 | .01522 | .00779 | .00048 |
| 58 | .07087 | .06243 | .05415 | .04603 | .03805 | .03022 | .02253 | .01497 | .00755 | .00024 |
| 60 | .07058 | .06215 | .05388 | .04576 | .03779 | .02996 | .02228 | .01472 | .00730 | .00000 |

## Greenwich Date Logarithm for the Moon. (p.)

| Min. | 0h | 1h | 2h | 3h | 4h | 5h | 6h | 7h | 8h | 9h | 10h | 11h | Min. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 1.07918 | .77815 | .60206 | .47712 | .38021 | .30103 | .23408 | .17609 | .12494 | .07918 | .03779 | 0 |
| 1 | 2.85733 | 1.07200 | .77455 | .59966 | .47532 | .37877 | .29983 | .23305 | .17519 | .12414 | .07846 | .03713 | 1 |
| 2 | 2.55630 | 1.06494 | .77097 | .59726 | .47352 | .37733 | .29863 | .23202 | .17429 | .12333 | .07774 | .03648 | 2 |
| 3 | 2.38021 | 1.05799 | .76743 | .59488 | .47173 | .37589 | .29743 | .23099 | .17339 | .12253 | .07702 | .03582 | 3 |
| 4 | 2.25527 | 1.05115 | .76391 | .59252 | .46994 | .37446 | .29623 | .22997 | .17249 | .12173 | .07630 | .03517 | 4 |
| 5 | 2.15836 | 1.04442 | .76042 | .59016 | .46817 | .37303 | .29504 | .22894 | .17159 | .12094 | .07558 | .03451 | 5 |
| 6 | 2.07918 | 1.03779 | .75696 | .58782 | .46640 | .37161 | .29385 | .22792 | .17070 | .12014 | .07486 | .03386 | 6 |
| 7 | 2.01224 | 1.03126 | .75353 | .58549 | .46464 | .37020 | .29267 | .22691 | .16980 | .11935 | .07415 | .03321 | 7 |
| 8 | 1.95424 | 1.02482 | .75012 | .58318 | .46288 | .36878 | .29149 | .22589 | .16891 | .11855 | .07343 | .03256 | 8 |
| 9 | 1.90309 | 1.01848 | .74674 | .58087 | .46113 | .36738 | .29031 | .22488 | .16802 | .11776 | .07272 | .03191 | 9 |
| 10 | 1.85733 | 1.01224 | .74339 | .57858 | .45939 | .36597 | .28913 | .22387 | .16714 | .11697 | .07200 | .03126 | 10 |
| 11 | 1.81594 | 1.00608 | .74006 | .57630 | .45766 | .36457 | .28796 | .22286 | .16625 | .11618 | .07129 | .03061 | 11 |
| 12 | 1.77815 | 1.00000 | .73676 | .57403 | .45593 | .36318 | .28679 | .22185 | .16537 | .11539 | .07058 | .02996 | 12 |
| 13 | 1.74339 | .99401 | 73348 | .57178 | .45421 | .36179 | .28562 | .22085 | .16449 | .11461 | .06987 | .02932 | 13 |
| 14 | 1.71121 | .98810 | .73023 | .56953 | .45250 | .36040 | .28446 | .21984 | .16361 | .11382 | .06917 | .02867 | 14 |
| 15 | 1.68124 | .98227 | .72700 | .56730 | .45079 | .35902 | .28330 | .21884 | .16273 | .11304 | .06846 | .02803 | 15 |
| 16 | 1.65321 | .97652 | .72379 | .56508 | .44909 | .35765 | .28215 | .21785 | .16185 | .11226 | .06775 | .02739 | 16 |
| 17 | 1.62688 | .97084 | .72061 | .56287 | .44740 | .35627 | .28099 | .21685 | .16098 | .11148 | .06705 | .02675 | 17 |
| 18 | 1.60206 | .96524 | .71745 | .56067 | .44571 | .35491 | .27984 | .21586 | .16010 | .11070 | .06635 | .02610 | 18 |
| 19 | 1.57858 | .95971 | .71432 | .55848 | .44403 | .35354 | .27869 | .21487 | .15923 | .10992 | .06564 | .02546 | 19 |
| 20 | 1.55630 | .95424 | .71121 | .55630 | .44236 | .35218 | .27755 | .21388 | .15836 | .10915 | .06494 | .02482 | 20 |
| 21 | 1.53511 | .94885 | .70811 | .55414 | .44069 | .35083 | .27641 | .21290 | .15750 | .10837 | .06424 | .02419 | 21 |
| 22 | 1.51491 | .94352 | .70505 | .55198 | .43903 | .34948 | .27527 | .21191 | .15663 | .10760 | .06354 | .02355 | 22 |
| 23 | 1.49561 | .93826 | .70200 | .54984 | .43738 | .34813 | .27413 | .21093 | .15577 | .10683 | .06285 | .02291 | 23 |
| 24 | 1.47712 | .93305 | .69897 | .54770 | .43573 | .34679 | .27300 | .20995 | .15490 | .10606 | .06215 | .02228 | 24 |
| 25 | 1.45939 | .92791 | .69597 | .54558 | .43409 | .34545 | .27187 | .20897 | .15404 | .10529 | .06145 | .02164 | 25 |
| 26 | 1.44236 | .92284 | .69298 | .54347 | .43245 | .34412 | .27075 | .20800 | .15318 | .10452 | .06076 | .02101 | 26 |
| 27 | 1.42597 | .91781 | .69002 | .54136 | .43082 | .34279 | .26962 | .20703 | .15233 | .10375 | .06007 | .02038 | 27 |
| 28 | 1.41018 | .91285 | .68707 | .53927 | .42920 | .34146 | .26850 | .20606 | .15147 | .10299 | .05937 | .01975 | 28 |
| 29 | 1.39494 | .90794 | .68415 | .53719 | .42758 | .34014 | .26738 | .20509 | .15062 | .10222 | .05868 | .01911 | 29 |
| 30 | 1.38021 | .90309 | .68124 | .53511 | .42597 | .33882 | .26627 | .20412 | .14976 | .10146 | .05799 | .01848 | 30 |
| 31 | 1.36597 | .89829 | .67836 | .53305 | .42436 | .33751 | .26516 | .20316 | .14891 | .10070 | .05730 | .01786 | 31 |
| 32 | 1.35218 | .89355 | .67549 | .53100 | .42276 | .33620 | .26405 | .20220 | .14806 | .09994 | .05662 | .01723 | 32 |
| 33 | 1.33882 | .88885 | .67264 | .52895 | .42117 | .33489 | .26294 | .20124 | .14722 | .09918 | .05593 | .01660 | 33 |
| 34 | 1.32585 | .88421 | .66981 | .52692 | .41958 | .33359 | .26184 | .20028 | .14637 | .09842 | .05524 | .01597 | 34 |
| 35 | 1.31327 | .87961 | .66700 | .52490 | .41800 | .33229 | .26074 | .19932 | .14553 | .09767 | .05456 | .01535 | 35 |
| 36 | 1.30103 | .87506 | .66421 | .52288 | .41642 | .33099 | .25964 | .19837 | .14468 | .09691 | .05388 | .01472 | 36 |
| 37 | 1.28913 | .87056 | .66143 | .52087 | .41485 | .32970 | .25854 | .19742 | .14384 | .09616 | .05319 | .01410 | 37 |
| 38 | 1.27755 | .86611 | .65868 | .51888 | .41329 | .32842 | .25745 | .19647 | .14300 | .09541 | .05251 | .01348 | 38 |
| 39 | 1.26627 | .86170 | .65594 | .51689 | .41173 | .32713 | .25636 | .19552 | .14217 | .09466 | .05183 | .01286 | 39 |
| 40 | 1.25527 | .85733 | .65321 | .51491 | .41018 | .32585 | .25527 | .19458 | .14133 | .09391 | .05115 | .01224 | 40 |
| 41 | 1.24455 | .85301 | .65051 | .51294 | .40863 | .32458 | .25419 | .19363 | .14050 | .09316 | .05048 | .01162 | 41 |
| 42 | 1.23408 | .84873 | .64782 | .51098 | .40708 | .32331 | .25311 | .19269 | .13966 | .09241 | .04980 | .01100 | 42 |
| 43 | 1.22387 | .84451 | .64515 | .50903 | .40555 | .32204 | .25203 | .19175 | .13883 | .09167 | .04912 | .01038 | 43 |
| 44 | 1.21388 | .84030 | .64249 | .50709 | .40402 | .32078 | .25095 | .19082 | .13800 | .09092 | .04845 | .00976 | 44 |
| 45 | 1.20412 | .83614 | .63985 | .50515 | .40249 | .31951 | .24988 | .18988 | .13717 | .09018 | .04777 | .00914 | 45 |
| 46 | 1.19458 | .83203 | .63723 | .50323 | .40097 | .31826 | .24881 | .18895 | .13635 | .08944 | .04710 | .00853 | 46 |
| 47 | 1.18524 | .82795 | .63462 | .50131 | .39945 | .31700 | .24774 | .18802 | .13552 | .08870 | .04643 | .00791 | 47 |
| 48 | 1.17609 | .82391 | .63202 | .49940 | .39794 | .31575 | .24667 | .18709 | .13470 | .08796 | .04576 | .00730 | 48 |
| 49 | 1.16714 | .81991 | .62945 | .49750 | .39644 | .31451 | .24561 | .18616 | .13388 | .08722 | .04509 | .00669 | 49 |
| 50 | 1.15836 | .81594 | .62688 | .49561 | .39494 | .31327 | .24455 | .18524 | .13306 | .08648 | .04442 | .00608 | 50 |
| 51 | 1.14976 | .81201 | .62434 | .49372 | .39344 | .31203 | .24349 | .18431 | .13224 | .08575 | .04375 | .00546 | 51 |
| 52 | 1.14133 | .80812 | .62181 | .49185 | .39195 | .31079 | .24244 | .18339 | .13142 | .08501 | .04309 | .00485 | 52 |
| 53 | 1.13306 | .80426 | .61929 | .48998 | .39047 | .30956 | .24138 | .18247 | .13061 | .08428 | .04242 | .00424 | 53 |
| 54 | 1.12494 | .80043 | .61678 | .48812 | .38899 | .30833 | .24033 | .18156 | .12979 | .08355 | .04176 | .00364 | 54 |
| 55 | 1.11697 | .79664 | .61430 | .48627 | .38751 | .30711 | .23929 | .18064 | .12898 | .08282 | .04109 | .00303 | 55 |
| 56 | 1.10915 | .79288 | .61182 | .48442 | .38604 | .30588 | .23824 | .17973 | .12817 | .08209 | .04043 | .00242 | 56 |
| 57 | 1.10146 | .78915 | .60936 | .48259 | .38458 | .30467 | .23720 | .17882 | .12736 | .08136 | .03977 | .00181 | 57 |
| 58 | 1.09391 | .78545 | .60691 | .48076 | .38312 | .30345 | .23616 | .17791 | .12655 | .08063 | .03911 | .00121 | 58 |
| 59 | 1.08648 | .78179 | .60448 | .47894 | .38166 | .30224 | .23512 | .17700 | .12574 | .07991 | .03845 | .00060 | 59 |

## Greenwich Date Logarithm for the Sun. (q.)

| Min. | 0h | 1h | 2h | 3h | 4h | 5h | 6h | 7h | 8h | 9h | 10h | 11h | Min. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 1.38021 | 1.07918 | .90309 | .77815 | .68124 | .60206 | .53511 | .47712 | .42597 | .38021 | .33882 | 0 |
| 1 | 3.15836 | 1.37303 | 1.07558 | .90069 | .77635 | .67980 | .60086 | .53408 | .47622 | .42517 | .37949 | .33816 | 1 |
| 2 | 2.85733 | 1.36597 | 1.07200 | .89829 | .77455 | .67836 | .59966 | .53305 | .47532 | .42436 | .37877 | .33751 | 2 |
| 3 | 2.68124 | 1.35902 | 1.06846 | .89591 | .77276 | .67692 | .59846 | .53202 | .47442 | .42356 | .37805 | .33685 | 3 |
| 4 | 2.55630 | 1.35218 | 1.06494 | .89355 | .77097 | .67549 | .59726 | .53090 | .47352 | .42276 | .37733 | .33620 | 4 |
| 5 | 2.45939 | 1.34545 | 1.06145 | .89119 | .76920 | .67406 | .59607 | .52997 | .47262 | .42197 | .37661 | .33554 | 5 |
| 6 | 2.38021 | 1.33882 | 1.05799 | .88885 | .76743 | .67264 | .59488 | .52895 | .47173 | .42117 | .37589 | .33489 | 6 |
| 7 | 2.31327 | 1.33229 | 1.05456 | .88652 | .76567 | .67123 | .59370 | .52794 | .47083 | .42038 | .37518 | .33424 | 7 |
| 8 | 2.25527 | 1.32585 | 1.05115 | .88421 | .76391 | .66981 | .59252 | .52692 | .46994 | .41958 | .37446 | .33359 | 8 |
| 9 | 2.20412 | 1.31951 | 1.04777 | .88190 | .76216 | .66841 | .59134 | .52591 | .46905 | .41879 | .37375 | .33294 | 9 |
| 10 | 2.15836 | 1.31327 | 1.04442 | .87961 | .76042 | .66700 | .59016 | .52490 | .46817 | .41800 | .37303 | .33229 | 10 |
| 11 | 2.11697 | 1.30711 | 1.04109 | .87733 | .75869 | .66560 | .58899 | .52389 | .46728 | .41721 | .37232 | .33164 | 11 |
| 12 | 2.07918 | 1.30103 | 1.03779 | .87506 | .75696 | .66421 | .58782 | .52288 | .46640 | .41642 | .37161 | .33099 | 12 |
| 13 | 2.04442 | 1.29504 | 1.03451 | .87281 | .75524 | .66282 | .58665 | .52188 | .46552 | .41564 | .37090 | .33035 | 13 |
| 14 | 2.01224 | 1.28913 | 1.03126 | .87056 | .75353 | .66143 | .58549 | .52087 | .46464 | .41485 | .37020 | .32970 | 14 |
| 15 | 1.98227 | 1.28330 | 1.02803 | .86833 | .75182 | .66005 | .58433 | .51987 | .46376 | .41407 | .36949 | .32906 | 15 |
| 16 | 1.95424 | 1.27755 | 1.02482 | .86611 | .75012 | .65868 | .58318 | .51888 | .46288 | .41329 | .36878 | .32842 | 16 |
| 17 | 1.92791 | 1.27187 | 1.02164 | .86390 | .74843 | .65730 | .58202 | .51788 | .46201 | .41251 | .36808 | .32778 | 17 |
| 18 | 1.90309 | 1.26627 | 1.01848 | .86170 | .74674 | .65594 | .58087 | .51689 | .46113 | .41173 | .36738 | .32713 | 18 |
| 19 | 1.87961 | 1.26074 | 1.01535 | .85951 | .74506 | .65457 | .57972 | .51590 | .46026 | .41095 | .36667 | .32649 | 19 |
| 20 | 1.85733 | 1.25527 | 1.01224 | .85733 | .74339 | .65321 | .57858 | .51491 | .45939 | .41018 | .36597 | .32585 | 20 |
| 21 | 1.83614 | 1.24988 | 1.00914 | .85517 | .74172 | .65186 | .57744 | .51393 | .45853 | .40940 | .36527 | .32522 | 21 |
| 22 | 1.81594 | 1.24455 | 1.00608 | .85301 | .74006 | .65051 | .57630 | .51294 | .45766 | .40863 | .36457 | .32458 | 22 |
| 23 | 1.79664 | 1.23929 | 1.00303 | .85087 | .73841 | .64916 | .57516 | .51196 | .45680 | .40786 | .36388 | .32394 | 23 |
| 24 | 1.77815 | 1.23408 | 1.00000 | .84873 | .73676 | .64782 | .57403 | 51098 | .45593 | .40709 | .36318 | .32331 | 24 |
| 25 | 1.76042 | 1.22894 | .99700 | .84661 | .73512 | .64648 | 57290 | .51000 | .45507 | .40632 | .36248 | .32267 | 25 |
| 26 | 1.74339 | 1.22387 | .99401 | .84450 | .73348 | .64515 | .57178 | .50903 | .45421 | .40555 | .36179 | .32204 | 26 |
| 27 | 1.72700 | 1.21884 | .99105 | .84239 | .73185 | .64382 | .57065 | .50806 | .45336 | .40478 | .36110 | .32141 | 27 |
| 28 | 1.71121 | 1.21388 | .98810 | .84030 | .73023 | .64249 | .56953 | .50709 | .45250 | .40402 | .36040 | .32078 | 28 |
| 29 | 1.69597 | 1.20897 | .98518 | .83822 | .72861 | .64117 | .56841 | .50612 | .45165 | .40325 | .35971 | .32014 | 29 |
| 30 | 1.68124 | 1.20412 | .98227 | .83614 | .72700 | .63985 | .56730 | .50515 | .45079 | .40249 | .35902 | .31951 | 30 |
| 31 | 1.66700 | 1.19932 | .97939 | .83408 | .72539 | .63854 | .56619 | .50419 | .44994 | .40173 | .35833 | .31889 | 31 |
| 32 | 1.65321 | 1.19458 | .97652 | .83203 | .72379 | .63723 | .56508 | .50323 | .44909 | .40097 | .35765 | .31826 | 32 |
| 33 | 1.63985 | 1.18988 | .97367 | .82998 | .72220 | .63592 | .56397 | .50227 | .44825 | .40021 | .35696 | .31763 | 33 |
| 34 | 1.62688 | 1.18524 | .97084 | .82795 | .72061 | .63462 | .56287 | .50131 | .44740 | .39945 | .35627 | .31700 | 34 |
| 35 | 1.61430 | 1.18064 | .96803 | .82593 | .71903 | .63332 | .56177 | .50035 | .44656 | .39870 | .35559 | .31638 | 35 |
| 36 | 1.60206 | 1.17609 | .96524 | .82391 | .71745 | .63202 | .56067 | .49940 | .44571 | .39794 | .35491 | .31575 | 36 |
| 37 | 1.59016 | 1.17159 | .96246 | .82190 | .71588 | .63073 | .55957 | .49845 | .44487 | .39719 | .35422 | .31513 | 37 |
| 38 | 1.57858 | 1.16714 | .95971 | .81991 | .71432 | .62945 | .55848 | .49750 | .44403 | .39644 | .35354 | .31451 | 38 |
| 39 | 1.56730 | 1.16273 | .95697 | .81792 | .71276 | .62816 | .55739 | .49655 | .44320 | .39569 | .35286 | .31389 | 39 |
| 40 | 1.55630 | 1.15836 | .95424 | .81594 | .71121 | .62688 | .55630 | .49561 | .44236 | .39494 | .35218 | .31327 | 40 |
| 41 | 1.54558 | 1.15404 | .95154 | .81397 | .70966 | .62561 | .55522 | .49466 | .44153 | .39419 | .35151 | .31265 | 41 |
| 42 | 1.53511 | 1.14976 | .94885 | .81201 | .70811 | .62434 | .55414 | .49372 | .44069 | .39344 | .35083 | .31203 | 42 |
| 43 | 1.52490 | 1.14554 | .94618 | .81006 | .70658 | .62307 | .55306 | .49278 | 43986 | .39270 | .35015 | .31141 | 43 |
| 44 | 1.51491 | 1.14133 | .94352 | .80812 | .70505 | .62181 | .55198 | .49185 | .43903 | .39195 | .34948 | .31079 | 44 |
| 45 | 1.50515 | 1.13717 | .94088 | .80618 | .70352 | .62054 | .55091 | .49091 | .43820 | 39121 | .34880 | .31017 | 45 |
| 46 | 1.49561 | 1.13306 | .93826 | .80426 | .70200 | .61929 | .54984 | .48998 | .43738 | .39047 | .34813 | .30956 | 46 |
| 47 | 1.48627 | 1.12898 | .93565 | .80234 | .70048 | .61803 | .54877 | .48905 | .43655 | .38973 | .34746 | .30894 | 47 |
| 48 | 1.47712 | 1.12494 | .93305 | .80043 | .69897 | .61678 | .54770 | .48812 | .43573 | .38899 | .34679 | .30833 | 48 |
| 49 | 1.46817 | 1.12094 | .93048 | .79853 | .69747 | .61554 | .54664 | .48719 | .43491 | .38825 | .34612 | .30772 | 49 |
| 50 | 1.45939 | 1.11697 | .92791 | .79664 | .69597 | .61430 | .54558 | .48627 | .43409 | .38751 | .34545 | .30711 | 50 |
| 51 | 1.45079 | 1.11304 | .92537 | .79475 | .69447 | .61306 | .54452 | .48534 | .43327 | .38678 | .34478 | .30649 | 51 |
| 52 | 1.44236 | 1.10915 | .92284 | .79288 | .69298 | .61182 | .54347 | .48442 | .43245 | .38604 | .34412 | .30588 | 52 |
| 53 | 1.43409 | 1.10529 | .92032 | .79101 | .69150 | .61059 | .54241 | .48350 | .43164 | .38531 | .34345 | .30527 | 53 |
| 54 | 1.42597 | 1.10146 | .91781 | .78915 | .69002 | .60936 | .54136 | .48259 | .43082 | .38458 | .34279 | .30467 | 54 |
| 55 | 1.41800 | 1.09767 | .91533 | .78730 | .68854 | .60814 | .54032 | .48167 | .43001 | .38385 | .34212 | .30406 | 55 |
| 56 | 1.41018 | 1.09391 | .91285 | .78545 | .68707 | .60691 | .53927 | .48076 | .42920 | .38312 | .34146 | .30345 | 56 |
| 57 | 1.40249 | 1.09018 | .91039 | .78362 | .68561 | .60570 | .53823 | .47985 | .42839 | .38239 | .34080 | .30283 | 57 |
| 58 | 1.39494 | 1.08648 | .90794 | .78179 | .68415 | .60448 | .53719 | .47894 | 42758 | .38166 | .34014 | .30224 | 58 |
| 59 | 1.38751 | 1.08282 | .90551 | .77997 | .68269 | .60327 | .53615 | .47803 | .42677 | 38094 | .33948 | .30165 | 59 |

## Greenwich Date Logarithm for the Sun. (q.)

| Min | 12h | 13h | 14h | 15h | 16h | 17h | 18h | 19h | 20h | 21h | 22h | 23h | Min. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .30103 | .26627 | .23408 | .20412 | .17609 | .14976 | .12491 | .10146 | .07918 | .05799 | .03779 | .01848 | 0 |
| 1 | .30043 | .26571 | .23357 | .20364 | .17564 | .14934 | .12454 | .10108 | .07882 | .05765 | .03746 | .01817 | 1 |
| 2 | .29983 | .26516 | .23305 | .20316 | .17519 | .14891 | .12414 | .10070 | .07846 | .05730 | .03713 | .01786 | 2 |
| 3 | .29923 | .26460 | .23254 | .20268 | .17474 | .14849 | .12374 | .10032 | .07810 | .05696 | .03680 | .01754 | 3 |
| 4 | .29863 | .26405 | .23202 | .20220 | .17429 | .14806 | .12333 | .09994 | .07774 | .05662 | .03646 | .01723 | 4 |
| 5 | .29803 | .26349 | .23151 | .20172 | .17384 | .14764 | .12293 | .09956 | .07738 | .05627 | .03615 | .01691 | 5 |
| 6 | .29743 | .26294 | .23099 | .20124 | .17339 | .14722 | .12253 | .09918 | .07702 | .05593 | .03582 | .01660 | 6 |
| 7 | .29683 | .26239 | .23048 | .20076 | .17294 | .14679 | .12213 | .09880 | .07666 | .05559 | .03549 | .01629 | 7 |
| 8 | .29623 | .26184 | .22997 | .20028 | .17249 | .14637 | .12173 | .09842 | .07630 | .05524 | .03517 | .01597 | 8 |
| 9 | .29564 | .26129 | .22946 | .19980 | .17204 | .14595 | .12134 | .09804 | .07594 | .05490 | .03484 | .01566 | 9 |
| 10 | .29504 | .26074 | .22894 | .19932 | .17159 | .14553 | .12094 | .09767 | .07558 | .05456 | .03451 | .01535 | 10 |
| 11 | .29445 | .26019 | .22843 | .19885 | .17114 | .14511 | .12054 | .09729 | .07522 | .05422 | .03419 | .01504 | 11 |
| 12 | .29385 | .25964 | .22792 | .19837 | .17070 | .14468 | .12014 | .09691 | .07486 | .05388 | .03386 | .01472 | 12 |
| 13 | .29326 | .25909 | .22741 | .19789 | .17025 | .14426 | .11974 | .09653 | .07450 | .05354 | .03353 | .01441 | 13 |
| 14 | .29267 | .25854 | .22691 | .19742 | .16980 | .14384 | .11935 | .09616 | .07415 | .05319 | .03321 | .01410 | 14 |
| 15 | .29208 | .25800 | .22640 | .19694 | .16936 | .14342 | .11895 | .09578 | .07379 | .05285 | .03288 | .01379 | 15 |
| 16 | .29149 | .25745 | .22589 | .19647 | .16891 | .14300 | .11855 | .09541 | .07343 | .05251 | .03256 | .01348 | 16 |
| 17 | .29090 | .25691 | .22538 | .19599 | .16847 | .14258 | .11816 | .09503 | .07307 | .05217 | .03223 | .01317 | 17 |
| 18 | .29031 | .25636 | .22488 | .19552 | .16802 | .14217 | .11776 | .09466 | .07272 | .05183 | .03191 | .01286 | 18 |
| 19 | .28972 | .25582 | .22437 | .19505 | .16758 | .14175 | .11737 | .09428 | .07236 | .05149 | .03158 | .01255 | 19 |
| 20 | .28913 | .25527 | .22387 | .19458 | .16714 | .14133 | .11697 | .09391 | .07200 | .05115 | .03126 | .01224 | 20 |
| 21 | .28855 | .25473 | .22336 | .19410 | .16669 | .14091 | .11658 | .09353 | .07165 | .05081 | .03093 | .01193 | 21 |
| 22 | .28796 | .25419 | .22286 | .19363 | .16625 | .14050 | .11618 | .09316 | .07129 | .05048 | .03061 | .01162 | 22 |
| 23 | .28737 | .25365 | .22235 | .19316 | .16581 | .14008 | .11579 | .09278 | .07094 | .05014 | .03029 | .01131 | 23 |
| 24 | .28679 | .25311 | .22185 | .19269 | .16537 | .13966 | .11539 | .09241 | .07058 | .04980 | .02996 | .01100 | 24 |
| 25 | .28621 | .25257 | .22135 | .19222 | .16493 | .13925 | .11500 | .09204 | .07023 | .04946 | .02964 | .01069 | 25 |
| 26 | .28562 | .25203 | .22085 | .19175 | .16449 | .13883 | .11461 | .09167 | .06987 | .04912 | .02932 | .01038 | 26 |
| 27 | .28504 | .25149 | .22034 | .19128 | .16405 | .13842 | .11422 | .09129 | .06952 | .04879 | .02900 | .01007 | 27 |
| 28 | .28446 | .25095 | .21984 | .19082 | .16361 | .13800 | .11382 | .09092 | .06917 | .04845 | .02867 | .00976 | 28 |
| 29 | .28388 | .25042 | .21934 | .19035 | .16317 | .13759 | .11343 | .09055 | .06881 | .04811 | .02835 | .00945 | 29 |
| 30 | .28330 | .24988 | .21884 | .18988 | .16273 | .13717 | .11304 | .09018 | .06846 | .04777 | .02803 | .00914 | 30 |
| 31 | .28272 | .24934 | .21835 | .18941 | .16229 | .13676 | .11265 | .08981 | .06811 | .04744 | .02771 | .00884 | 31 |
| 32 | .28215 | .24881 | .21785 | .18895 | .16185 | .13635 | .11226 | .08944 | .06775 | .04710 | .02739 | .00853 | 32 |
| 33 | .28157 | .24827 | .21735 | .18848 | .16141 | .13594 | .11187 | .08907 | .06740 | .04677 | .02707 | .00822 | 33 |
| 34 | .28099 | .24774 | .21685 | .18802 | .16098 | .13552 | .11148 | .08870 | .06705 | .04643 | .02675 | .00791 | 34 |
| 35 | .28042 | .24721 | .21636 | .18755 | .16054 | .13511 | .11109 | .08833 | .06670 | .04609 | .02642 | .00761 | 35 |
| 36 | .27984 | .24667 | .21586 | .18709 | .16010 | .13470 | .11070 | .08796 | .06635 | .04576 | .02610 | .00730 | 36 |
| 37 | .27927 | .24614 | .21536 | .18662 | .15967 | .13429 | .11031 | .08759 | .06599 | .04542 | .02578 | .00699 | 37 |
| 38 | .27869 | .24561 | .21487 | .18616 | .15923 | .13388 | .10992 | .08722 | .06564 | .04509 | .02546 | .00669 | 38 |
| 39 | .27812 | .24508 | .21437 | .18570 | .15880 | .13347 | .10953 | .08685 | .06529 | .04475 | .02514 | .00638 | 39 |
| 40 | .27755 | .24455 | .21388 | .18524 | .15836 | .13306 | .10915 | .08648 | .06494 | .04442 | .02482 | .00608 | 40 |
| 41 | .27698 | .24402 | .21339 | .18477 | .15793 | .13265 | .10876 | .08611 | .06459 | .04409 | .02451 | .00577 | 41 |
| 42 | .27641 | .24349 | .21290 | .18431 | .15750 | .13224 | .10837 | .08575 | .06424 | .04375 | .02419 | .00546 | 42 |
| 43 | .27584 | .24296 | .21240 | .18385 | .15706 | .13183 | .10798 | .08538 | .06389 | .04342 | .02387 | .00516 | 43 |
| 44 | .27527 | .24244 | .21191 | .18339 | .15663 | .13142 | .10760 | .08501 | .06354 | .04309 | .02355 | .00485 | 44 |
| 45 | .27470 | .24191 | .21142 | .18293 | .15620 | .13101 | .10721 | .08465 | .06319 | .04275 | .02323 | .00455 | 45 |
| 46 | .27413 | .24138 | .21093 | .18247 | .15577 | .13061 | .10683 | .08428 | .06285 | .04242 | .02291 | .00424 | 46 |
| 47 | .27357 | .24086 | .21044 | .18201 | .15533 | .13020 | .10644 | .08391 | .06250 | .04209 | .02260 | .00394 | 47 |
| 48 | .27300 | .24033 | .20995 | .18156 | .15490 | .12979 | .10605 | .08355 | .06215 | .04176 | .02228 | .00364 | 48 |
| 49 | .27244 | .23981 | .20946 | .18110 | .15447 | .12939 | .10567 | .08318 | .06180 | .04142 | .02196 | .00333 | 49 |
| 50 | .27187 | .23929 | .20897 | .18064 | .15404 | .12898 | .10529 | .08282 | .06145 | .04109 | .02164 | .00303 | 50 |
| 51 | .27131 | .23876 | .20849 | .18018 | .15361 | .12857 | .10490 | .08245 | .06111 | .04076 | .02133 | .00272 | 51 |
| 52 | .27075 | .23824 | .20800 | .17973 | .15318 | .12817 | .10452 | .08209 | .06076 | .04043 | .02101 | .00242 | 52 |
| 53 | .27018 | .23772 | .20751 | .17927 | .15275 | .12776 | .10413 | .08172 | .06041 | .04010 | .02069 | .00212 | 53 |
| 54 | .26962 | .23720 | .20703 | .17882 | .15233 | .12736 | .10375 | .08136 | .06007 | .03977 | .02038 | .00181 | 54 |
| 55 | .26906 | .23668 | .20654 | .17836 | .15190 | .12696 | .10337 | .08100 | .05972 | .03944 | .02006 | .00151 | 55 |
| 56 | .26850 | .23616 | .20606 | .17791 | .15147 | .12655 | .10299 | .08063 | .05937 | .03911 | .01975 | .00121 | 56 |
| 57 | .26794 | .23564 | .20557 | .17745 | .15104 | .12615 | .10260 | .08027 | .05903 | .03878 | .01943 | .00091 | 57 |
| 58 | .26738 | .23512 | .20509 | .17700 | .15062 | .12574 | .10222 | .07991 | .05868 | .03845 | .01911 | .00060 | 58 |
| 59 | .26683 | .23460 | .20460 | .17655 | .15019 | .12534 | .10184 | .07954 | .05834 | .03912 | .01880 | .00030 | 59 |

## Prop. Logarithms for Seconds and Tenths of Seconds. (qq)

| " | .0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 5.03342 | 4.73239 | 4.55630 | 4.43136 | 4.33445 | 4.25527 | 4.18833 | 4.13033 | 4.07918 |
| 1 | 4.03342 | 3.99203 | 3.95424 | 3.91948 | 3.88730 | 3.85733 | 3.82930 | 3.80297 | 3.77815 | 3.75467 |
| 2 | 3.73239 | 3.71120 | 3.69100 | 3.67170 | 3.65321 | 3.63548 | 3.61845 | 3.60206 | 3.58627 | 3.57103 |
| 3 | 3.55630 | 3.54206 | 3.52827 | 3.51491 | 3.50194 | 3.48936 | 3.47712 | 3.46522 | 3.45364 | 3.44236 |
| 4 | 3.43136 | 3.42064 | 3.41017 | 3.39996 | 3.38997 | 3.38021 | 3.37067 | 3.36133 | 3.35218 | 3.34323 |
| 5 | 3.33445 | 3.32585 | 3.31742 | 3.30915 | 3.30103 | 3.29306 | 3.28524 | 3.27755 | 3.27000 | 3.26257 |
| 6 | 3.25527 | 3.24809 | 3.24103 | 3.23408 | 3.22724 | 3.22051 | 3.21388 | 3.20735 | 3.20091 | 3.19457 |
| 7 | 3.18833 | 3.18217 | 3.17609 | 3.17010 | 3.16419 | 3.15836 | 3.15261 | 3.14693 | 3.14133 | 3.13580 |
| 8 | 3.13033 | 3.12494 | 3.11961 | 3.11435 | 3.10914 | 3.10400 | 3.09893 | 3.09390 | 3.08894 | 3.08403 |
| 9 | 3.07918 | 3.07438 | 3.06964 | 3.06494 | 3.06030 | 3.05570 | 3.05115 | 3.04665 | 3.04220 | 3.03779 |
| 10 | 3.03342 | 3.02910 | 3.02482 | 3.02060 | 3.01639 | 3.01223 | 3.00812 | 3.00404 | 3.00000 | 2.99600 |
| 11 | 2.99203 | 2.98810 | 2.98421 | 2.98035 | 2.97652 | 2.97273 | 2.96897 | 2.96524 | 2.96154 | 2.95788 |
| 12 | 2.95424 | 2.95064 | 2.94706 | 2.94352 | 2.94000 | 2.93651 | 2.93305 | 2.92962 | 2.92621 | 2.92283 |
| 13 | 2.91948 | 2.91615 | 2.91285 | 2.90957 | 2.90632 | 2.90309 | 2.89988 | 2.89670 | 2.89354 | 2.89041 |
| 14 | 2.88730 | 2.88420 | 2.88114 | 2.87809 | 2.87506 | 2.87206 | 2.86907 | 2.86611 | 2.86316 | 2.86024 |
| 15 | 2.85733 | 2.85445 | 2.85158 | 2.84873 | 2.84590 | 2.84309 | 2.84030 | 2.83752 | 2.83477 | 2.83203 |
| 16 | 2.82930 | 2.82660 | 2.82391 | 2.82124 | 2.81858 | 2.81594 | 2.81332 | 2.81071 | 2.80811 | 2.80554 |
| 17 | 2.80297 | 2.80043 | 2.79790 | 2.79538 | 2.79287 | 2.79039 | 2.78791 | 2.78545 | 2.78300 | 2.78057 |
| 18 | 2.77815 | 2.77575 | 2.77335 | 2.77097 | 2.76861 | 2.76625 | 2.76391 | 2.76158 | 2.75927 | 2.75696 |
| 19 | 2.75467 | 2.75239 | 2.75012 | 2.74787 | 2.74562 | 2.74339 | 2.74117 | 2.73896 | 2.73676 | 2.73457 |
| 20 | 2.73239 | 2.73023 | 2.72807 | 2.72593 | 2.72379 | 2.72167 | 2.71956 | 2.71745 | 2.71536 | 2.71328 |
| 21 | 2.71120 | 2.70914 | 2.70709 | 2.70504 | 2.70301 | 2.70099 | 2.69897 | 2.69696 | 2.69497 | 2.69298 |
| 22 | 2.69100 | 2.68903 | 2.68707 | 2.68512 | 2.68318 | 2.68124 | 2.67932 | 2.67740 | 2.67549 | 2.67359 |
| 23 | 2.67170 | 2.66981 | 2.66794 | 2.66607 | 2.66421 | 2.66236 | 2.66051 | 2.65868 | 2.65685 | 2.65502 |
| 24 | 2.65321 | 2.65141 | 2.64961 | 2.64782 | 2.64603 | 2.64426 | 2.64249 | 2.64073 | 2.63897 | 2.63722 |
| 25 | 2.63548 | 2.63375 | 2.63202 | 2.63030 | 2.62859 | 2.62688 | 2.62518 | 2.62349 | 2.62180 | 2.62012 |
| 26 | 2.61845 | 2.61678 | 2.61512 | 2.61347 | 2.61182 | 2.61018 | 2.60854 | 2.60691 | 2.60529 | 2.60367 |
| 27 | 2.60206 | 2.60045 | 2.59885 | 2.59726 | 2.59567 | 2.59409 | 2.59251 | 2.59094 | 2.58938 | 2.58782 |
| 28 | 2.58627 | 2.58472 | 2.58317 | 2.58164 | 2.58011 | 2.57858 | 2.57706 | 2.57554 | 2.57403 | 2.57253 |
| 29 | 2.57103 | 2.56953 | 2.56804 | 2.56656 | 2.56508 | 2.56360 | 2.56213 | 2.56067 | 2.55921 | 2.55775 |
| 30 | 2.55630 | 2.55486 | 2.55342 | 2.55198 | 2.55055 | 2.54912 | 2.54770 | 2.54629 | 2.54487 | 2.54347 |
| 31 | 2.54206 | 2.54066 | 2.53927 | 2.53788 | 2.53649 | 2.53511 | 2.53374 | 2.53236 | 2.53100 | 2.52963 |
| 32 | 2.52827 | 2.52692 | 2.52557 | 2.52422 | 2.52288 | 2.52154 | 2.52021 | 2.51888 | 2.51755 | 2.51623 |
| 33 | 2.51491 | 2.51360 | 2.51229 | 2.51098 | 2.50968 | 2.50838 | 2.50708 | 2.50579 | 2.50451 | 2.50322 |
| 34 | 2.50194 | 2.50067 | 2.49940 | 2.49813 | 2.49687 | 2.49560 | 2.49435 | 2.49309 | 2.49184 | 2.49060 |
| 35 | 2.48936 | 2.48812 | 2.48688 | 2.48565 | 2.48442 | 2.48320 | 2.48197 | 2.48076 | 2.47954 | 2.47833 |
| 36 | 2.47712 | 2.47592 | 2.47472 | 2.47352 | 2.47232 | 2.47113 | 2.46994 | 2.46876 | 2.46758 | 2.46640 |
| 37 | 2.46522 | 2.46405 | 2.46288 | 2.46171 | 2.46055 | 2.45939 | 2.45824 | 2.45708 | 2.45593 | 2.45478 |
| 38 | 2.45364 | 2.45250 | 2.45136 | 2.45022 | 2.44909 | 2.44796 | 2.44684 | 2.44571 | 2.44459 | 2.44347 |
| 39 | 2.44236 | 2.44125 | 2.44014 | 2.43903 | 2.43793 | 2.43683 | 2.43573 | 2.43463 | 2.43354 | 2.43245 |
| 40 | 2.43136 | 2.43028 | 2.42920 | 2.42812 | 2 42704 | 2.42597 | 2.42490 | 2.42383 | 2.42276 | 2.42170 |
| 41 | 2.42064 | 2.41958 | 2.41853 | 2.41747 | 2.41642 | 2.41538 | 2.41433 | 2.41329 | 2.41225 | 2.41121 |
| 42 | 2.41017 | 2.40914 | 2.40811 | 2.40708 | 2.40606 | 2.40503 | 2.40401 | 2.40300 | 2.40198 | 2.40097 |
| 43 | 2.39996 | 2.39895 | 2.39794 | 2.39694 | 2.39593 | 2.39493 | 2.39394 | 2.39294 | 2.39195 | 2.39096 |
| 44 | 2.38997 | 2.38899 | 2.38800 | 2.38702 | 2.38604 | 2.38506 | 2.38409 | 2.38312 | 2.38215 | 2.38118 |
| 45 | 2.38021 | 2.37925 | 2.37829 | 2.37733 | 2.37637 | 2.37541 | 2.37446 | 2.37351 | 2.37256 | 2.37161 |
| 46 | 2.37067 | 2.36972 | 2.36878 | 2.36784 | 2.36691 | 2.36597 | 2.36504 | 2.36411 | 2.36318 | 2.36225 |
| 47 | 2.36133 | 2.36040 | 2.35948 | 2.35856 | 2.35765 | 2.35673 | 2.35582 | 2.35491 | 2.35400 | 2.35309 |
| 48 | 2.35218 | 2.35128 | 2.35038 | 2.34948 | 2.34858 | 2.34768 | 2.34679 | 2.34589 | 2.34500 | 2.34411 |
| 49 | 2.34323 | 2.34234 | 2.34146 | 2.34058 | 2.33970 | 2.33882 | 2.33794 | 2.33707 | 2.33619 | 2.33532 |
| 50 | 2.33445 | 2.33359 | 2.33272 | 2.33186 | 2.33099 | 2.33013 | 2.32927 | 2.32842 | 2.32756 | 2.32671 |
| 51 | 2.32585 | 2.32500 | 2.32415 | 2.32331 | 2.32246 | 2.32162 | 2.32077 | 2.31993 | 2.31909 | 2.31826 |
| 52 | 2.31742 | 2.31659 | 2.31575 | 2.31492 | 2.31409 | 2.31326 | 2.31244 | 2.31161 | 2.31079 | 2.30997 |
| 53 | 2.30915 | 2.30833 | 2.30751 | 2.30670 | 2.30588 | 2.30507 | 2.30426 | 2.30345 | 2.30264 | 2.30183 |
| 54 | 2.30103 | 2.30023 | 2.29942 | 2.29862 | 2.29782 | 2.29703 | 2.29623 | 2.29544 | 2.29464 | 2.29385 |
| 55 | 2.29306 | 2.29227 | 2.29148 | 2.29070 | 2.28991 | 2.28913 | 2.28835 | 2.28757 | 2.28679 | 2.28601 |
| 56 | 2.28524 | 2.28446 | 2.28369 | 2.28292 | 2.28215 | 2.28138 | 2.28061 | 2.27984 | 2.27908 | 2.27831 |
| 57 | 2.27755 | 2.27679 | 2.27603 | 2.27527 | 2.27451 | 2.27376 | 2.27300 | 2.27225 | 2.27150 | 2.27075 |
| 58 | 2.27000 | 2.26925 | 2.26850 | 2.26776 | 2.26701 | 2.26627 | 2.26553 | 2.26479 | 2.26405 | 2.26331 |
| 59 | 2.26257 | 2.26184 | 2.26110 | 2.26037 | 2.25964 | 2.25891 | 2.25818 | 2.25745 | 2.25672 | 2.25600 |

| 0h or 0°. | PROP. LOGARITHMS. (r.) | 0h or 0°. |
|---|---|---|

| ″ | 0′ | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | ″ |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | 2.25527 | 1.95424 | 1.77815 | 1.65321 | 1.55630 | 1.47712 | 1.41017 | 0 |
| 1 | 4.03342 | 2.24809 | 1.95064 | 1.77575 | 1 65141 | 1.55486 | 1.47592 | 1.40914 | 1 |
| 2 | 3.73239 | 2.24103 | 1.94706 | 1.77335 | 1.64961 | 1.55342 | 1.47472 | 1.40811 | 2 |
| 3 | 3.55630 | 2.23408 | 1.94352 | 1.77097 | 1.64782 | 1.55198 | 1.47352 | 1.40708 | 3 |
| 4 | 3.43136 | 2.22724 | 1.94000 | 1.76861 | 1.64603 | 1.55055 | 1.47232 | 1.40606 | 4 |
| 5 | 3.33445 | 2.22051 | 1.93651 | 1.76625 | 1.64426 | 1.54912 | 1.47113 | 1.40503 | 5 |
| 6 | 3.25527 | 2.21388 | 1.93306 | 1.76391 | 1.64249 | 1.54770 | 1.46994 | 1.40401 | 6 |
| 7 | 3.18833 | 2.20735 | 1.92962 | 1.76158 | 1.64073 | 1.54629 | 1.46876 | 1.40300 | 7 |
| 8 | 3.13033 | 2.20091 | 1.92621 | 1.75927 | 1.63897 | 1.54487 | 1.46758 | 1.40198 | 8 |
| 9 | 3.07918 | 2.19457 | 1.92283 | 1.75696 | 1.63722 | 1 54347 | 1.46640 | 1.40097 | 9 |
| 10 | 3.03342 | 2.18833 | 1.91948 | 1.75467 | 1.63548 | 1.54206 | 1.46522 | 1.39996 | 10 |
| 11 | 2.99203 | 2.18217 | 1.91615 | 1.75239 | 1.63375 | 1.54066 | 1.46405 | 1.39895 | 11 |
| 12 | 2.95424 | 2.17609 | 1.91285 | 1.75012 | 1.63202 | 1.53927 | 1.46288 | 1.39794 | 12 |
| 13 | 2.91948 | 2.17010 | 1.90957 | 1.74787 | 1.63030 | 1.53788 | 1.46171 | 1.39694 | 13 |
| 14 | 2.88730 | 2.16419 | 1.90632 | 1.74562 | 1.62859 | 1.53649 | 1.46055 | 1.39593 | 14 |
| 15 | 2.85733 | 2.15836 | 1.90309 | 1.74339 | 1.62688 | 1.53511 | 1.45939 | 1.39493 | 15 |
| 16 | 2.82930 | 2.15261 | 1.89988 | 1.74117 | 1.62518 | 1.53374 | 1.45824 | 1.39394 | 16 |
| 17 | 2.80297 | 2.14693 | 1.89670 | 1.73896 | 1.62349 | 1.53236 | 1.45708 | 1.39294 | 17 |
| 18 | 2.77815 | 2.14133 | 1.89354 | 1.73676 | 1.62180 | 1.53100 | 1.45593 | 1.39195 | 18 |
| 19 | 2.75467 | 2.13580 | 1.89041 | 1.73457 | 1.62012 | 1.52963 | 1.45478 | 1.39096 | 19 |
| 20 | 2.73239 | 2.13033 | 1.88730 | 1.73239 | 1.61845 | 1.52827 | 1.45364 | 1.38997 | 20 |
| 21 | 2.71120 | 2.12494 | 1.88420 | 1.73023 | 1.61678 | 1.52692 | 1.45250 | 1.38899 | 21 |
| 22 | 2.69100 | 2.11961 | 1.88114 | 1.72807 | 1.61512 | 1.52557 | 1.45136 | 1.38800 | 22 |
| 23 | 2.67170 | 2.11435 | 1.87809 | 1.72593 | 1.61347 | 1.52422 | 1.45022 | 1.38702 | 23 |
| 24 | 2.65321 | 2.10914 | 1.87506 | 1.72379 | 1.61182 | 1.52288 | 1.44909 | 1.38604 | 24 |
| 25 | 2.63548 | 2.10400 | 1.87206 | 1.72167 | 1.61018 | 1.52154 | 1.44796 | 1.38506 | 25 |
| 26 | 2.61845 | 2.09893 | 1.86907 | 1.71956 | 1.60854 | 1.52021 | 1.44684 | 1.38409 | 26 |
| 27 | 2.60206 | 2.09390 | 1.86611 | 1.71745 | 1.60691 | 1.51888 | 1.44571 | 1.38312 | 27 |
| 28 | 2.58627 | 2.08894 | 1.86316 | 1.71536 | 1.60529 | 1.51755 | 1.44459 | 1.38215 | 28 |
| 29 | 2.57103 | 2.08403 | 1.86024 | 1.71328 | 1.60367 | 1.51623 | 1.44347 | 1.38118 | 29 |
| 30 | 2.55630 | 2.07918 | 1.85733 | 1.71120 | 1.60206 | 1.51491 | 1.44236 | 1.38021 | 30 |
| 31 | 2.54206 | 2.07438 | 1.85445 | 1.70914 | 1.60045 | 1.51360 | 1.44125 | 1.37925 | 31 |
| 32 | 2.52827 | 2.06964 | 1.85158 | 1.70709 | 1.59885 | 1.51229 | 1.44014 | 1.37829 | 32 |
| 33 | 2.51491 | 2.06494 | 1.84873 | 1.70504 | 1.59726 | 1.51098 | 1.43903 | 1.37733 | 33 |
| 34 | 2.50194 | 2.06030 | 1.84590 | 1.70301 | 1.59567 | 1.50968 | 1.43793 | 1.37637 | 34 |
| 35 | 2.48936 | 2.05570 | 1.84309 | 1 70099 | 1.59409 | 1.50838 | 1.43683 | 1.37541 | 35 |
| 36 | 2.47712 | 2.05115 | 1.84030 | 1.69897 | 1.59251 | 1.50708 | 1.43573 | 1.37446 | 36 |
| 37 | 2.46522 | 2.04665 | 1.83752 | 1.69696 | 1.59094 | 1.50579 | 1.43463 | 1.37351 | 37 |
| 38 | 2.45364 | 2.04220 | 1.83477 | 1.69497 | 1.58938 | 1.50451 | 1.43354 | 1.37256 | 38 |
| 39 | 2.44236 | 2.03779 | 1.83203 | 1.69298 | 1.58782 | 1.50322 | 1.43245 | 1.37161 | 39 |
| 40 | 2.43136 | 2.03342 | 1.82930 | 1.69100 | 1.58627 | 1.50194 | 1.43136 | 1.37067 | 40 |
| 41 | 2.42064 | 2.02910 | 1.82660 | 1.68903 | 1.58472 | 1.50067 | 1.43028 | 1.36972 | 41 |
| 42 | 2.41017 | 2.02482 | 1.82391 | 1.68707 | 1.58317 | 1.49940 | 1.42920 | 1.36878 | 42 |
| 43 | 2.39996 | 2.02060 | 1.82124 | 1.68512 | 1.58164 | 1.49813 | 1.42812 | 1.36784 | 43 |
| 44 | 2.38997 | 2.01639 | 1.81858 | 1.68318 | 1.58011 | 1.49687 | 1.42704 | 1.36691 | 44 |
| 45 | 2.38021 | 2.01223 | 1.81594 | 1.68124 | 1.57858 | 1.49560 | 1.42597 | 1.36597 | 45 |
| 46 | 2.37067 | 2.00812 | 1.81332 | 1.67932 | 1.57706 | 1.49435 | 1.42490 | 1.36504 | 46 |
| 47 | 2.36133 | 2.00404 | 1.81071 | 1.67740 | 1.57554 | 1.49309 | 1.42383 | 1.36411 | 47 |
| 48 | 2.35218 | 2.00000 | 1.80811 | 1.67549 | 1.57403 | 1.49184 | 1.42276 | 1.36318 | 48 |
| 49 | 2.34323 | 1.99600 | 1.80554 | 1.67359 | 1.57253 | 1.49060 | 1.42170 | 1.36225 | 49 |
| 50 | 2.33445 | 1.99203 | 1.80297 | 1.67170 | 1.57103 | 1.48936 | 1.42064 | 1.36133 | 50 |
| 51 | 2.32585 | 1.98810 | 1.80043 | 1.66981 | 1.56953 | 1.48812 | 1.41958 | 1.36040 | 51 |
| 52 | 2.31742 | 1.98421 | 1.79790 | 1.66794 | 1.56804 | 1.48688 | 1.41853 | 1.35948 | 52 |
| 53 | 2.30915 | 1.98035 | 1.79538 | 1.66607 | 1.56656 | 1.48565 | 1.41747 | 1.35856 | 53 |
| 54 | 2.30103 | 1.97652 | 1.79287 | 1.66421 | 1.56508 | 1.48442 | 1.41642 | 1.35765 | 54 |
| 55 | 2.29306 | 1.97273 | 1.79039 | 1 66236 | 1.56360 | 1.48320 | 1.41538 | 1.35673 | 55 |
| 56 | 2.28524 | 1.96897 | 1.78791 | 1.66051 | 1.56213 | 1.48197 | 1.41433 | 1.35582 | 56 |
| 57 | 2.27755 | 1.96524 | 1.78545 | 1.65868 | 1.56067 | 1.48076 | 1.41329 | 1.35491 | 57 |
| 58 | 2.27000 | 1.96154 | 1.78300 | 1.65685 | 1.55921 | 1.47954 | 1.41225 | 1.35400 | 58 |
| 59 | 2.26257 | 1 95788 | 1.78057 | 1.65503 | 1 55775 | 1.47833 | 1.41121 | 1.35309 | 59 |

| 0h or 0° | PROP. LOGARITHMS. (r.) | | | | | | | | 0h or 0° |
|---|---|---|---|---|---|---|---|---|---|
| ″ | 8′ | 9 | 10′ | 11′ | 12 | 13′ | 14′ | 15′ | ″ |
| 0 | 1.35218 | 1.30103 | 1.25527 | 1.21388 | 1.17609 | 1.14133 | 1.10914 | 1.07918 | 0 |
| 1 | 1.35128 | 1.30023 | 1.25455 | 1.21322 | 1.17549 | 1.14077 | 1.10863 | 1.07870 | 1 |
| 2 | 1.35038 | 1.29942 | 1.25383 | 1.21257 | 1.17489 | 1.14022 | 1.10811 | 1.07822 | 2 |
| 3 | 1.34948 | 1.29862 | 1.25311 | 1.21191 | 1.17429 | 1.13966 | 1.10760 | 1.07774 | 3 |
| 4 | 1.34858 | 1.29782 | 1.25239 | 1.21126 | 1.17369 | 1.13911 | 1.10708 | 1.07726 | 4 |
| 5 | 1.34768 | 1.29703 | 1.25167 | 1.21060 | 1.17309 | 1.13855 | 1.10657 | 1.07678 | 5 |
| 6 | 1.34679 | 1.29623 | 1.25095 | 1.20995 | 1.17249 | 1.13800 | 1.10605 | 1.07630 | 6 |
| 7 | 1.34589 | 1.29544 | 1.25024 | 1.20930 | 1.17189 | 1.13745 | 1.10554 | 1.07582 | 7 |
| 8 | 1.34500 | 1.29464 | 1.24952 | 1.20865 | 1.17129 | 1.13690 | 1.10503 | 1.07534 | 8 |
| 9 | 1.34411 | 1.29385 | 1.24881 | 1.20800 | 1.17070 | 1.13635 | 1.10452 | 1.07486 | 9 |
| 10 | 1.34323 | 1.29306 | 1.24809 | 1.20735 | 1.17010 | 1.13580 | 1.10400 | 1.07438 | 10 |
| 11 | 1.34234 | 1.29227 | 1.24738 | 1.20670 | 1.16951 | 1.13525 | 1.10349 | 1.07391 | 11 |
| 12 | 1.34146 | 1.29148 | 1.24667 | 1.20605 | 1.16891 | 1.13470 | 1.10298 | 1.07343 | 12 |
| 13 | 1.34058 | 1.29070 | 1.24596 | 1.20541 | 1.16832 | 1.13415 | 1.10247 | 1.07295 | 13 |
| 14 | 1.33970 | 1.28991 | 1.24526 | 1.20476 | 1.16773 | 1.13360 | 1.10197 | 1.07248 | 14 |
| 15 | 1.33882 | 1.28913 | 1.24455 | 1.20412 | 1.16714 | 1.13306 | 1.10146 | 1.07200 | 15 |
| 16 | 1.33794 | 1.28835 | 1.24384 | 1.20348 | 1.16655 | 1.13251 | 1.10095 | 1.07153 | 16 |
| 17 | 1.33707 | 1.28757 | 1.24314 | 1.20284 | 1.16596 | 1.13197 | 1.10044 | 1.07105 | 17 |
| 18 | 1.33619 | 1.28679 | 1.24244 | 1.20219 | 1.16537 | 1.13142 | 1.09994 | 1.07058 | 18 |
| 19 | 1.33532 | 1.28601 | 1.24173 | 1.20155 | 1.16478 | 1.13088 | 1.09943 | 1.07011 | 19 |
| 20 | 1.33445 | 1.28524 | 1.24103 | 1.20091 | 1.16419 | 1.13033 | 1.09893 | 1.06964 | 20 |
| 21 | 1.33359 | 1.28446 | 1.24033 | 1.20028 | 1.16361 | 1.12979 | 1.09842 | 1.06916 | 21 |
| 22 | 1.33272 | 1.28369 | 1.23963 | 1.19964 | 1.16302 | 1.12925 | 1.09792 | 1.06869 | 22 |
| 23 | 1.33186 | 1.28292 | 1.23894 | 1.19900 | 1.16243 | 1.12871 | 1.09741 | 1.06822 | 23 |
| 24 | 1.33099 | 1.28215 | 1.23824 | 1.19837 | 1.16185 | 1.12817 | 1.09691 | 1.06775 | 24 |
| 25 | 1.33013 | 1.28138 | 1.23754 | 1.19773 | 1.16127 | 1.12763 | 1.09641 | 1.06728 | 25 |
| 26 | 1.32927 | 1.28061 | 1.23685 | 1.19710 | 1.16068 | 1.12709 | 1.09591 | 1.06681 | 26 |
| 27 | 1.32842 | 1.27984 | 1.23616 | 1.19647 | 1.16010 | 1.12655 | 1.09540 | 1.06634 | 27 |
| 28 | 1.32756 | 1.27908 | 1.23546 | 1.19584 | 1.15952 | 1.12601 | 1.09490 | 1.06588 | 28 |
| 29 | 1.32671 | 1.27831 | 1.23477 | 1.19520 | 1.15894 | 1.12548 | 1.09440 | 1.06541 | 29 |
| 30 | 1.32585 | 1.27755 | 1.23408 | 1.19457 | 1.15836 | 1.12494 | 1.09390 | 1.06494 | 30 |
| 31 | 1.32500 | 1.27679 | 1.23339 | 1.19395 | 1.15778 | 1.12440 | 1.09341 | 1.06447 | 31 |
| 32 | 1.32415 | 1.27603 | 1.23271 | 1.19332 | 1.15721 | 1.12387 | 1.09291 | 1.06401 | 32 |
| 33 | 1.32331 | 1.27527 | 1.23202 | 1.19269 | 1.15663 | 1.12333 | 1.09241 | 1.06354 | 33 |
| 34 | 1.32246 | 1.27451 | 1.23133 | 1.19206 | 1.15605 | 1.12280 | 1.09191 | 1.06308 | 34 |
| 35 | 1.32162 | 1.27376 | 1.23065 | 1.19144 | 1.15548 | 1.12227 | 1.09142 | 1.06261 | 35 |
| 36 | 1.32077 | 1.27300 | 1.22997 | 1.19081 | 1.15490 | 1.12173 | 1.09092 | 1.06215 | 36 |
| 37 | 1.31993 | 1.27225 | 1.22928 | 1.19019 | 1.15433 | 1.12120 | 1.09042 | 1.06168 | 37 |
| 38 | 1.31909 | 1.27150 | 1.22860 | 1.18957 | 1.15375 | 1.12067 | 1.08993 | 1.06122 | 38 |
| 39 | 1.31826 | 1.27075 | 1.22792 | 1.18895 | 1.15318 | 1.12014 | 1.08943 | 1.06076 | 39 |
| 40 | 1.31742 | 1.27000 | 1.22724 | 1.18833 | 1.15261 | 1.11961 | 1.08894 | 1.06030 | 40 |
| 41 | 1.31659 | 1.26925 | 1.22657 | 1.18771 | 1.15204 | 1.11908 | 1.08845 | 1.05983 | 41 |
| 42 | 1.31575 | 1.26850 | 1.22589 | 1.18709 | 1.15147 | 1.11855 | 1.08796 | 1.05937 | 42 |
| 43 | 1.31492 | 1.26776 | 1.22521 | 1.18647 | 1.15090 | 1.11802 | 1.08746 | 1.05891 | 43 |
| 44 | 1.31409 | 1.26701 | 1.22454 | 1.18585 | 1.15033 | 1.11750 | 1.08697 | 1.05845 | 44 |
| 45 | 1.31326 | 1.26627 | 1.22386 | 1.18523 | 1.14976 | 1.11697 | 1.08648 | 1.05799 | 45 |
| 46 | 1.31244 | 1.26553 | 1.22319 | 1.18462 | 1.14919 | 1.11644 | 1.08599 | 1.05753 | 46 |
| 47 | 1.31161 | 1.26479 | 1.22252 | 1.18400 | 1.14863 | 1.11592 | 1.08550 | 1.05707 | 47 |
| 48 | 1.31079 | 1.26405 | 1.22185 | 1.18339 | 1.14806 | 1.11539 | 1.08501 | 1.05662 | 48 |
| 49 | 1.30997 | 1.26331 | 1.22118 | 1.18278 | 1.14750 | 1.11487 | 1.08452 | 1.05616 | 49 |
| 50 | 1.30915 | 1.26257 | 1.22051 | 1.18217 | 1.14693 | 1.11435 | 1.08403 | 1.05570 | 50 |
| 51 | 1.30833 | 1.26184 | 1.21984 | 1.18155 | 1.14637 | 1.11382 | 1.08355 | 1.05524 | 51 |
| 52 | 1.30751 | 1.26110 | 1.21918 | 1.18094 | 1.14581 | 1.11330 | 1.08306 | 1.05479 | 52 |
| 53 | 1.30670 | 1.26037 | 1.21851 | 1.18033 | 1.14524 | 1.11278 | 1.08257 | 1.05433 | 53 |
| 54 | 1.30588 | 1.25964 | 1.21785 | 1.17973 | 1.14468 | 1.11226 | 1.08209 | 1.05388 | 54 |
| 55 | 1.30507 | 1.25891 | 1.21718 | 1.17912 | 1.14412 | 1.11174 | 1.08160 | 1.05342 | 55 |
| 56 | 1.30426 | 1.25818 | 1.21652 | 1.17851 | 1.14356 | 1.11122 | 1.08112 | 1.05297 | 56 |
| 57 | 1.30345 | 1.25745 | 1.21586 | 1.17790 | 1.14300 | 1.11070 | 1.08063 | 1.05251 | 57 |
| 58 | 1.30264 | 1.25672 | 1.21520 | 1.17730 | 1.14244 | 1.11018 | 1.08015 | 1.05206 | 58 |
| 59 | 1.30183 | 1.25600 | 1.21454 | 1.17669 | 1.14189 | 1.10966 | 1.07966 | 1.05161 | 59 |

| 0h or 0° | PROP. LOGARITHMS. (r.) | | | | | | | | | 0h or 0° |
|---|---|---|---|---|---|---|---|---|---|---|
| ′ | 16′ | 17′ | 18′ | 19′ | 20′ | 21′ | 22′ | 23′ | 24′ | ′ |
| 0 | 1.05115 | 1.02482 | 1.00000 | .97652 | .95424 | .93305 | .91285 | .89354 | .87506 | 0 |
| 1 | 1.05070 | 1.02440 | .99960 | .97614 | .95388 | .93271 | .91252 | .89323 | .87476 | 1 |
| 2 | 1.05025 | 1.02397 | .99920 | .97576 | .95352 | .93236 | .91219 | .89292 | .87446 | 2 |
| 3 | 1.04980 | 1.02355 | .99880 | .97538 | .95316 | .93202 | .91186 | .89260 | .87416 | 3 |
| 4 | 1.04935 | 1.02312 | .99839 | .97500 | .95280 | .93168 | .91154 | .89229 | .87386 | 4 |
| 5 | 1.04890 | 1.02270 | .99799 | .97462 | .95244 | .93133 | .91121 | .89197 | .87356 | 5 |
| 6 | 1.04845 | 1.02228 | .99759 | .97424 | .95208 | .93099 | .91088 | .89166 | .87326 | 6 |
| 7 | 1.04800 | 1.02185 | .99719 | .97386 | .95172 | .93065 | .91055 | .89135 | .87296 | 7 |
| 8 | 1.04755 | 1.02143 | .99679 | .97348 | .95136 | .93030 | .91023 | .89103 | .87266 | 8 |
| 9 | 1.04710 | 1.02101 | .99640 | .97310 | .95100 | .92996 | .90990 | .89072 | .87236 | 9 |
| 10 | 1.04665 | 1.02059 | .99600 | .97273 | .95064 | .92962 | .90957 | .89041 | .87206 | 10 |
| 11 | 1.04620 | 1.02017 | .99560 | .97235 | .95028 | .92928 | .90925 | .89010 | .87176 | 11 |
| 12 | 1.04576 | 1.01974 | .99520 | .97197 | .94992 | .92894 | .90892 | .88978 | .87146 | 12 |
| 13 | 1.04531 | 1.01932 | .99480 | .97159 | .94956 | .92860 | .90859 | .88947 | .87116 | 13 |
| 14 | 1.04486 | 1.01890 | .99441 | .97122 | .94921 | .92825 | .90827 | .88916 | .87086 | 14 |
| 15 | 1.04442 | 1.01848 | .99401 | .97084 | .94885 | .92791 | .90794 | .88885 | .87056 | 15 |
| 16 | 1.04397 | 1.01806 | .99361 | .97047 | .94849 | .92757 | .90762 | .88854 | .87026 | 16 |
| 17 | 1.04353 | 1.01764 | .99322 | .97009 | .94813 | .92723 | .90729 | .88823 | .86996 | 17 |
| 18 | 1.04308 | 1.01723 | .99282 | .96972 | .94778 | .92689 | .90697 | .88792 | .86967 | 18 |
| 19 | 1.04264 | 1.01681 | .99243 | .96934 | .94742 | .92655 | .90664 | .88761 | .86937 | 19 |
| 20 | 1.04220 | 1.01639 | .99203 | .96897 | .94706 | .92621 | .90632 | .88730 | .86907 | 20 |
| 21 | 1.04175 | 1.01597 | .99164 | .96859 | .94671 | .92587 | .90599 | .88699 | .86877 | 21 |
| 22 | 1.04131 | 1.01556 | .99124 | .96822 | .94635 | .92554 | .90567 | .88668 | .86848 | 22 |
| 23 | 1.04087 | 1.01514 | .99085 | .96784 | .94600 | .92520 | .90535 | .88637 | .86818 | 23 |
| 24 | 1.04043 | 1.01472 | .99045 | .96747 | .94564 | .92486 | .90502 | .88606 | .86788 | 24 |
| 25 | 1.03999 | 1.01431 | .99006 | .96710 | .94529 | .92452 | .90470 | .88575 | .86759 | 25 |
| 26 | 1.03955 | 1.01389 | .98967 | .96673 | .94493 | .92418 | .90438 | .88544 | .86729 | 26 |
| 27 | 1.03911 | 1.01348 | .98928 | .96635 | .94458 | .92385 | .90406 | .88513 | .86699 | 27 |
| 28 | 1.03867 | 1.01306 | .98888 | .96598 | .94423 | .92351 | .90373 | .88482 | .86670 | 28 |
| 29 | 1.03823 | 1.01265 | .98849 | .96561 | .94387 | .92317 | .90341 | .88451 | .86640 | 29 |
| 30 | 1.03779 | 1.01223 | .98810 | .96524 | .94352 | .92283 | .90309 | .88420 | .86611 | 30 |
| 31 | 1.03735 | 1.01182 | .98771 | .96487 | .94317 | .92250 | .90277 | .88390 | .86581 | 31 |
| 32 | 1.03691 | 1.01141 | .98732 | .96450 | .94281 | .92216 | .90245 | .88359 | .86552 | 32 |
| 33 | 1.03647 | 1.01100 | .98693 | .96413 | .94246 | .92183 | .90213 | .88328 | .86522 | 33 |
| 34 | 1.03604 | 1.01058 | .98654 | .96376 | .94211 | .92149 | .90181 | .88297 | .86493 | 34 |
| 35 | 1.03560 | 1.01017 | .98615 | .96339 | .94176 | .92115 | .90148 | .88267 | .86463 | 35 |
| 36 | 1.03516 | 1.00976 | .98576 | .96302 | .94141 | .92082 | .90116 | .88236 | .86434 | 36 |
| 37 | 1.03473 | 1.00935 | .98537 | .96265 | .94105 | .92048 | .90084 | .88205 | .86404 | 37 |
| 38 | 1.03429 | 1.00894 | .98498 | .96228 | .94070 | .92015 | .90052 | .88175 | .86375 | 38 |
| 39 | 1.03386 | 1.00853 | .98459 | .96191 | .94035 | .91981 | .90020 | .88144 | .86346 | 39 |
| 40 | 1.03342 | 1.00812 | .98421 | .96154 | .94000 | .91948 | .89988 | .88114 | .86316 | 40 |
| 41 | 1.03299 | 1.00771 | .98382 | .96117 | .93965 | .91915 | .89957 | .88083 | .86287 | 41 |
| 42 | 1.03256 | 1.00730 | .98343 | .96081 | .93930 | .91881 | .89925 | .88052 | .86258 | 42 |
| 43 | 1.03212 | 1.00689 | .98304 | .96044 | .93895 | .91848 | .89893 | .88022 | .86228 | 43 |
| 44 | 1.03169 | 1.00648 | .98266 | .96007 | .93860 | .91815 | .89861 | .87991 | .86199 | 44 |
| 45 | 1.03126 | 1.00607 | .98227 | .95971 | .93825 | .91781 | .89829 | .87961 | .86170 | 45 |
| 46 | 1.03083 | 1.00567 | .98189 | .95934 | .93791 | .91748 | .89797 | .87930 | .86140 | 46 |
| 47 | 1.03039 | 1.00526 | .98150 | .95897 | .93756 | .91715 | .89766 | .87900 | .86111 | 47 |
| 48 | 1.02996 | 1.00485 | .98111 | .95861 | .93721 | .91682 | .89734 | .87870 | .86082 | 48 |
| 49 | 1.02953 | 1.00445 | .98073 | .95824 | .93686 | .91648 | .89702 | .87839 | .86053 | 49 |
| 50 | 1.02910 | 1.00404 | .98035 | .95788 | .93651 | .91615 | .89670 | .87809 | .86024 | 50 |
| 51 | 1.02867 | 1.00363 | .97996 | .95751 | .93617 | .91582 | .89639 | .87778 | .85995 | 51 |
| 52 | 1.02824 | 1.00323 | .97958 | .95715 | .93582 | .91549 | .89607 | .87748 | .85965 | 52 |
| 53 | 1.02781 | 1.00282 | .97919 | .95678 | .93547 | .91516 | .89575 | .87718 | .85936 | 53 |
| 54 | 1.02739 | 1.00242 | .97881 | .95642 | .93513 | .91483 | .89544 | .87687 | .85907 | 54 |
| 55 | 1.02696 | 1.00202 | .97843 | .95606 | .93478 | .91450 | .89512 | .87657 | .85878 | 55 |
| 56 | 1.02653 | 1.00161 | .97805 | .95569 | .93443 | .91417 | .89481 | .87627 | .85849 | 56 |
| 57 | 1.02610 | 1.00121 | .97766 | .95533 | .93409 | .91384 | .89449 | .87597 | .85820 | 57 |
| 58 | 1.02568 | 1.00080 | .97728 | .95497 | .93374 | .91351 | .89417 | .87566 | .85791 | 58 |
| 59 | 1.02525 | 1.00040 | .97690 | .95460 | .93340 | .91318 | .89386 | .87536 | .85762 | 59 |

| 0h or 0° | PROP. LOGARITHMS. (r.) | | | | | | | | | 0h or 0° |
|---|---|---|---|---|---|---|---|---|---|---|
| ′. | 25′ | 26′ | 27′ | 28′ | 29′ | 30′ | 31′ | 32′ | 33 | ″ |
| 0 | .85733 | .84030 | .82391 | .80811 | .79287 | .77815 | .76391 | .75012 | .73676 | 0 |
| 1 | .85704 | .84002 | .82364 | .80786 | .79262 | .77791 | .76368 | .74990 | .73654 | 1 |
| 2 | 85675 | .83974 | .82337 | .80760 | .79238 | .77767 | .76344 | .74967 | .73632 | 2 |
| 3 | .85646 | .83946 | .82311 | .80734 | .79213 | .77743 | .76321 | .74944 | .73610 | 3 |
| 4 | .85618 | .83919 | .82284 | .80708 | .79188 | .77719 | .76298 | .74922 | .73588 | 4 |
| 5 | .85589 | .83891 | .82257 | .80683 | .79163 | .77695 | .76274 | .74899 | .73566 | 5 |
| 6 | .85560 | .83863 | .82230 | .80657 | .79138 | .77671 | .76251 | .74877 | .73544 | 6 |
| 7 | .85531 | .83835 | .82204 | .80631 | .79113 | .77647 | .76228 | .74854 | .73523 | 7 |
| 8 | .85502 | .83808 | .82177 | .80605 | .79088 | .77623 | .76205 | .74832 | .73501 | 8 |
| 9 | .85473 | .83780 | .82150 | .80579 | .79063 | .77599 | .76181 | .74809 | .73479 | 9 |
| 10 | .85445 | .83752 | .82124 | .80554 | .79039 | .77575 | .76158 | .74787 | .73457 | 10 |
| 11 | .85416 | .83725 | .82097 | .80528 | .79014 | .77551 | .76135 | .74764 | .73435 | 11 |
| 12 | .85387 | .83697 | .82070 | .80502 | .78989 | .77527 | .76112 | .74742 | .73413 | 12 |
| 13 | .85358 | .83670 | .82044 | .80477 | .78964 | .77503 | .76089 | .74719 | .73392 | 13 |
| 14 | .85330 | .83642 | .82017 | .80451 | .78939 | .77479 | .76065 | .74697 | .73370 | 14 |
| 15 | .85301 | .83614 | .81991 | .80425 | .78915 | .77455 | .76042 | .74674 | .73348 | 15 |
| 16 | .85272 | .83587 | .81964 | .80400 | .78890 | .77431 | .76019 | .74652 | .73326 | 16 |
| 17 | .85244 | .83559 | .81938 | .80374 | .78865 | .77407 | .75996 | .74629 | .73305 | 17 |
| 18 | .85215 | .83532 | .81911 | .80349 | .78840 | .77383 | .75973 | .74607 | .73283 | 18 |
| 19 | .85187 | .83504 | .81884 | .80323 | .78816 | .77359 | .75950 | .74585 | .73261 | 19 |
| 20 | .85158 | .83477 | .81858 | .80297 | .78791 | .77335 | .75927 | .74562 | .73239 | 20 |
| 21 | .85129 | .83449 | .81832 | .80272 | .78766 | .77311 | .75903 | .74540 | .73218 | 21 |
| 22 | .85101 | .83422 | .81805 | .80246 | .78742 | .77288 | .75880 | .74517 | .73196 | 22 |
| 23 | .85072 | .83394 | .81779 | .80221 | .78717 | .77264 | .75857 | .74495 | .73174 | 23 |
| 24 | .85044 | .83367 | .81752 | .80195 | .78693 | .77240 | .75834 | .74473 | .73153 | 24 |
| 25 | .85015 | .83339 | .81726 | .80170 | .78668 | .77216 | .75811 | .74450 | .73131 | 25 |
| 26 | .84987 | .83312 | .81699 | .80144 | .78643 | .77192 | .75788 | .74428 | .73109 | 26 |
| 27 | .84958 | .83285 | .81673 | .80119 | .78619 | .77169 | .75765 | .74406 | .73088 | 27 |
| 28 | .84930 | .83257 | .81647 | .80094 | .78594 | .77145 | .75742 | .74383 | .73066 | 28 |
| 29 | .84902 | .83230 | .81620 | .80068 | .78570 | .77121 | .75719 | .74361 | .73044 | 29 |
| 30 | .84873 | .83203 | .81594 | .80043 | .78545 | .77097 | .75696 | .74339 | .73023 | 30 |
| 31 | .84845 | .83175 | .81568 | .80017 | .78521 | .77074 | .75673 | .74317 | .73001 | 31 |
| 32 | .84816 | .83148 | .81541 | .79992 | .78496 | .77050 | .75650 | .74294 | .72980 | 32 |
| 33 | .84788 | .83121 | .81515 | .79967 | .78472 | .77026 | .75627 | .74272 | .72958 | 33 |
| 34 | .84760 | .83094 | .81489 | .79941 | .78447 | .77002 | .75604 | .74250 | .72936 | 34 |
| 35 | .84732 | .83066 | .81463 | .79916 | .78423 | .76979 | .75581 | .74228 | .72915 | 35 |
| 36 | .84703 | .83039 | .81436 | .79891 | .78398 | .76955 | .75559 | .74205 | .72893 | 36 |
| 37 | .84675 | .83012 | .81410 | .79865 | .78374 | .76931 | .75536 | .74183 | .72872 | 37 |
| 38 | .84647 | .82985 | .81384 | .79840 | .78349 | .76908 | .75513 | .74161 | .72850 | 38 |
| 39 | .84619 | .82958 | .81358 | .79815 | .78325 | .76884 | .75490 | .74139 | .72829 | 39 |
| 40 | .84590 | .82930 | .81332 | .79790 | .78300 | .76861 | .75467 | .74117 | .72807 | 40 |
| 41 | .84562 | .82903 | .81305 | .79764 | .78276 | .76837 | .75444 | .74095 | .72786 | 41 |
| 42 | .84534 | .82876 | .81279 | .79739 | .78252 | .76813 | .75421 | .74072 | .72764 | 42 |
| 43 | .84506 | .82849 | .81253 | .79714 | .78227 | .76790 | .75398 | .74050 | .72743 | 43 |
| 44 | .84478 | .82822 | .81227 | .79689 | .78203 | .76766 | .75376 | .74028 | .72721 | 44 |
| 45 | .84450 | .82795 | .81201 | .79663 | .78179 | .76743 | .75353 | .74006 | .72700 | 45 |
| 46 | .84421 | .82768 | .81175 | .79638 | .78154 | .76719 | .75330 | .73984 | .72678 | 46 |
| 47 | .84393 | .82741 | .81149 | .79613 | .78130 | .76696 | .75307 | .73962 | .72657 | 47 |
| 48 | .84365 | .82714 | .81123 | .79588 | .78106 | .76672 | .75285 | .73940 | .72636 | 48 |
| 49 | .84337 | .82687 | .81097 | .79563 | .78081 | .76649 | .75262 | .73918 | .72614 | 49 |
| 50 | .84309 | .82660 | .81071 | .79538 | .78057 | .76625 | .75239 | .73896 | .72593 | 50 |
| 51 | .84281 | .82633 | .81045 | .79513 | .78033 | .76602 | .75216 | .73874 | .72571 | 51 |
| 52 | .84253 | .82606 | .81019 | .79488 | .78009 | .76578 | .75194 | .73852 | .72550 | 52 |
| 53 | .84225 | .82579 | .80993 | .79463 | .77984 | .76555 | .75171 | .73830 | .72529 | 53 |
| 54 | .84197 | .82552 | .80967 | .79437 | .77960 | .76531 | .75148 | .73808 | .72507 | 54 |
| 55 | .84169 | .82525 | .80941 | .79412 | .77936 | .76508 | .75126 | .73786 | .72486 | 55 |
| 56 | .84141 | .82498 | .80915 | .79387 | .77912 | .76485 | .75103 | .73764 | .72465 | 56 |
| 57 | .84114 | .82471 | .80889 | .79362 | .77888 | .76461 | .75080 | .73742 | .72443 | 57 |
| 58 | .84086 | .82445 | .80863 | .79337 | .77863 | .76438 | .75058 | .73720 | .72422 | 58 |
| 59 | .84058 | .82418 | .80837 | .79312 | .77839 | .76414 | .75035 | .73698 | .72401 | 59 |

| 0ᵉ or 0° | | | PROP. LOGARITHMS. (r.) | | | | | 0ʰ or 6ʰ | |
|---|---|---|---|---|---|---|---|---|---|
| ″ | 34′ | 35′ | 36′ | 37′ | 38′ | 39′ | 40′ | 41′ | 42′ | ″ |
| 0 | .72379 | .71120 | .69897 | .68707 | .67549 | .66421 | .65321 | .64249 | .63202 | 0 |
| 1 | .72358 | .71100 | .69877 | .68688 | .67530 | .66402 | .65303 | .64231 | .63185 | 1 |
| 2 | .72337 | .71079 | .69857 | .68668 | .67511 | .66384 | .65285 | .64214 | .63168 | 2 |
| 3 | .72316 | .71058 | .69837 | .68648 | .67492 | .66365 | .65267 | .64196 | .63151 | 3 |
| 4 | .72294 | .71038 | .69817 | .68629 | .67473 | .66347 | .65249 | .64178 | .63133 | 4 |
| 5 | .72273 | .71017 | .69797 | .68609 | .67454 | .66328 | .65231 | .64161 | .63116 | 5 |
| 6 | .72252 | .70997 | .69777 | .68590 | .67435 | .66310 | .65213 | .64143 | .63099 | 6 |
| 7 | .72231 | .70976 | .69756 | .68570 | .67416 | .66291 | .65195 | .64125 | .63082 | 7 |
| 8 | .72209 | .70955 | .69736 | .68551 | .67397 | .66273 | .65177 | .64108 | .63065 | 8 |
| 9 | .72188 | .70935 | .69716 | .68531 | .67378 | .66254 | .65159 | .64090 | .63047 | 9 |
| 10 | .72167 | .70914 | .69696 | .68512 | .67359 | .66236 | .65141 | .64073 | .63030 | 10 |
| 11 | .72146 | .70894 | .69676 | .68492 | .67340 | .66217 | .65123 | .64055 | .63013 | 11 |
| 12 | .72125 | .70873 | .69656 | .68473 | .67321 | .66199 | .65105 | .64038 | .62996 | 12 |
| 13 | .72103 | .70852 | .69636 | .68454 | .67302 | .66180 | .65087 | .64020 | .62979 | 13 |
| 14 | .72082 | .70832 | .69616 | .68434 | .67283 | .66162 | .65069 | .64002 | .62962 | 14 |
| 15 | .72061 | .70811 | .69596 | .68415 | .67264 | .66143 | .65051 | .63985 | .62945 | 15 |
| 16 | .72040 | .70791 | .69576 | .68395 | .67245 | .66125 | .65033 | .63967 | .62927 | 16 |
| 17 | .72019 | .70770 | .69557 | .68376 | .67226 | .66106 | .65015 | .63950 | .62910 | 17 |
| 18 | .71998 | .70750 | .69537 | .68356 | .67207 | .66088 | .64997 | .63932 | .62893 | 18 |
| 19 | .71977 | .70729 | .69517 | .68337 | .67188 | .66070 | .64979 | .63915 | .62876 | 19 |
| 20 | .71956 | .70709 | .69497 | .68318 | .67170 | .66051 | .64961 | .63897 | .62859 | 20 |
| 21 | .71935 | .70688 | .69477 | .68298 | .67151 | .66033 | .64943 | .63880 | .62842 | 21 |
| 22 | .71914 | .70668 | .69457 | .68279 | .67132 | .66014 | .64925 | .63862 | .62825 | 22 |
| 23 | .71892 | .70647 | .69437 | .68259 | .67113 | .65996 | .64907 | .63845 | .62808 | 23 |
| 24 | .71871 | .70627 | .69417 | .68240 | .67094 | .65978 | .64889 | .63827 | .62791 | 24 |
| 25 | .71850 | .70606 | .69397 | .68221 | .67075 | .65959 | .64871 | .63810 | .62774 | 25 |
| 26 | .71829 | .70586 | .69377 | .68201 | .67056 | .65941 | .64853 | .63792 | .62757 | 26 |
| 27 | .71808 | .70566 | .69357 | .68182 | .67038 | .65923 | .64835 | .63775 | .62739 | 27 |
| 28 | .71787 | .70545 | .69338 | .68163 | .67019 | .65904 | .64818 | .63757 | .62722 | 28 |
| 29 | .71766 | .70525 | .69318 | .68143 | .67000 | .65886 | .64800 | .63740 | .62705 | 29 |
| 30 | .71745 | .70504 | .69298 | .68124 | .66981 | .65868 | .64782 | .63722 | .62688 | 30 |
| 31 | .71724 | .70484 | .69278 | .68105 | .66962 | .65849 | .64764 | .63705 | .62671 | 31 |
| 32 | .71703 | .70464 | .69258 | .68086 | .66944 | .65831 | .64746 | .63688 | .62654 | 32 |
| 33 | .71682 | .70443 | .69239 | .68066 | .66925 | .65813 | .64728 | .63670 | .62637 | 33 |
| 34 | .71661 | .70423 | .69219 | .68047 | .66906 | .65794 | .64710 | .63653 | .62620 | 34 |
| 35 | .71641 | .70403 | .69199 | .68028 | .66887 | .65776 | .64692 | .63635 | .62603 | 35 |
| 36 | .71620 | .70382 | .69179 | .68009 | .66869 | .65758 | .64675 | .63618 | .62586 | 36 |
| 37 | .71599 | .70362 | .69159 | .67989 | .66850 | .65739 | .64657 | .63601 | .62569 | 37 |
| 38 | .71578 | .70342 | .69140 | .67970 | .66831 | .65721 | .64639 | .63583 | .62552 | 38 |
| 39 | .71557 | .70321 | .69120 | .67951 | .66812 | .65703 | .64621 | .63566 | .62535 | 39 |
| 40 | .71536 | .70301 | .69100 | .67932 | .66794 | .65685 | .64603 | .63548 | .62518 | 40 |
| 41 | .71515 | .70281 | .69080 | .67912 | .66775 | .65666 | .64586 | .63531 | .62501 | 41 |
| 42 | .71494 | .70260 | .69061 | .67893 | .66756 | .65648 | .64568 | .63514 | .62485 | 42 |
| 43 | .71473 | .70240 | .69041 | .67874 | .66737 | .65630 | .64550 | .63496 | .62468 | 43 |
| 44 | .71453 | .70220 | .69021 | .67855 | .66719 | .65612 | .64532 | .63479 | .62451 | 44 |
| 45 | .71432 | .70200 | .69002 | .67836 | .66700 | .65594 | .64514 | .63462 | .62434 | 45 |
| 46 | .71411 | .70179 | .68982 | .67816 | .66681 | .65575 | .64497 | .63444 | .62417 | 46 |
| 47 | .71390 | .70159 | .68962 | .67797 | .66663 | .65557 | .64479 | .63427 | .62400 | 47 |
| 48 | .71369 | .70139 | .68942 | .67778 | .66644 | .65539 | .64461 | .63410 | .62383 | 48 |
| 49 | .71349 | .70119 | .68923 | .67759 | .66625 | .65521 | .64443 | .63392 | .62366 | 49 |
| 50 | .71328 | .70099 | .68903 | .67740 | .66607 | .65503 | .64426 | .63375 | .62349 | 50 |
| 51 | .71307 | .70078 | .68884 | .67721 | .66588 | .65484 | .64408 | .63358 | .62332 | 51 |
| 52 | .71286 | .70058 | .68864 | .67702 | .66570 | .65466 | .64390 | .63340 | .62315 | 52 |
| 53 | .71265 | .70038 | .68844 | .67682 | .66551 | .65448 | .64373 | .63323 | .62298 | 53 |
| 54 | .71245 | .70018 | .68825 | .67663 | .66532 | .65430 | .64355 | .63306 | .62282 | 54 |
| 55 | .71224 | .69998 | .68805 | .67644 | .66514 | .65412 | .64337 | .63289 | .62265 | 55 |
| 56 | .71203 | .69977 | .68785 | .67625 | .66495 | .65394 | .64320 | .63271 | .62248 | 56 |
| 57 | .71183 | .69957 | .68766 | .67606 | .66477 | .65376 | .64302 | .63254 | .62231 | 57 |
| 58 | .71162 | .69937 | .68746 | .67587 | .66458 | .65357 | .64284 | .63237 | .62214 | 58 |
| 59 | .71141 | .69917 | .68727 | .67568 | .66439 | .65339 | .64267 | .63220 | .62197 | 59 |

| 0h or 0° | PROP. LOGARITHMS. (r) | 0h or 0° |
|---|---|---|

| " | 43′ | 44′ | 45′ | 46′ | 47′ | 48′ | 49′ | 50′ | 51′ | " |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .62180 | .61182 | .60206 | .59251 | .58317 | .57403 | .56508 | .55630 | .54770 | 0 |
| 1 | .62164 | .61166 | .60190 | .59236 | .58302 | .57388 | .56493 | .55616 | .54756 | 1 |
| 2 | .62147 | .61149 | .60174 | .59220 | .58287 | .57373 | .56478 | .55601 | .54742 | 2 |
| 3 | .62130 | .61133 | .60158 | .59204 | .58271 | .57358 | .56463 | .55587 | .54728 | 3 |
| 4 | .62113 | .61116 | .60142 | .59189 | .58256 | .57343 | .56449 | .55572 | .54714 | 4 |
| 5 | .62096 | .61100 | .60126 | .59173 | .58241 | .57328 | .56434 | .55558 | .54699 | 5 |
| 6 | .62080 | .61083 | .60110 | .59157 | .58225 | .57313 | .56419 | .55543 | .54685 | 6 |
| 7 | .62063 | .61067 | .60094 | .59141 | .58210 | .57298 | .56404 | .55529 | .54671 | 7 |
| 8 | .62046 | .61051 | .60078 | .59126 | .58194 | .57283 | .56390 | .55515 | .54657 | 8 |
| 9 | .62029 | .61034 | .60061 | .59110 | .58179 | .57268 | .56375 | .55500 | .54643 | 9 |
| 10 | .62012 | .61018 | .60045 | .59094 | .58164 | .57253 | .56360 | .55486 | .54629 | 10 |
| 11 | .61996 | .61001 | .60029 | .59079 | .58148 | .57238 | .56345 | .55471 | .54614 | 11 |
| 12 | .61979 | .60985 | .60013 | .59063 | .58133 | .57223 | .56331 | .55457 | .54600 | 12 |
| 13 | .61962 | .60969 | .59997 | .59047 | .58118 | .57208 | .56316 | .55442 | .54586 | 13 |
| 14 | .61945 | .60952 | .59981 | .59032 | .58102 | .57193 | .56301 | .55428 | .54572 | 14 |
| 15 | .61929 | .60936 | .59965 | .59016 | .58087 | .57178 | .56287 | .55414 | .54558 | 15 |
| 16 | .61912 | .60920 | .59949 | .59000 | .58072 | .57163 | .56272 | .55399 | .54544 | 16 |
| 17 | .61895 | .60903 | .59933 | .58985 | .58056 | .57148 | .56257 | .55385 | .54530 | 17 |
| 18 | .61878 | .60887 | .59917 | .58969 | .58041 | .57133 | .56243 | .55370 | .54516 | 18 |
| 19 | .61862 | .60871 | .59901 | .58953 | .58026 | .57118 | .56228 | .55356 | .54501 | 19 |
| 20 | .61845 | .60854 | .59885 | .58938 | .58011 | .57103 | .56213 | .55342 | .54487 | 20 |
| 21 | .61828 | .60838 | .59870 | .58922 | .57995 | .57088 | .56199 | .55327 | .54473 | 21 |
| 22 | .61812 | .60822 | .59854 | .58907 | .57980 | .57073 | .56184 | .55313 | .54459 | 22 |
| 23 | .61795 | .60805 | .59838 | .58891 | .57965 | .57058 | .56169 | .55299 | .54445 | 23 |
| 24 | 61778 | .60789 | .59822 | .58875 | .57949 | .57043 | .56155 | .55284 | .54431 | 24 |
| 25 | .61762 | .60773 | .59806 | .58860 | .57934 | .57028 | .56140 | .55270 | .54417 | 25 |
| 26 | .61745 | .60756 | .59790 | .58844 | .57919 | .57013 | .56125 | .55255 | .54403 | 26 |
| 27 | .61728 | .60740 | .59774 | .58829 | .57904 | .56998 | .56111 | .55241 | .54389 | 27 |
| 28 | .61712 | .60724 | .59758 | .58813 | .57888 | .56983 | .56096 | .55227 | .54375 | 28 |
| 29 | .61695 | .60708 | .59742 | .58798 | .57873 | .56968 | .56081 | .55212 | .54361 | 29 |
| 30 | .61678 | .60691 | .59726 | .58782 | .57858 | .56953 | .56067 | .55198 | .54347 | 30 |
| 31 | .61662 | .60675 | .59710 | .58766 | .57843 | .56938 | .56052 | .55184 | 54332 | 31 |
| 32 | .61645 | .60659 | .59694 | .58751 | .57827 | .56923 | .56037 | .55169 | .54318 | 32 |
| 33 | .61628 | .60642 | .59678 | .58735 | .57812 | .56908 | .56023 | .55155 | .54304 | 33 |
| 34 | .61612 | .60626 | .59663 | .58720 | .57797 | .56893 | .56008 | .55141 | .54290 | 34 |
| 35 | .61595 | .60610 | .59647 | .58704 | .57782 | .56879 | .55994 | .55127 | .54276 | 35 |
| 36 | .61579 | .60594 | .59631 | .58689 | .57767 | .56864 | .55979 | .55112 | .54262 | 36 |
| 37 | .61562 | .60578 | .59615 | .58673 | .57751 | .56849 | .55964 | .55098 | .54248 | 37 |
| 38 | .61545 | .60561 | .59599 | .58658 | .57736 | .56834 | .55950 | .55084 | .54234 | 38 |
| 39 | .61529 | .60545 | .59583 | .58642 | .57721 | .56819 | .55935 | .55069 | .54220 | 39 |
| 40 | .61512 | .60529 | .59567 | .58627 | .57706 | .56804 | .55921 | .55055 | .54206 | 40 |
| 41 | .61496 | .60513 | .59551 | .58611 | .57691 | .56789 | .55906 | .55041 | .54192 | 41 |
| 42 | .61479 | .60496 | .59536 | .58596 | .57675 | .56774 | .55892 | .55026 | .54178 | 42 |
| 43 | .61463 | .60480 | .59520 | .58580 | .57660 | .56759 | .55877 | .55012 | .54164 | 43 |
| 44 | .61446 | .60464 | .59504 | .58565 | .57645 | .56745 | .55862 | .54998 | .54150 | 44 |
| 45 | .61429 | .60448 | .59488 | .58549 | .57630 | .56730 | .55848 | .54984 | .54136 | 45 |
| 46 | .61413 | .60432 | .59472 | .58534 | .57615 | .56715 | .55833 | .54969 | .54122 | 46 |
| 47 | .61396 | .60416 | .59457 | .58518 | .57600 | .56700 | .55819 | .54955 | .54108 | 47 |
| 48 | .61380 | .60399 | .59441 | .58503 | .57584 | .56685 | .55804 | .54941 | .54094 | 48 |
| 49 | 61363 | .60383 | .59425 | .58487 | .57569 | .56670 | .55790 | .54927 | .54080 | 49 |
| 50 | .61347 | .60367 | .59409 | .58472 | .57554 | .56656 | .55775 | .54912 | .54066 | 50 |
| 51 | .61330 | .60351 | .59393 | .58456 | .57539 | .56641 | .55761 | .54898 | .54052 | 51 |
| 52 | .61314 | .60335 | .59378 | .58441 | .57524 | .56626 | .55746 | .54884 | .54038 | 52 |
| 53 | .61297 | .60319 | .59362 | .58425 | .57509 | .56611 | .55732 | .54870 | .54024 | 53 |
| 54 | .61281 | .60303 | .59346 | .58410 | .57494 | .56596 | .55717 | .54855 | .54011 | 54 |
| 55 | .61264 | .60286 | .59330 | .58395 | .57479 | .56582 | .55703 | .54841 | .53997 | 55 |
| 56 | .61248 | .60270 | .59314 | .58379 | .57463 | .56567 | .55688 | .54827 | .53983 | 56 |
| 57 | .61231 | .60254 | .59299 | .58364 | .57448 | .56552 | .55674 | .54813 | .53969 | 57 |
| 58 | .61215 | .60238 | .59283 | .58348 | .57433 | .56537 | .55659 | .54799 | .53955 | 58 |
| 59 | .61198 | .60222 | .59267 | .58333 | .57418 | .56522 | .55645 | .54784 | .53941 | 59 |

| 0h or 0° | PROP. LOGARITHMS. (r.) | | | | | | | | 0h or 0° |
|---|---|---|---|---|---|---|---|---|---|
| ′ | 52′ | 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | ″ |
| 0 | .53927 | .53100 | .52288 | .51491 | .50708 | .49940 | .49184 | .48442 | 0 |
| 1 | .53913 | .53086 | .52274 | .51478 | .50696 | .49927 | .49172 | .48430 | 1 |
| 2 | .53899 | .53072 | .52261 | .51465 | .50683 | .49914 | .49159 | .48418 | 2 |
| 3 | .53885 | .53059 | .52248 | .51452 | .50670 | .49902 | .49147 | .48405 | 3 |
| 4 | .53871 | .53045 | .52234 | .51438 | .50657 | .49889 | .49135 | .48393 | 4 |
| 5 | .53857 | .53031 | .52221 | .51425 | 50644 | .49876 | .49122 | .48381 | 5 |
| 6 | .53843 | .53018 | .52208 | .51412 | .50631 | .49864 | .49110 | .48369 | 6 |
| 7 | .53830 | .53004 | .52194 | .51399 | .50618 | .49851 | .49097 | .48356 | 7 |
| 8 | .53816 | .52991 | .52181 | .51386 | 50605 | .49838 | .49085 | .48344 | 8 |
| 9 | .53802 | .52977 | .52167 | .51373 | .50592 | .49826 | .49072 | .48332 | 9 |
| 10 | .53788 | .52963 | .52154 | .51360 | .50579 | .49813 | .49060 | .48320 | 10 |
| 11 | .53774 | 52950 | .52141 | .51346 | .50566 | .49800 | .49047 | .48307 | 11 |
| 12 | .53760 | .52936 | .52127 | .51333 | .50554 | .49788 | .49035 | .48295 | 12 |
| 13 | .53746 | .52922 | .52114 | .51320 | .50541 | .49775 | .49023 | .48283 | 13 |
| 14 | .53732 | .52909 | .52101 | .51307 | .50528 | .49762 | .49010 | .48271 | 14 |
| 15 | .53719 | .52895 | .52087 | .51294 | .50515 | .49750 | .48998 | .48258 | 15 |
| 16 | .53705 | .52882 | .52074 | .51281 | .50502 | .49737 | .48985 | .48246 | 16 |
| 17 | .53691 | .52868 | .52061 | .51268 | 50489 | .49724 | .48973 | .48234 | 17 |
| 18 | .53677 | .52855 | .52047 | .51255 | .50476 | .49712 | .48960 | .48222 | 18 |
| 19 | .53663 | .52841 | .52034 | .51242 | .50464 | .49699 | .48948 | .48210 | 19 |
| 20 | .53649 | .52827 | .52021 | .51229 | .50451 | .49687 | .48936 | .48197 | 20 |
| 21 | .53636 | 52814 | .52007 | .51215 | .50438 | .49674 | .48923 | .48185 | 21 |
| 22 | .53622 | .52800 | .51994 | .51202 | .50425 | .49661 | .48911 | .48173 | 22 |
| 23 | .53608 | .52787 | .51981 | .51189 | .50412 | .49649 | .48898 | .48161 | 23 |
| 24 | .53594 | .52773 | .51967 | .51176 | .50399 | .49636 | .48886 | .48149 | 24 |
| 25 | .53580 | .52760 | .51954 | .51163 | .50387 | .49623 | .48874 | .48136 | 25 |
| 26 | .53567 | .52746 | .51941 | .51150 | .50374 | .49611 | .48861 | .48124 | 26 |
| 27 | .53553 | .52732 | .51927 | .51137 | .50361 | .49598 | .48849 | .48112 | 27 |
| 28 | .53539 | .52719 | .51914 | .51124 | .50348 | .49586 | .48836 | .48100 | 28 |
| 29 | .53525 | .52705 | .51901 | .51111 | .50335 | .49573 | .48824 | .48088 | 29 |
| 30 | .53511 | .52692 | .51888 | .51098 | .50322 | .49560 | .48812 | .48076 | 30 |
| 31 | .53498 | .52678 | .51874 | .51085 | .50310 | .49548 | .48799 | .48063 | 31 |
| 32 | .53484 | 52665 | .51861 | .51072 | .50297 | .49535 | .48787 | .48051 | 32 |
| 33 | .53470 | .52651 | .51848 | .51059 | .50284 | .49523 | .48775 | .48039 | 33 |
| 34 | .53456 | .52638 | .51835 | 51046 | .50271 | .49510 | .48762 | .48027 | 34 |
| 35 | .53442 | .52624 | .51821 | .51033 | .50258 | .49498 | .48750 | .48015 | 35 |
| 36 | .53429 | .52611 | .51808 | .51020 | .50246 | .49485 | .48737 | .48003 | 36 |
| 37 | .53415 | .52597 | .51795 | .51007 | .50233 | .49472 | .48725 | .47990 | 37 |
| 38 | .53401 | .52584 | .51781 | .50994 | .50220 | .49460 | .48713 | .47978 | 38 |
| 39 | .53387 | .52570 | .51768 | 50981 | .50207 | .49447 | .48700 | .47966 | 39 |
| 40 | .53374 | .52557 | .51755 | .50968 | .50194 | .49435 | .48688 | .47954 | 40 |
| 41 | .53360 | .52543 | .51742 | .50955 | .50182 | .49422 | .48676 | .47942 | 41 |
| 42 | .53346 | .52530 | .51729 | .50942 | .50169 | .49410 | .48663 | .47930 | 42 |
| 43 | .53332 | .52516 | .51715 | .50929 | .50156 | .49397 | .48651 | .47918 | 43 |
| 44 | .53319 | .52503 | .51702 | .50916 | .50143 | .49385 | .48639 | .47906 | 44 |
| 45 | .53305 | .52489 | .51689 | .50903 | .50131 | .49372 | .48626 | .47893 | 45 |
| 46 | .53291 | .52476 | .51676 | .50890 | .50118 | .49360 | .48614 | .47881 | 46 |
| 47 | .53278 | .52462 | .51662 | .50877 | .50105 | .49347 | .48602 | .47869 | 47 |
| 48 | .53264 | .52449 | .51649 | .50864 | .50092 | .49334 | .48590 | .47857 | 48 |
| 49 | .53250 | .52436 | .51636 | .50851 | .50080 | .49322 | .48577 | .47845 | 49 |
| 50 | .53236 | .52422 | .51623 | 50838 | .50067 | .49309 | .48565 | .47833 | 50 |
| 51 | .53223 | .52409 | .51610 | .50825 | .50054 | .49297 | .48553 | .47821 | 51 |
| 52 | .53209 | .52395 | .51596 | .50812 | .50041 | .49284 | .48540 | .47809 | 52 |
| 53 | .53195 | .52382 | .51583 | .50799 | .50029 | .49272 | .48528 | .47797 | 53 |
| 54 | .53182 | .52368 | .51570 | .50786 | .50016 | .49259 | .48516 | .47785 | 54 |
| 55 | .53168 | .52355 | .51557 | .50773 | .50003 | .49247 | .48503 | .47772 | 55 |
| 56 | .53154 | .52342 | .51544 | .50760 | .49991 | .49234 | .48491 | .47760 | 56 |
| 57 | .53141 | .52328 | .51530 | .50747 | .49978 | .49222 | .48479 | .47748 | 57 |
| 58 | .53127 | .52315 | .51517 | .50734 | .49965 | .49209 | .48467 | .47736 | 58 |
| 59 | .53113 | .52301 | .51504 | .50721 | .49952 | .49197 | .48454 | .47724 | 59 |

| 1h or 1° | PROP. LOGARITHMS. (r.) | | | | | | | | | 1h or 1' |
|---|---|---|---|---|---|---|---|---|---|---|
| " | 0' | 1 | 2' | 3' | 4' | 5' | 6' | 7' | 8' | 9' |
| 0 | .47712 | .46994 | .46288 | .45593 | .44909 | .44236 | .43573 | .42920 | .42276 | .41642 |
| 1 | .47700 | .46982 | .46276 | .45582 | .44898 | .44225 | .43562 | .42909 | .42266 | .41632 |
| 2 | .47688 | .46971 | .46265 | .45570 | .44887 | .44214 | .43551 | .42898 | .42255 | .41621 |
| 3 | .47676 | .46959 | .46253 | .45559 | .44875 | .44203 | .43540 | .42887 | .42244 | .41611 |
| 4 | .47664 | .46947 | .46241 | .45547 | .44864 | .44191 | .43529 | .42877 | .42234 | .41600 |
| 5 | .47652 | .46935 | .46230 | .45536 | .44853 | .44180 | .43518 | .42866 | .42223 | .41590 |
| 6 | .47640 | .46923 | .46218 | .45524 | .44841 | .44169 | .43507 | .42855 | .42213 | .41579 |
| 7 | .47628 | .46911 | .46206 | .45513 | .44830 | .44158 | .43496 | .42844 | .42202 | .41569 |
| 8 | .47616 | .46899 | .46195 | .45501 | .44819 | .44147 | .43485 | .42833 | .42191 | .41559 |
| 9 | .47604 | .46888 | .46183 | .45490 | .44808 | .44136 | .43474 | .42823 | .42181 | .41548 |
| 10 | .47592 | .46876 | .46171 | .45478 | .44796 | .44125 | .43463 | .42812 | .42170 | .41538 |
| 11 | .47580 | .46864 | .46160 | .45467 | .44785 | .44114 | .43452 | .42801 | .42159 | .41527 |
| 12 | .47568 | .46852 | .46148 | .45456 | .44774 | .44102 | .43441 | .42790 | .42149 | .41517 |
| 13 | .47556 | .46840 | .46137 | .45444 | .44762 | .44091 | .43431 | .42780 | .42138 | .41506 |
| 14 | .47544 | .46828 | .46125 | .45433 | .44751 | .44080 | .43420 | .42769 | .42128 | .41496 |
| 15 | .47532 | .46817 | .46113 | .45421 | .44740 | .44069 | .43409 | .42758 | .42117 | .41485 |
| 16 | .47520 | .46805 | .46102 | .45410 | .44729 | .44058 | .43398 | .42747 | .42106 | .41475 |
| 17 | .47508 | .46793 | .46090 | .45398 | .44717 | .44047 | .43387 | .42737 | .42096 | .41464 |
| 18 | .47496 | .46781 | .46078 | .45387 | .44706 | .44036 | .43376 | .42726 | .42085 | .41454 |
| 19 | .47484 | .46769 | .46067 | .45375 | .44695 | .44025 | .43365 | .42715 | .42075 | .41443 |
| 20 | .47472 | .46758 | .46055 | .45364 | .44684 | .44014 | .43354 | .42704 | .42064 | .41433 |
| 21 | .47460 | .46746 | .46044 | .45353 | .44672 | .44003 | .43343 | .42693 | .42053 | .41423 |
| 22 | .47448 | .46734 | .46032 | .45341 | .44661 | .43992 | .43332 | .42683 | .42043 | .41412 |
| 23 | .47436 | .46722 | .46020 | .45330 | .44650 | .43981 | .43321 | .42672 | .42032 | .41402 |
| 24 | .47424 | .46710 | .46009 | .45318 | .44639 | .43969 | .43310 | .42661 | .42022 | .41391 |
| 25 | .47412 | .46699 | .45997 | .45307 | .44627 | .43958 | .43300 | .42651 | .42011 | .41381 |
| 26 | .47400 | .46687 | .45986 | .45295 | .44616 | .43947 | .43289 | .42640 | .42000 | .41370 |
| 27 | .47388 | .46675 | .45974 | .45284 | .44605 | .43936 | .43278 | .42629 | .41990 | .41360 |
| 28 | .47376 | .46663 | .45962 | .45273 | .44594 | .43925 | .43267 | .42618 | .41979 | .41350 |
| 29 | .47364 | .46652 | .45951 | .45261 | .44583 | .43914 | .43256 | .42608 | .41969 | .41339 |
| 30 | .47352 | .46640 | .45939 | .45250 | .44571 | .43903 | .43245 | .42597 | .41958 | .41329 |
| 31 | .47340 | .46628 | .45928 | .45238 | .44560 | .43892 | .43234 | .42586 | .41948 | .41318 |
| 32 | .47328 | .46616 | .45916 | .45227 | .44549 | .43881 | .43223 | .42575 | .41937 | .41308 |
| 33 | .47316 | .46604 | .45905 | .45216 | .44538 | .43870 | .43212 | .42565 | .41927 | .41298 |
| 34 | .47304 | .46593 | .45893 | .45204 | .44526 | .43859 | .43202 | .42554 | .41916 | .41287 |
| 35 | .47292 | .46581 | .45881 | .45193 | .44515 | .43848 | .43191 | .42543 | .41905 | .41277 |
| 36 | .47280 | .46569 | .45870 | .45182 | .44504 | .43837 | .43180 | .42533 | .41895 | .41266 |
| 37 | .47268 | .46557 | .45858 | .45170 | .44493 | .43826 | .43169 | .42522 | .41884 | .41256 |
| 38 | .47256 | .46546 | .45847 | .45159 | .44482 | .43815 | .43158 | .42511 | .41874 | .41246 |
| 39 | .47244 | .46534 | .45835 | .45147 | .44470 | .43804 | .43147 | .42500 | .41863 | .41235 |
| 40 | .47232 | .46522 | .45824 | .45136 | .44459 | .43793 | .43136 | .42490 | .41853 | .41225 |
| 41 | .47220 | .46510 | .45812 | .45125 | .44448 | .43782 | .43126 | .42479 | .41842 | .41214 |
| 42 | .47208 | .46499 | .45800 | .45113 | .44437 | .43771 | .43115 | .42468 | .41832 | .41204 |
| 43 | .47196 | .46487 | .45789 | .45102 | .44426 | .43760 | .43104 | .42458 | .41821 | .41194 |
| 44 | .47185 | .46475 | .45777 | .45091 | .44414 | .43749 | .43093 | .42447 | .41811 | .41183 |
| 45 | .47173 | .46464 | .45766 | .45079 | .44403 | .43738 | .43082 | .42436 | .41800 | .41173 |
| 46 | .47161 | .46452 | .45754 | .45068 | .44392 | .43727 | .43071 | .42426 | .41789 | .41162 |
| 47 | .47149 | .46440 | .45743 | .45057 | .44381 | .43716 | .43060 | .42415 | .41779 | .41152 |
| 48 | .47137 | .46428 | .45731 | .45045 | .44370 | .43705 | .43050 | .42404 | .41768 | .41142 |
| 49 | .47125 | .46417 | .45720 | .45034 | .44359 | .43694 | .43039 | .42394 | .41758 | .41131 |
| 50 | .47113 | .46405 | .45708 | .45022 | .44347 | .43683 | .43028 | .42383 | .41747 | .41121 |
| 51 | .47101 | .46393 | .45697 | .45011 | .44336 | .43672 | .43017 | .42372 | .41737 | .41111 |
| 52 | .47089 | .46382 | .45685 | .45000 | .44325 | .43661 | .43006 | .42362 | .41726 | .41100 |
| 53 | .47077 | .46370 | .45674 | .44988 | .44314 | .43650 | .42995 | .42351 | .41716 | .41090 |
| 54 | .47066 | .46358 | .45662 | .44977 | .44303 | .43639 | .42985 | .42340 | .41705 | .41080 |
| 55 | .47054 | .46346 | .45651 | .44966 | .44292 | .43628 | .42974 | .42330 | .41695 | .41069 |
| 56 | .47042 | .46335 | .45639 | .44955 | .44280 | .43617 | .42963 | .42319 | .41684 | .41059 |
| 57 | .47030 | .46323 | .45628 | .44943 | .44269 | .43606 | .42952 | .42308 | .41674 | .41048 |
| 58 | .47018 | .46311 | .45616 | .44932 | .44258 | .43595 | .42941 | .42298 | .41663 | .41038 |
| 59 | .47006 | .46300 | .45605 | .44921 | .44247 | .43584 | .42931 | .42287 | .41653 | .41028 |

| 1ʰ or 1° | PROP. LOGARITHMS. (r.) | | | | | | | | | 1ʰ or 1° |
|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 10′ | 11′ | 12′ | 13′ | 14′ | 15′ | 16′ | 17′ | 18′ | 19′ |
| 0 | .41017 | .40401 | .39794 | .39195 | .38604 | .38021 | .37446 | .36878 | .36318 | .35765 |
| 1 | .41007 | .40391 | .39784 | .39185 | .38594 | .38011 | .37436 | .36869 | .36309 | .35755 |
| 2 | .40997 | .40381 | .39774 | .39175 | .38585 | .38002 | .37427 | .36859 | .36299 | .35746 |
| 3 | .40986 | .40371 | .39764 | .39165 | .38575 | .37992 | .37417 | .36850 | .36290 | .35737 |
| 4 | .40976 | .40361 | .39754 | .39155 | .38565 | .37983 | .37408 | .36841 | .36281 | .35728 |
| 5 | .40966 | .40350 | .39744 | .39145 | .38555 | .37973 | .37398 | .36831 | .36271 | .35719 |
| 6 | .40955 | .40340 | .39734 | .39136 | .38545 | .37963 | .37389 | .36822 | .36262 | .35710 |
| 7 | .40945 | .40330 | .39724 | .39126 | .38536 | .37954 | .37379 | .36812 | .36253 | .35700 |
| 8 | .40935 | .40320 | .39714 | .39116 | .38526 | .37944 | .37370 | .36803 | .36244 | .35691 |
| 9 | .40924 | .40310 | .39704 | .39106 | .38516 | .37934 | .37360 | .36794 | .36234 | .35682 |
| 10 | .40914 | .40300 | .39694 | .39096 | .38506 | .37925 | .37351 | .36784 | .36225 | .35673 |
| 11 | .40904 | .40289 | .39684 | .39086 | .38497 | .37915 | .37341 | .36775 | .36216 | .35664 |
| 12 | .40894 | .40279 | .39674 | .39076 | .38487 | .37905 | .37332 | .36766 | .36207 | .35655 |
| 13 | .40883 | .40269 | .39664 | .39066 | .38477 | .37896 | .37322 | .36756 | .36197 | .35646 |
| 14 | .40873 | .40259 | .39653 | .39056 | .38467 | .37886 | .37313 | .36747 | .36188 | .35636 |
| 15 | .40863 | .40249 | .39643 | .39046 | .38458 | .37877 | .37303 | .36737 | .36179 | .35627 |
| 16 | .40852 | .40239 | .39633 | .39037 | .38448 | .37867 | .37294 | .36728 | .36170 | .35618 |
| 17 | .40842 | .40228 | .39623 | .39027 | .38438 | .37857 | .37284 | .36719 | .36160 | .35609 |
| 18 | .40832 | .40218 | .39613 | .39017 | .38428 | .37848 | .37275 | .36709 | .36151 | .35600 |
| 19 | .40821 | .40208 | .39603 | .39007 | .38419 | .37838 | .37265 | .36700 | .36142 | .35591 |
| 20 | .40811 | .40198 | .39593 | .38997 | .38409 | .37829 | .37256 | .36691 | .36133 | .35582 |
| 21 | .40801 | .40188 | .39583 | .38987 | .38399 | .37819 | .37246 | .36681 | .36123 | .35573 |
| 22 | .40791 | .40178 | .39573 | .38977 | .38389 | .37809 | .37237 | .36672 | .36114 | .35563 |
| 23 | .40780 | .40168 | .39563 | .38968 | .38380 | .37800 | .37227 | .36663 | .36105 | .35554 |
| 24 | .40770 | .40157 | .39553 | .38958 | .38370 | .37790 | .37218 | .36653 | .36096 | .35545 |
| 25 | .40760 | .40147 | .39543 | .38948 | .38360 | .37781 | .37208 | .36644 | .36086 | .35536 |
| 26 | .40749 | .40137 | .39533 | .38938 | .38351 | .37771 | .37199 | .36634 | .36077 | .35527 |
| 27 | .40739 | .40127 | .39523 | .38928 | .38341 | .37761 | .37189 | .36625 | .36068 | .35518 |
| 28 | .40729 | .40117 | .39513 | .38918 | .38331 | .37752 | .37180 | .36616 | .36059 | .35509 |
| 29 | .40719 | .40107 | .39503 | .38908 | .38321 | .37742 | .37171 | .36606 | .36050 | .35500 |
| 30 | .40708 | .40097 | .39493 | .38899 | .38312 | .37733 | .37161 | .36597 | .36040 | .35491 |
| 31 | .40698 | .40087 | .39483 | .38889 | .38302 | .37723 | .37152 | .36588 | .36031 | .35481 |
| 32 | .40688 | .40076 | .39473 | .38879 | .38292 | .37713 | .37142 | .36578 | .36022 | .35472 |
| 33 | .40678 | .40066 | .39464 | .38869 | .38282 | .37704 | .37133 | .36569 | .36013 | .35463 |
| 34 | .40667 | .40056 | .39454 | .38859 | .38273 | .37694 | .37123 | .36560 | .36003 | .35454 |
| 35 | .40657 | .40046 | .39444 | .38849 | .38263 | .37685 | .37114 | .36550 | .35994 | .35445 |
| 36 | .40647 | .40036 | .39434 | .38839 | .38253 | .37675 | .37104 | .36541 | .35985 | .35436 |
| 37 | .40637 | .40026 | .39424 | .38830 | .38244 | .37665 | .37095 | .36532 | .35976 | .35427 |
| 38 | .40626 | .40016 | .39414 | .38820 | .38234 | .37656 | .37085 | .36522 | .35967 | .35418 |
| 39 | .40616 | .40006 | .39404 | .38810 | .38224 | .37646 | .37076 | .36513 | .35957 | .35409 |
| 40 | .40606 | .39996 | .39394 | .38800 | .38215 | .37637 | .37067 | .36504 | .35948 | .35400 |
| 41 | .40596 | .39985 | .39384 | .38790 | .38205 | .37627 | .37057 | .36494 | .35939 | .35391 |
| 42 | .40585 | .39975 | .39374 | .38781 | .38195 | .37618 | .37048 | .36485 | .35930 | .35381 |
| 43 | .40575 | .39965 | .39364 | .38771 | .38186 | .37608 | .37038 | .36476 | .35921 | .35372 |
| 44 | .40565 | .39955 | .39354 | .38761 | .38176 | .37599 | .37029 | .36467 | .35911 | .35363 |
| 45 | .40555 | .39945 | .39344 | .38751 | .38166 | .37589 | .37019 | .36457 | .35902 | .35354 |
| 46 | .40544 | .39935 | .39334 | .38741 | .38156 | .37579 | .37010 | .36448 | .35893 | .35345 |
| 47 | .40534 | .39925 | .39324 | .38731 | .38147 | .37570 | .37001 | .36439 | .35884 | .35336 |
| 48 | .40524 | .39915 | .39314 | .38722 | .38137 | .37560 | .36991 | .36429 | .35875 | .35327 |
| 49 | .40514 | .39905 | .39304 | .38712 | .38127 | .37551 | .36982 | .36420 | .35865 | .35318 |
| 50 | .40503 | .39895 | .39294 | .38702 | .38118 | .37541 | .36972 | .36411 | .35856 | .35309 |
| 51 | .40493 | .39885 | .39284 | .38692 | .38108 | .37532 | .36963 | .36401 | .35847 | .35300 |
| 52 | .40483 | .39874 | .39274 | .38682 | .38098 | .37522 | .36953 | .36392 | .35838 | .35291 |
| 53 | .40473 | .39864 | .39264 | .38673 | .38089 | .37513 | .36944 | .36383 | .35829 | .35282 |
| 54 | .40463 | .39854 | .39254 | .38663 | .38079 | .37503 | .36935 | .36374 | .35820 | .35273 |
| 55 | .40452 | .39844 | .39245 | .38653 | .38069 | .37494 | .36925 | .36364 | .35810 | .35264 |
| 56 | .40442 | .39834 | .39235 | .38643 | .38060 | .37484 | .36916 | .36355 | .35801 | .35254 |
| 57 | .40432 | .39824 | .39225 | .38633 | .38050 | .37474 | .36906 | .36346 | .35792 | .35245 |
| 58 | .40422 | .39814 | .39215 | .38624 | .38040 | .37465 | .36897 | .36336 | .35783 | .35236 |
| 59 | .40412 | .39804 | .39205 | .38614 | .38031 | .37455 | .36888 | .36327 | .35774 | .35227 |

| 1h or 1°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 1h or 1°. |
|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 20′ | 21′ | 22′ | 23′ | 24′ | 25′ | 26′ | 27′ | 28′ | 29′ |
| 0 | .35218 | .34679 | .34146 | .33619 | .33099 | .32585 | .32077 | .31575 | .31079 | .30588 |
| 1 | .35209 | .34670 | .34137 | .33611 | .33091 | .32577 | .32069 | .31567 | .31071 | .30580 |
| 2 | .35200 | .34661 | .34128 | .33602 | .33082 | .32568 | .32061 | .31559 | .31063 | .30572 |
| 3 | .35191 | .34652 | .34119 | .33593 | .33073 | .32560 | .32052 | .31550 | .31054 | .30564 |
| 4 | .35182 | .34643 | .34111 | .33585 | .33065 | .32551 | .32044 | .31542 | .31046 | .30556 |
| 5 | .35173 | .34634 | .34102 | .33576 | .33056 | .32543 | .32035 | .31534 | .31038 | .30548 |
| 6 | .35164 | .34625 | .34093 | .33567 | .33048 | .32534 | .32027 | .31525 | .31030 | .30539 |
| 7 | .35155 | .34616 | .34084 | .33558 | .33039 | .32526 | .32019 | .31517 | .31021 | .30531 |
| 8 | .35146 | .34607 | .34075 | .33550 | .33030 | .32517 | .32010 | .31509 | .31013 | .30523 |
| 9 | .35137 | .34598 | .34066 | .33541 | .33022 | .32509 | .32002 | .31501 | .31005 | .30515 |
| 10 | .35128 | .34589 | .34058 | .33532 | .33013 | .32500 | .31993 | .31492 | .30997 | .30507 |
| 11 | .35119 | .34581 | .34049 | .33524 | .33005 | .32492 | .31985 | .31484 | .30989 | .30499 |
| 12 | .35110 | .34572 | .34040 | .33515 | .32996 | .32483 | .31977 | .31476 | .30980 | .30491 |
| 13 | .35101 | .34563 | .34031 | .33506 | .32987 | .32475 | .31968 | .31467 | .30972 | .30483 |
| 14 | .35092 | .34554 | .34022 | .33498 | .32979 | .32466 | .31960 | .31459 | .30964 | .30475 |
| 15 | .35083 | .34545 | .34014 | .33489 | .32970 | .32458 | .31951 | .31451 | .30956 | .30466 |
| 16 | .35074 | .34536 | .34005 | .33480 | .32962 | .32449 | .31943 | .31442 | .30948 | .30458 |
| 17 | .35065 | .34527 | .33996 | .33471 | .32953 | .32441 | .31935 | .31434 | .30939 | .30450 |
| 18 | .35056 | .34518 | .33987 | .33463 | .32944 | .32432 | .31926 | .31426 | .30931 | .30442 |
| 19 | .35047 | .34509 | .33978 | .33454 | .32936 | .32424 | .31918 | .31418 | .30923 | .30434 |
| 20 | .35038 | .34500 | .33970 | .33445 | .32927 | .32415 | .31909 | .31409 | .30915 | .30426 |
| 21 | .35029 | .34491 | .33961 | .33437 | .32919 | .32407 | .31901 | .31401 | .30907 | .30418 |
| 22 | .35020 | .34483 | .33952 | .33428 | .32910 | .32398 | .31893 | .31393 | .30898 | .30410 |
| 23 | .35011 | .34474 | .33943 | .33419 | .32902 | .32390 | .31884 | .31384 | .30890 | .30402 |
| 24 | .35002 | .34465 | .33935 | .33411 | .32893 | .32381 | .31876 | .31376 | .30882 | .30393 |
| 25 | .34993 | .34456 | .33926 | .33402 | .32884 | .32373 | .31867 | .31368 | .30874 | .30385 |
| 26 | .34984 | .34447 | .33917 | .33393 | .32876 | .32365 | .31859 | .31360 | .30866 | .30377 |
| 27 | .34975 | .34438 | .33908 | .33385 | .32867 | .32356 | .31851 | .31351 | .30857 | .30369 |
| 28 | .34966 | .34429 | .33899 | .33376 | .32859 | .32348 | .31842 | .31343 | .30849 | .30361 |
| 29 | .34957 | .34420 | .33891 | .33367 | .32850 | .32339 | .31834 | .31335 | .30841 | .30353 |
| 30 | .34948 | .34411 | .33882 | .33359 | .32842 | .32331 | .31826 | .31326 | .30833 | .30345 |
| 31 | .34939 | .34403 | .33873 | .33350 | .32833 | .32322 | .31817 | .31318 | .30825 | .30337 |
| 32 | .34930 | .34394 | .33864 | .33341 | .32824 | .32314 | .31809 | .31310 | .30817 | .30329 |
| 33 | .34921 | .34385 | .33856 | .33333 | .32816 | .32305 | .31801 | .31302 | .30808 | .30321 |
| 34 | .34912 | .34376 | .33847 | .33324 | .32807 | .32297 | .31792 | .31293 | .30800 | .30313 |
| 35 | .34903 | .34367 | .33838 | .33315 | .32799 | .32288 | .31784 | .31285 | .30792 | .30305 |
| 36 | .34894 | .34358 | .33829 | .33307 | .32790 | .32280 | .31775 | .31277 | .30784 | .30296 |
| 37 | .34885 | .34349 | .33820 | .33298 | .32782 | .32271 | .31767 | .31269 | .30776 | .30288 |
| 38 | .34876 | .34340 | .33812 | .33289 | .32773 | .32263 | .31759 | .31260 | .30768 | .30280 |
| 39 | .34867 | .34332 | .33803 | .33281 | .32765 | .32255 | .31750 | .31252 | .30759 | .30272 |
| 40 | .34858 | .34323 | .33794 | .33272 | .32756 | .32246 | .31742 | .31244 | .30751 | .30264 |
| 41 | .34849 | .34314 | .33785 | .33263 | .32747 | .32238 | .31734 | .31236 | .30743 | .30256 |
| 42 | .34840 | .34305 | .33777 | .33255 | .32739 | .32229 | .31725 | .31227 | .30735 | .30248 |
| 43 | .34831 | .34296 | .33768 | .33246 | .32730 | .32221 | .31717 | .31219 | .30727 | .30240 |
| 44 | .34822 | .34287 | .33759 | .33237 | .32722 | .32212 | .31709 | .31211 | .30718 | .30232 |
| 45 | .34813 | .34278 | .33750 | .33229 | .32713 | .32204 | .31700 | .31203 | .30710 | .30224 |
| 46 | .34804 | .34270 | .33742 | .33220 | .32705 | .32195 | .31692 | .31194 | .30702 | .30216 |
| 47 | .34795 | .34261 | .33733 | .33211 | .32696 | .32187 | .31684 | .31186 | .30694 | .30208 |
| 48 | .34786 | .34252 | .33724 | .33203 | .32688 | .32179 | .31675 | .31178 | .30686 | .30200 |
| 49 | .34777 | .34243 | .33715 | .33194 | .32679 | .32170 | .31667 | .31170 | .30678 | .30192 |
| 50 | .34768 | .34234 | .33707 | .33186 | .32671 | .32162 | .31659 | .31161 | .30670 | .30183 |
| 51 | .34759 | .34225 | .33698 | .33177 | .32662 | .32153 | .31650 | .31153 | .30662 | .30175 |
| 52 | .34750 | .34217 | .33689 | .33168 | .32654 | .32145 | .31642 | .31145 | .30653 | .30167 |
| 53 | .34741 | .34208 | .33681 | .33160 | .32645 | .32136 | .31634 | .31137 | .30645 | .30159 |
| 54 | .34732 | .34199 | .33672 | .33151 | .32636 | .32128 | .31625 | .31128 | .30637 | .30151 |
| 55 | .34723 | .34190 | .33663 | .33142 | .32628 | .32120 | .31617 | .31120 | .30629 | .30143 |
| 56 | .34715 | .34181 | .33654 | .33134 | .32619 | .32111 | .31609 | .31112 | .30621 | .30135 |
| 57 | .34706 | .34172 | .33646 | .33125 | .32611 | .32103 | .31600 | .31104 | .30613 | .30127 |
| 58 | .34697 | .34164 | .33637 | .33117 | .32602 | .32094 | .31592 | .31095 | .30605 | .30119 |
| 59 | .34688 | .34155 | .33628 | .33108 | .32594 | .32086 | .31584 | .31087 | .30596 | .30111 |

| 1h or 1°. | PROP. LOGARITHMS. (r.) | 1h or 1°. |
|---|---|---|

| ″ | 30′ | 31′ | 32′ | 33′ | 34′ | 35′ | 36′ | 37′ | 38′ | 39′ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .30103 | .29623 | .29148 | .28679 | .28214 | .27755 | .27300 | .26850 | .26405 | .25964 |
| 1 | .30095 | .29615 | .29141 | .28671 | .28207 | .27747 | .27293 | .26843 | .26397 | .25956 |
| 2 | .30087 | .29607 | .29133 | .28663 | .28199 | .27740 | .27285 | .26835 | .26390 | .25949 |
| 3 | .30079 | .29599 | .29125 | .28656 | .28191 | .27732 | .27278 | .26828 | .26382 | .25942 |
| 4 | .30071 | .29591 | .29117 | .28648 | .28184 | .27724 | .27270 | .26820 | .26375 | .25934 |
| 5 | .30063 | .29583 | .29109 | .28640 | .28176 | .27717 | .27262 | .26813 | .26368 | .25927 |
| 6 | .30055 | .29575 | .29101 | .28632 | .28168 | .27709 | .27255 | .26805 | .26360 | .25920 |
| 7 | .30047 | .29567 | .29093 | .28625 | .28161 | .27702 | .27247 | .26798 | .26353 | .25913 |
| 8 | .30039 | .29560 | .29086 | .28617 | .28153 | .27694 | .27240 | .26790 | .26346 | .25905 |
| 9 | .30031 | .29552 | .29078 | .28609 | .28145 | .27686 | .27232 | .26783 | .26338 | .25898 |
| 10 | .30023 | .29544 | .29070 | .28601 | .28138 | .27679 | .27225 | .26775 | .26331 | .25891 |
| 11 | .30015 | .29536 | .29062 | .28593 | .28130 | .27671 | .27217 | .26768 | .26323 | .25883 |
| 12 | .30007 | .29528 | .29054 | .28586 | .28122 | .27664 | .27210 | .26761 | .26316 | .25876 |
| 13 | .29999 | .29520 | .29046 | .28578 | .28114 | .27656 | .27202 | .26753 | .26309 | .25869 |
| 14 | .29991 | .29512 | .29038 | .28570 | .28107 | .27648 | .27195 | .26746 | .26301 | .25861 |
| 15 | .29983 | .29504 | .29031 | .28562 | .28099 | .27641 | .27187 | .26738 | .26294 | .25854 |
| 16 | .29975 | .29496 | .29023 | .28555 | .28091 | .27633 | .27180 | .26731 | .26287 | .25847 |
| 17 | .29966 | .29488 | .29015 | .28547 | .28084 | .27626 | .27172 | .26723 | .26279 | .25839 |
| 18 | .29958 | .29480 | .2900 | .28539 | .28076 | .27618 | .27165 | .26716 | .26272 | .25832 |
| 19 | .29950 | .29472 | .28999 | .28531 | .28068 | .27610 | .27157 | .26709 | .26265 | .25825 |
| 20 | .29942 | .29464 | .28991 | .28524 | .28061 | .27603 | .27150 | .26701 | .26257 | .25818 |
| 21 | .29934 | .29456 | .28984 | .28516 | .28053 | .27595 | .27142 | .26694 | .26250 | .25810 |
| 22 | .29926 | .29448 | .28976 | .28508 | .28045 | .27588 | .27135 | .26686 | .26242 | .25803 |
| 23 | .29918 | .29441 | .28968 | .28500 | .28038 | .27580 | .27127 | .26679 | .26235 | .25796 |
| 24 | .29910 | .29433 | .28960 | .28493 | .28030 | .27572 | .27120 | .26671 | .26228 | .25789 |
| 25 | .29902 | .29425 | .28952 | .28485 | .28022 | .27565 | .27112 | .26664 | .26220 | .25781 |
| 26 | .29894 | .29417 | .28944 | .28477 | .28015 | .27557 | .27105 | .26656 | .26213 | .25774 |
| 27 | .29886 | .29409 | .28937 | .28469 | .28007 | .27550 | .27097 | .26649 | .26206 | .25767 |
| 28 | .29878 | .29401 | .28929 | .28462 | .27999 | .27542 | .27090 | .26642 | .26198 | .25759 |
| 29 | .29870 | .29393 | .28921 | .28454 | .27992 | .27534 | .27082 | .26634 | .26191 | .25752 |
| 30 | .29862 | .29385 | .28913 | .28446 | .27984 | .27527 | .27075 | .26627 | .26184 | .25745 |
| 31 | .29854 | .29377 | .28905 | .28438 | .27976 | .27519 | .27067 | .26619 | .26176 | .25738 |
| 32 | .29846 | .29369 | .28897 | .28431 | .27969 | .27512 | .27060 | .26612 | .26169 | .25730 |
| 33 | .29838 | .29361 | .28890 | .28423 | .27961 | .27504 | .27052 | .26605 | .26162 | .25723 |
| 34 | .29830 | .29354 | .28882 | .28415 | .27953 | .27497 | .27045 | .26597 | .26154 | .25716 |
| 35 | .29822 | .29346 | .28874 | .28407 | .27946 | .27489 | .27037 | .26590 | .26147 | .25709 |
| 36 | .29814 | .29338 | .28866 | .28400 | .27938 | .27481 | .27030 | .26582 | .26140 | .25701 |
| 37 | .29806 | .29330 | .28858 | .28392 | .27930 | .27474 | .27022 | .26575 | .26132 | .25694 |
| 38 | .29798 | .29322 | .28851 | .28384 | .27923 | .27466 | .27015 | .26567 | .26125 | .25687 |
| 39 | .29790 | .29314 | .28843 | .28376 | .27915 | .27459 | .27007 | .26560 | .26118 | .25680 |
| 40 | .29782 | .29306 | .28835 | .28369 | .27908 | .27451 | .27000 | .26553 | .26110 | .25672 |
| 41 | .29775 | .29298 | .28827 | .28361 | .27900 | .27444 | .26992 | .26545 | .26103 | .25665 |
| 42 | .29767 | .29290 | .28819 | .28353 | .27892 | .27436 | .26985 | .26538 | .26096 | .25658 |
| 43 | .29759 | .29282 | .28811 | .28346 | .27885 | .27428 | .26977 | .26530 | .26088 | .25650 |
| 44 | .29751 | .29275 | .28804 | .28338 | .27877 | .27421 | .26970 | .26523 | .26081 | .25643 |
| 45 | .29743 | .29267 | .28796 | .28330 | .27869 | .27413 | .26962 | .26516 | .26074 | .25636 |
| 46 | .29735 | .29259 | .28788 | .28322 | .27862 | .27406 | .26955 | .26508 | .26066 | .25629 |
| 47 | .29727 | .29251 | .28780 | .28315 | .27854 | .27398 | .26947 | .26501 | .26059 | .25621 |
| 48 | .29719 | .29243 | .28772 | .28307 | .27846 | .27391 | .26940 | .26493 | .26052 | .25614 |
| 49 | .29711 | .29235 | .28765 | .28299 | .27839 | .27383 | .26932 | .26486 | .26044 | .25607 |
| 50 | .29703 | .29227 | .28757 | .28292 | .27831 | .27376 | .26925 | .26479 | .26037 | .25600 |
| 51 | .29695 | .29219 | .28749 | .28284 | .27824 | .27368 | .26917 | .26471 | .26030 | .25592 |
| 52 | .29687 | .29211 | .28741 | .28276 | .27816 | .27360 | .26910 | .26464 | .26022 | .25585 |
| 53 | .29679 | .29204 | .28733 | .28268 | .27808 | .27353 | .26902 | .26456 | .26015 | .25578 |
| 54 | .29671 | .29196 | .28726 | .28261 | .27801 | .27345 | .26895 | .26449 | .26008 | .25571 |
| 55 | .29663 | .29188 | .28718 | .28253 | .27793 | .27338 | .26887 | .26442 | .26000 | .25563 |
| 56 | .29655 | .29180 | .28710 | .28245 | .27785 | .27330 | .26880 | .26434 | .25993 | .25556 |
| 57 | .29647 | .29172 | .28702 | .28238 | .27778 | .27323 | .26872 | .26427 | .25986 | .25549 |
| 58 | .29639 | .29164 | .28695 | .28230 | .27770 | .27315 | .26865 | .26420 | .25978 | .25542 |
| 59 | .29631 | .29156 | .28687 | .28222 | .27763 | .27308 | .26858 | .26412 | .25971 | .25534 |

| 1ʰ or 1°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 1ʰ or 1°. |
|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 40′ | 41′ | 42′ | 43′ | 44′ | 45′ | 46′ | 47′ | 48′ | 49′ |
| 0 | .25527 | .25095 | .24667 | .24244 | .23824 | .23408 | 22997 | .22589 | .22185 | .21785 |
| 1 | .25520 | .25088 | .24660 | .24237 | .23817 | .23401 | .22990 | .22582 | .22178 | .21778 |
| 2 | .25513 | .25081 | .24653 | .24229 | .23810 | .23395 | .22983 | .22575 | .22171 | .21771 |
| 3 | .25506 | .25074 | .24646 | .24222 | .23803 | .23388 | .22976 | .22569 | .22165 | .21765 |
| 4 | .25498 | .25066 | .24639 | .24215 | .23796 | .23381 | .22969 | .22562 | .22158 | .21758 |
| 5 | .25491 | .25059 | .24632 | .24208 | .23789 | .23374 | .22963 | .22555 | .22151 | .21751 |
| 6 | .25484 | .25052 | .24625 | 24201 | .23782 | .23367 | .22956 | .22548 | .22145 | .21745 |
| 7 | .25477 | .25045 | .24618 | .24194 | .23775 | .23360 | .22949 | .22542 | .22138 | .21738 |
| 8 | .25469 | .25038 | .24610 | .24187 | .23768 | .23353 | .22942 | .22535 | .22131 | .21732 |
| 9 | .25462 | .25031 | .24603 | .24180 | .23761 | .23346 | .22935 | .22528 | .22125 | .21725 |
| 10 | .25455 | .25024 | .24596 | .24173 | .23754 | .23339 | .22928 | .22521 | .22118 | .21718 |
| 11 | .25448 | .25016 | .24589 | .24166 | .23747 | .23333 | .22922 | .22515 | .22111 | .21712 |
| 12 | .25440 | .25009 | .24582 | .24159 | .23740 | .23326 | .22915 | .22508 | .22105 | .21705 |
| 13 | .25433 | .25002 | .24575 | .24152 | .23734 | .23319 | .22908 | .22501 | .22098 | .21698 |
| 14 | .25426 | .24995 | .24568 | .24145 | .23727 | .23312 | .22901 | .22494 | .22091 | .21692 |
| 15 | .25419 | .24988 | .24561 | .24138 | .23720 | .23305 | .22894 | .22488 | .22084 | .21685 |
| 16 | .25412 | .24981 | .24554 | .24131 | .23713 | .23298 | .22888 | .22481 | .22078 | .21678 |
| 17 | .25404 | .24974 | .24547 | .24124 | .23706 | .23291 | .22881 | .22474 | .22071 | .21672 |
| 18 | .25397 | .24966 | .24540 | .24117 | .23699 | .23284 | .22874 | .22467 | .22064 | .21665 |
| 19 | .25390 | .24959 | .24533 | .24110 | .23692 | .23278 | .22867 | .22461 | .22058 | .21659 |
| 20 | .25383 | .24952 | .24526 | .24103 | .23685 | .23271 | .22860 | .22454 | .22051 | .21652 |
| 21 | .25376 | .24945 | .24518 | .24096 | .23678 | .23264 | .22854 | .22447 | .22044 | .21645 |
| 22 | .25368 | .24938 | .24511 | .24089 | .23671 | .23257 | .22847 | .22440 | .22038 | .21639 |
| 23 | .25361 | .24931 | .24504 | .24082 | .23664 | .23250 | .22840 | .22434 | .22031 | .21632 |
| 24 | .25354 | .24923 | .24497 | .24075 | .23657 | .23243 | .22833 | .22427 | .22024 | .21626 |
| 25 | .25347 | .24916 | .24490 | .24068 | .23650 | .23236 | .22826 | .22420 | .22018 | .21619 |
| 26 | .25339 | .24909 | .24483 | .24061 | .23643 | .23229 | .22819 | .22413 | .22011 | .21612 |
| 27 | .25332 | .24902 | .24476 | .24054 | .23636 | .23223 | .22813 | .22407 | .22004 | .21606 |
| 28 | .25325 | .24895 | .24469 | .24047 | .23629 | .23216 | .22806 | .22400 | .21998 | .21599 |
| 29 | .25318 | .24888 | .24462 | .24040 | .23623 | .23209 | .22799 | .22393 | .21991 | .21592 |
| 30 | .25311 | .24881 | .24455 | .24033 | .23616 | .23202 | .22792 | .22386 | .21984 | .21586 |
| 31 | .25303 | .24874 | .24448 | .24026 | .23609 | .23195 | .22785 | .22380 | .21978 | .21579 |
| 32 | .25296 | .24866 | .24441 | .24019 | .23602 | .23188 | .22779 | .22373 | .21971 | .21573 |
| 33 | .25289 | .24859 | .24434 | .24012 | .23595 | .23181 | .22772 | .22366 | .21964 | .21566 |
| 34 | .25282 | .24852 | .24427 | .24005 | .23588 | .23175 | .22765 | .22359 | .21958 | .21559 |
| 35 | .25275 | .24845 | .24420 | .23998 | .23581 | .23168 | .22758 | .22353 | .21951 | .21553 |
| 36 | .25267 | .24838 | .24413 | .23991 | .23574 | .23161 | .22752 | .22346 | .21944 | .21546 |
| 37 | .25260 | .24831 | .24405 | .23984 | .23567 | .23154 | .22745 | .22339 | .21938 | .21540 |
| 38 | .25253 | .24824 | .24398 | .23977 | .23560 | .23147 | .22738 | .22333 | .21931 | .21533 |
| 39 | .25246 | .24817 | .24391 | .23970 | .23553 | .23140 | .22731 | .22326 | .21924 | .21526 |
| 40 | .25239 | .24809 | .24384 | .23963 | .23546 | .23133 | .22724 | .22319 | .21918 | .21520 |
| 41 | .25231 | .24802 | .24377 | .23956 | .23539 | .23127 | .22718 | .22312 | .21911 | .21513 |
| 42 | .25224 | .24795 | .24370 | .23949 | .23533 | .23120 | .22711 | .22306 | .21904 | .21507 |
| 43 | .25217 | .24788 | .24363 | .23942 | .23526 | .23113 | .22704 | .22299 | .21898 | .21500 |
| 44 | .25210 | .24781 | .24356 | .23935 | .23519 | .23106 | .22697 | .22292 | .21891 | .21493 |
| 45 | .25203 | .24774 | .24349 | .23928 | .23512 | .23099 | .22690 | .22286 | .21884 | .21487 |
| 46 | .25196 | .24767 | .24342 | .23921 | .23505 | .23092 | .22684 | .22279 | .21878 | .21480 |
| 47 | .25188 | .24760 | .24335 | .23914 | .23498 | .23086 | .22677 | .22272 | .21871 | .21474 |
| 48 | .25181 | .24752 | .24328 | .23908 | .23491 | .23079 | .22670 | .22265 | .21864 | .21467 |
| 49 | .25174 | .24745 | .24321 | .23901 | .23484 | .23072 | .22663 | .22259 | .21858 | .21460 |
| 50 | .25167 | .24738 | .24314 | .23894 | .23477 | .23065 | .22657 | .22252 | .21851 | .21454 |
| 51 | .25160 | .24731 | .24307 | .23887 | .23470 | .23058 | .22650 | .22245 | .21844 | .21447 |
| 52 | .25152 | .24724 | .24300 | .23880 | .23464 | .23051 | .22643 | .22239 | .21838 | .21441 |
| 53 | .25145 | .24717 | .24293 | .23873 | .23457 | .23044 | .22636 | .22232 | .21831 | .21434 |
| 54 | .25138 | .24710 | .24286 | .23866 | .23450 | .23038 | .22629 | .22225 | .21824 | .21427 |
| 55 | .25131 | .24703 | .24279 | .23859 | .23443 | .23031 | .22623 | .22218 | .21818 | .21421 |
| 56 | .25124 | .24696 | .24272 | .23852 | .23436 | .23024 | .22616 | .22212 | .21811 | .21414 |
| 57 | .25117 | .24689 | .24265 | .23845 | .23429 | .23017 | .22609 | .22205 | .21805 | .21408 |
| 58 | .25109 | .24681 | .24258 | .23838 | .23422 | .23010 | .22602 | .22198 | .21798 | .21401 |
| 59 | .25102 | .24674 | .24251 | .23831 | .23415 | .23003 | .22596 | .22192 | .21791 | .21395 |

| 1" or 1°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 1" or 1° |
|---|---|---|---|---|---|---|---|---|---|---|
| " | 50' | 51' | 52' | 53' | 54' | 55' | 56' | 57' | 58' | 59' |
| 0 | .21388 | .20995 | .20605 | .20219 | .19837 | .19457 | .19081 | .18710 | .18339 | .17973 |
| 1 | .21381 | .20988 | .20599 | .20213 | .19830 | .19451 | .19075 | .18702 | .18333 | .17966 |
| 2 | .21375 | .20982 | .20593 | .20207 | .19824 | .19445 | .19069 | .18696 | .18327 | .17960 |
| 3 | .21368 | .20975 | .20586 | .20200 | .19818 | .19439 | .19063 | .18690 | .18321 | .17954 |
| 4 | .21362 | .20969 | .20580 | .20194 | .19811 | .19432 | .19056 | .18684 | .18315 | .17948 |
| 5 | .21355 | .20962 | .20573 | .20187 | .19805 | .19426 | .19050 | .18678 | .18308 | .17942 |
| 6 | .21349 | .20956 | .20567 | .20181 | .19799 | .19420 | .19044 | .18672 | .18302 | .17936 |
| 7 | .21342 | .20949 | .20560 | .20175 | .19792 | .19413 | .19038 | .18665 | .18296 | .17930 |
| 8 | .21335 | .20943 | .20554 | .20168 | .19786 | .19407 | .19032 | .18659 | .18290 | .17924 |
| 9 | .21329 | .20936 | .20547 | .20162 | .19780 | .19401 | .19025 | .18653 | .18284 | .17918 |
| 10 | .21322 | .20930 | .20541 | .20155 | .19773 | .19395 | .19019 | .18647 | .18278 | .17912 |
| 11 | .21316 | .20923 | .20534 | .20149 | .19767 | .19388 | .19013 | .18641 | .18272 | .17906 |
| 12 | .21309 | .20917 | .20528 | .20143 | .19761 | .19382 | .19007 | .18634 | .18266 | .17900 |
| 13 | .21303 | .20910 | .20522 | .20136 | .19754 | .19376 | .19000 | .18628 | .18259 | .17894 |
| 14 | .21296 | .20904 | .20515 | .20130 | .19748 | .19369 | .18994 | .18622 | .18253 | .17887 |
| 15 | .21289 | .20897 | .20509 | .20123 | .19742 | .19363 | .18988 | .18616 | .18247 | .17881 |
| 16 | .21283 | .20891 | .20502 | .20117 | .19735 | .19357 | .18982 | .18610 | .18241 | .17875 |
| 17 | .21276 | .20884 | .20496 | .20111 | .19729 | .19351 | .18976 | .18604 | .18235 | .17869 |
| 18 | .21270 | .20878 | .20489 | .20104 | .19723 | .19344 | .18969 | .18597 | .18229 | .17863 |
| 19 | .21263 | .20871 | .20483 | .20098 | .19716 | .19338 | .18963 | .18591 | .18223 | .17857 |
| 20 | .21257 | .20865 | .20476 | .20091 | .19710 | .19332 | .18957 | .18585 | .18217 | .17851 |
| 21 | .21250 | .20858 | .20470 | .20085 | .19704 | .19325 | .18951 | .18579 | .18210 | .17845 |
| 22 | .21243 | .20852 | .20464 | .20079 | .19697 | .19319 | .18944 | .18573 | .18204 | .17839 |
| 23 | .21237 | .20845 | .20457 | .20072 | .19691 | .19313 | .18938 | .18567 | .18198 | .17833 |
| 24 | .21230 | .20839 | .20451 | .20066 | .19685 | .19307 | .18932 | .18560 | .18192 | .17827 |
| 25 | .21224 | .20832 | .20444 | .20060 | .19678 | .19300 | .18926 | .18554 | .18186 | .17821 |
| 26 | .21217 | .20826 | .20438 | .20053 | .19672 | .19294 | .18920 | .18548 | .18180 | .17815 |
| 27 | .21211 | .20819 | .20431 | .20047 | .19666 | .19288 | .18913 | .18542 | .18174 | .17809 |
| 28 | .21204 | .20813 | .20425 | .20040 | .19659 | .19282 | .18907 | .18536 | .18168 | .17803 |
| 29 | .21198 | .20806 | .20418 | .20034 | .19653 | .19275 | .18901 | .18530 | .18162 | .17797 |
| 30 | .21191 | .20800 | .20412 | .20028 | .19647 | .19269 | .18895 | .18523 | .18155 | .17790 |
| 31 | .21184 | .20793 | .20406 | .20021 | .19640 | .19263 | .18888 | .18517 | .18149 | .17784 |
| 32 | .21178 | .20787 | .20399 | .20015 | .19634 | .19257 | .18882 | .18511 | .18143 | .17778 |
| 33 | .21171 | .20780 | .20393 | .20009 | .19628 | .19250 | .18876 | .18505 | .18137 | .17772 |
| 34 | .21165 | .20774 | .20386 | .20002 | .19621 | .19244 | .18870 | .18499 | .18131 | .17766 |
| 35 | .21158 | .20767 | .20380 | .19996 | .19615 | .19238 | .18864 | .18493 | .18125 | .17760 |
| 36 | .21152 | .20761 | .20373 | .19989 | .19609 | .19231 | .18857 | .18487 | .18119 | .17754 |
| 37 | .21145 | .20754 | .20367 | .19983 | .19602 | .19225 | .18851 | .18480 | .18113 | .17748 |
| 38 | .21139 | .20748 | .20361 | .19977 | .19596 | .19219 | .18845 | .18474 | .18107 | .17742 |
| 39 | .21132 | .20741 | .20354 | .19970 | .19590 | .19213 | .18839 | .18468 | .18100 | .17736 |
| 40 | .21126 | .20735 | .20348 | .19964 | .19584 | .19206 | .18833 | .18462 | .18094 | .17730 |
| 41 | .21119 | .20728 | .20341 | .19958 | .19577 | .19200 | .18826 | .18456 | .18088 | .17724 |
| 42 | .21112 | .20722 | .20335 | .19951 | .19571 | .19194 | .18820 | .18450 | .18082 | .17718 |
| 43 | .21106 | .20715 | .20328 | .19945 | .19565 | .19188 | .18814 | .18443 | .18076 | .17712 |
| 44 | .21099 | .20709 | .20322 | .19938 | .19558 | .19181 | .18808 | .18437 | .18070 | .17706 |
| 45 | .21093 | .20702 | .20316 | .19932 | .19552 | .19175 | .18802 | .18431 | .18064 | .17700 |
| 46 | .21086 | .20696 | .20309 | .19926 | .19546 | .19169 | .18795 | .18425 | .18058 | .17694 |
| 47 | .21080 | .20690 | .20303 | .19919 | .19539 | .19163 | .18789 | .18419 | .18052 | .17688 |
| 48 | .21073 | .20683 | .20296 | .19913 | .19533 | .19156 | .18783 | .18413 | .18046 | .17682 |
| 49 | .21067 | .20677 | .20290 | .19907 | .19527 | .19150 | .18777 | .18407 | .18040 | .17676 |
| 50 | .21060 | .20670 | .20284 | .19900 | .19520 | .19144 | .18771 | .18400 | .18033 | .17669 |
| 51 | .21054 | .20664 | .20277 | .19894 | .19514 | .19138 | .18764 | .18394 | .18027 | .17663 |
| 52 | .21047 | .20657 | .20271 | .19888 | .19508 | .19131 | .18758 | .18388 | .18021 | .17657 |
| 53 | .21041 | .20651 | .20264 | .19881 | .19502 | .19125 | .18752 | .18382 | .18015 | .17651 |
| 54 | .21034 | .20644 | .20258 | .19875 | .19495 | .19119 | .18746 | .18376 | .18009 | .17645 |
| 55 | .21028 | .20638 | .20251 | .19869 | .19489 | .19113 | .18740 | .18370 | .18003 | .17639 |
| 56 | .21021 | .20631 | .20245 | .19862 | .19483 | .19106 | .18733 | .18364 | .17997 | .17633 |
| 57 | .21015 | .20625 | .20239 | .19856 | .19476 | .19100 | .18727 | .18357 | .17991 | .17627 |
| 58 | .21008 | .20618 | .20232 | .19849 | .19470 | .19094 | .18721 | .18351 | .17985 | .17621 |
| 59 | .21001 | .20612 | .20226 | .19843 | .19464 | .19088 | .18715 | .18345 | .17979 | .17615 |

| 2h or 2°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 2h or 2° |
|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 0′ | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ |
| 0 | .17609 | .17249 | .16891 | .16537 | .16185 | .15836 | .15490 | .15147 | .14806 | .14 |
| 1 | .17603 | .17243 | .16885 | .16531 | .16179 | .15830 | .15484 | .15141 | .14801 | .14 |
| 2 | .17597 | .17237 | .16879 | .16525 | .16173 | .15825 | .15479 | .15135 | .14795 | .14 |
| 3 | .17591 | .17231 | .16873 | .16519 | .16168 | .15819 | .15473 | .15130 | .14789 | .14 |
| 4 | .17585 | .17225 | .16868 | .16513 | .16162 | .15813 | .15467 | ..5124 | .14784 | .14 |
| 5 | .17579 | .17219 | .16862 | .16507 | .16156 | .15807 | .15461 | .15118 | .14778 | .14 |
| 6 | .17573 | .17213 | .16856 | .16501 | .16150 | .15802 | .15456 | .15113 | .14772 | .14 |
| 7 | .17567 | .17207 | .16850 | .16496 | .16144 | .15796 | .15450 | .15107 | .14767 | .14 |
| 8 | .17561 | .17201 | .16844 | .16490 | .16138 | .15790 | .15444 | .15101 | .14761 | .14 |
| 9 | .17555 | .17195 | .16838 | .16484 | .16133 | .15784 | .15439 | .15096 | .14755 | .14 |
| 10 | .17549 | .17189 | .16832 | .16478 | .16127 | .15778 | .15433 | .15090 | .14750 | .14 |
| 11 | .17543 | .17183 | .16826 | .16472 | .16121 | .15773 | .15427 | .15084 | .14744 | .14 |
| 12 | .17537 | .17177 | .16820 | .16466 | .16115 | .15767 | .15421 | .15079 | .14738 | .14 |
| 13 | .17531 | .17171 | .16814 | .16460 | .16109 | .15761 | .15416 | .15073 | .14733 | .14 |
| 14 | .17525 | .17165 | .16808 | .16454 | .16103 | .15755 | .15410 | .15067 | .14727 | .14 |
| 15 | .17519 | .17159 | .16802 | .16449 | .16098 | .15749 | .15404 | .15061 | .14722 | .14 |
| 16 | .17513 | .17153 | .16796 | .16443 | .16092 | .15744 | .15398 | .15056 | .14716 | .14 |
| 17 | .17507 | .17147 | .16791 | .16437 | .16086 | .15738 | .15393 | .15050 | .14710 | .14 |
| 18 | .17501 | .17141 | .16785 | .16431 | .16080 | .15732 | .15387 | .15044 | .14705 | .14 |
| 19 | .17495 | .17135 | .16779 | .16425 | .16074 | .15726 | .15381 | .15039 | .14699 | .14 |
| 20 | .17489 | .17129 | .16773 | .16419 | .16068 | .15721 | .15375 | .15033 | .14693 | .14 |
| 21 | .17483 | .17123 | .16767 | .16413 | .16063 | .15715 | .15370 | .15027 | .14688 | .14 |
| 22 | .17477 | .17117 | .16761 | .16407 | .16057 | .15709 | .15364 | .15022 | .14682 | .14 |
| 23 | .17471 | .17111 | .16755 | .16402 | .16051 | .15703 | .15358 | .15016 | .14676 | .14 |
| 24 | .17465 | .17105 | .16749 | .16396 | .16045 | .15697 | .15353 | .15010 | .14671 | .14 |
| 25 | .17460 | .17099 | .16743 | .16390 | .16039 | .15692 | .15347 | .15005 | .14665 | .14 |
| 26 | .17453 | .17093 | .16737 | .16384 | .16034 | .15686 | .15341 | .14999 | .14659 | .14 |
| 27 | .17447 | .17087 | .16731 | .16378 | .16028 | .15680 | .15335 | .14993 | .14654 | .14 |
| 28 | .17441 | .17082 | .16725 | .16372 | .16022 | .15674 | .15330 | .14988 | .14648 | .14 |
| 29 | .17435 | .17076 | .16720 | .16366 | .16016 | .15669 | .15324 | .14982 | .14643 | .14 |
| 30 | .17429 | .17070 | .16714 | .16361 | .16010 | .15663 | .15318 | .14976 | .14637 | .14 |
| 31 | .17423 | .17064 | .16708 | .16354 | .16005 | .15657 | .15312 | .14971 | .14631 | .14 |
| 32 | .17417 | .17058 | .16702 | .16349 | .15999 | .15651 | .15307 | .14965 | .14626 | .14 |
| 33 | .17411 | .17052 | .16696 | .16343 | .15993 | .15646 | .15301 | .14959 | .14620 | .14 |
| 34 | .17405 | .17046 | .16690 | .16337 | .15987 | .15640 | .15295 | .14954 | .14614 | .14 |
| 35 | .17399 | .17040 | .16684 | .16331 | .15981 | .15634 | .15290 | .14948 | .14609 | .14 |
| 36 | .17393 | .17034 | .16678 | .16325 | .15975 | .15628 | .15284 | .14942 | 14603 | .14 |
| 37 | .17387 | .17028 | .16672 | .16320 | .15970 | .15623 | .15278 | .14937 | .14598 | .14 |
| 38 | .17381 | .17022 | .16666 | .16314 | .15964 | .15617 | .15272 | .14931 | .14592 | .14 |
| 39 | .17375 | .17016 | .16660 | .16308 | .15958 | .15611 | .15267 | .14925 | .14587 | .14 |
| 40 | .17369 | .17010 | .16655 | .16302 | .15952 | .15605 | .15261 | .14919 | .14581 | .14 |
| 41 | .17363 | .17004 | .16649 | .16296 | .15946 | .15599 | 15255 | .14914 | .14575 | .14 |
| 42 | .17357 | .16998 | .16643 | .16290 | .15941 | .15594 | .15250 | .14908 | .14569 | .14 |
| 43 | .17351 | .16992 | .16637 | .16284 | .15935 | .15588 | .15244 | .14902 | .14564 | .14 |
| 44 | .17345 | .16986 | .16631 | .16279 | .15929 | .15582 | .15238 | .14897 | .14558 | .14 |
| 45 | .17339 | .16980 | .16625 | .16273 | .15923 | .15576 | .15232 | .14891 | .14553 | .14 |
| 46 | .17333 | .16974 | .16619 | .16267 | .15917 | .15571 | .15227 | .14886 | .14547 | .14 |
| 47 | .17327 | .16968 | .16613 | .16261 | .15912 | .15565 | .15221 | .14880 | .14541 | .14 |
| 48 | .17321 | .16963 | .16607 | .16255 | .15906 | .15559 | .15215 | .14874 | .14536 | .14 |
| 49 | .17315 | .16957 | .16602 | .16249 | .15900 | .15553 | .15210 | .14869 | .14530 | .14 |
| 50 | .17309 | .16951 | .16596 | .16243 | .15894 | .155.8 | .15204 | .1.863 | .1.524 | .14 |
| 51 | .17303 | .16945 | .16590 | .16238 | .15888 | .15542 | .15198 | .14857 | .14519 | .14 |
| 52 | .17297 | .16939 | .16584 | .16232 | .15883 | .15536 | .15192 | .14852 | .14513 | .14 |
| 53 | .17291 | .16933 | .16578 | .16226 | .15877 | .15530 | .15187 | .148.6 | .14508 | .14 |
| 54 | .17285 | .16927 | .16572 | .16220 | .15871 | .15525 | .15181 | .14840 | .14502 | .14 |
| 55 | .17279 | .16921 | .16566 | .16214 | .15865 | .15519 | .15175 | .14835 | .14496 | .14 |
| 56 | .17273 | .16915 | .16560 | .16208 | .15859 | .15513 | .15170 | .14829 | .14491 | .14 |
| 57 | .17267 | .16909 | .16554 | .16203 | .15854 | .15507 | .15164 | .14823 | .14485 | .14 |
| 58 | .17261 | .16903 | .16549 | .16197 | .15848 | .15502 | .15158 | .14818 | .14480 | .14 |
| 59 | .17255 | .16897 | .16543 | .16191 | .15842 | .15496 | .15153 | .14812 | .14474 | .14 |

| ' or 2°. | | | PROP. LOGARITHMS. (r.) | | | | | | 2' or 2°. |
|---|---|---|---|---|---|---|---|---|---|
| 10′ | 11 | 12′ | 13′ | 14′ | 15′ | 16′ | 17′ | 18′ | 19′ |
| .14133 | .13800 | .13470 | .13142 | .12817 | .12494 | .12173 | .11855 | .11539 | .11226 |
| .14127 | .13795 | .13464 | .13137 | .12811 | .12489 | .12168 | .11850 | .11534 | .11221 |
| .14122 | .13789 | .13459 | .13131 | .12806 | .12483 | .12163 | .11845 | .11529 | .11215 |
| .14116 | .13784 | .13453 | .13126 | .12801 | .12478 | .12157 | .11839 | .11524 | .11210 |
| .14111 | .13778 | .13448 | .13120 | .12795 | .12472 | .12152 | .11834 | .11518 | .11205 |
| .14105 | .13773 | .13442 | .13115 | .12790 | .12467 | .12147 | .11829 | .11513 | .11200 |
| .14100 | .13767 | .13437 | .13109 | .12784 | .12462 | .12141 | .11824 | .11508 | .11195 |
| .14094 | .13761 | .13431 | .13104 | .12779 | .12456 | .12136 | .11818 | .11503 | .11189 |
| .14088 | .13756 | .13426 | .13099 | .12774 | .12451 | .12131 | .11813 | .11497 | .11184 |
| .14083 | .13750 | .13421 | .13093 | .12768 | .12446 | .12125 | .11808 | .11492 | .11179 |
| .14077 | .13745 | .13415 | .13088 | .12763 | .12440 | .12120 | .11802 | .11487 | .11174 |
| .14072 | .13739 | .13410 | .13082 | .12757 | .12435 | .12115 | .11797 | .11482 | .11169 |
| .14066 | .13734 | .13404 | .13077 | .12752 | .12430 | .12110 | .11792 | .11476 | .11163 |
| .14061 | .13728 | .13399 | .13071 | .12747 | .12424 | .12104 | .11787 | .11471 | .11158 |
| .14055 | .13723 | .13393 | .13066 | .12741 | .12419 | .12099 | .11781 | .11466 | .11153 |
| .14049 | .13717 | .13388 | .13061 | 12736 | .12414 | .12094 | .11776 | .11461 | .11148 |
| .14044 | .13712 | .13382 | .13055 | .12730 | .12408 | .12088 | .11771 | .11456 | .11143 |
| .14038 | .13706 | .13377 | .13050 | .12725 | .12403 | .12083 | .11765 | .11450 | .11137 |
| .14033 | .13701 | .13371 | .13044 | .12720 | .12397 | .12078 | .11760 | .11445 | .11132 |
| .14027 | .13695 | .13366 | .13039 | .12714 | .12392 | .12072 | .11755 | .11440 | .11127 |
| .14022 | .13690 | .13360 | .13033 | .12709 | .12387 | .12067 | .11750 | .11435 | .11122 |
| .14016 | .13684 | .13355 | .13028 | .12703 | .12381 | .12062 | .11744 | .11429 | .11117 |
| .14011 | .13679 | .13349 | .13023 | .12698 | .12376 | .12056 | .11739 | .11424 | .11111 |
| .14005 | .13673 | .13344 | .13017 | .12693 | .12371 | .12051 | .11734 | .11419 | .11106 |
| .13999 | .13668 | .13338 | .13012 | .12687 | .12365 | .12046 | .11729 | .11414 | .11101 |
| .13994 | .13662 | .13333 | .13006 | .12682 | .12360 | .12041 | .11723 | .11408 | .11096 |
| .13988 | .13657 | .13328 | .13001 | .12677 | .12355 | .12035 | .11718 | .11403 | .11091 |
| .13983 | .13651 | .13322 | .12995 | .12671 | .12349 | .12030 | .11713 | .11398 | .11086 |
| .13977 | .13646 | .13317 | .12990 | .12666 | .12344 | .12025 | .11708 | .11393 | .11080 |
| .13972 | .13640 | .13311 | .12985 | .12660 | .12339 | 12019 | .11702 | .11387 | .11075 |
| .13966 | .13635 | .13306 | .12979 | .12655 | .12333 | .12014 | .11697 | .11382 | .11070 |
| .13961 | .13629 | .13300 | .12974 | .12650 | .12328 | .12009 | .11692 | .11377 | .11065 |
| .13955 | .13624 | .13295 | .12968 | .12644 | .12323 | .12003 | .11686 | .11372 | .11059 |
| .13949 | .13618 | .13289 | .12963 | .12639 | .12317 | .11998 | .11681 | .11367 | .11054 |
| .13944 | .13613 | .13284 | .12957 | .12634 | .12312 | .11993 | .11676 | .11361 | .11049 |
| .13938 | .13607 | .13278 | 12952 | .12628 | .12307 | .11987 | .11671 | .11356 | .11044 |
| .13933 | .13602 | .13273 | .12947 | .12623 | .12301 | .11982 | .11665 | .11351 | .11039 |
| .13927 | .13596 | .13267 | .12941 | .12617 | .12296 | .11977 | .11660 | .11346 | .11034 |
| .13922 | .13591 | .13262 | .12936 | .12612 | .12291 | .11972 | .11655 | .11340 | .11028 |
| .13916 | .13585 | .13257 | .12930 | .12607 | .12285 | .11966 | .11650 | .11335 | .11023 |
| .13911 | .13580 | .13251 | .12925 | .12601 | .12280 | .11961 | .11644 | .11330 | .11018 |
| .13905 | .13574 | .13246 | .12920 | .12596 | .12275 | .11956 | .11639 | .11325 | .11013 |
| .13900 | .13569 | .13240 | .12914 | .12590 | .12269 | .11950 | .11634 | .11320 | .11008 |
| .13894 | .13563 | .13235 | .12909 | .12585 | .12264 | .11945 | .11629 | .11314 | .11002 |
| .13889 | .13558 | .13229 | .12903 | .12580 | .12259 | .11940 | .11623 | .11309 | .10997 |
| .13883 | .13552 | .13224 | .12898 | .12574 | .12253 | .11935 | .11618 | .11304 | .10992 |
| .13878 | .13547 | .13218 | .12892 | .12569 | .12248 | .11929 | .11613 | .11299 | .10987 |
| .13872 | .13541 | .13213 | .12887 | .12564 | .12243 | .11924 | .11608 | .11294 | .10982 |
| .13866 | .13536 | .13207 | .12882 | .12558 | .12237 | .11919 | .11602 | .11288 | .10977 |
| .13861 | .13530 | .13202 | .12876 | .12553 | .12232 | .11913 | .11597 | .11283 | .10971 |
| .13855 | .13525 | .13197 | .12871 | .12548 | .12227 | .11908 | .11592 | .11278 | .10966 |
| .13850 | .13519 | .13191 | .12865 | .12542 | .12221 | .11903 | .11587 | .11273 | .10961 |
| .13844 | .13514 | .13186 | .12860 | .12537 | .12216 | .11897 | .11581 | .11267 | .10956 |
| .13839 | .13508 | .13180 | .12855 | .12531 | .12211 | .11892 | .11576 | .11262 | .10951 |
| .13833 | .13503 | .13175 | .12849 | .12526 | .12205 | .11887 | .11571 | .11257 | .10945 |
| .13828 | .13497 | .13169 | .12844 | .12521 | .12200 | .11882 | .11566 | .11252 | .10940 |
| .13822 | .13492 | .13164 | .12838 | .12515 | .12195 | .11876 | .11560 | .11247 | .10935 |
| .13817 | .13486 | .13158 | .12833 | .12510 | .12189 | .11871 | .11555 | .11241 | .10930 |
| .13811 | .13481 | .13153 | .12828 | .12505 | .12184 | .11866 | .11550 | .11236 | .10925 |
| .13806 | .13475 | .13148 | .12822 | .12499 | .12179 | .11860 | .11545 | .11231 | .10920 |

| 2h or 2°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 2h or 2°. |
|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 20′ | 21′ | 22′ | 23′ | 24′ | 25′ | 26′ | 27′ | 28′ | 29′ |
| 0 | .10914 | .10605 | .10298 | .09994 | .09691 | .09390 | .09092 | .08796 | .08501 | .08209 |
| 1 | .10909 | .10600 | .10293 | .09989 | .09686 | .09385 | .09087 | .08791 | .08496 | .08204 |
| 2 | .10904 | .10595 | .10288 | .09984 | .09681 | .09380 | .09082 | .08786 | .08491 | .08199 |
| 3 | .10899 | .10590 | .10283 | .09978 | .09676 | .09375 | .09077 | .08781 | .08486 | .08194 |
| 4 | .10894 | .10585 | .10278 | .09973 | .09671 | .09370 | .09072 | .08776 | .08482 | .08189 |
| 5 | .10889 | .10580 | .10273 | .09968 | .09666 | .09365 | .09067 | .08771 | .08477 | .08184 |
| 6 | .10883 | .10575 | .10268 | .09963 | .09661 | .09360 | .09062 | .08766 | .08472 | .08179 |
| 7 | .10878 | .10569 | .10263 | .09958 | .09656 | .09356 | .09057 | .08761 | .08467 | .08175 |
| 8 | .10873 | .10564 | .10258 | .09953 | .09651 | .09351 | .09052 | .08756 | .08462 | .08170 |
| 9 | .10868 | .10559 | .10253 | .09948 | .09646 | .09346 | .09047 | .08751 | .08457 | .08165 |
| 10 | .10863 | .10554 | .10247 | .09943 | .09641 | .09341 | .09042 | .08746 | .08452 | .08160 |
| 11 | .10858 | .10549 | .10242 | .09938 | .09636 | .09336 | .09037 | .08741 | .08447 | .08155 |
| 12 | .10852 | .10544 | .10237 | .09933 | .09631 | .09331 | .09033 | .08736 | .08442 | .08150 |
| 13 | .10847 | .10539 | .10232 | .09928 | .09626 | .09326 | .09028 | .08732 | .08438 | .08146 |
| 14 | .10842 | .10534 | .10227 | .09923 | .09621 | .09321 | .09023 | .08727 | .08433 | .08141 |
| 15 | .10837 | .10528 | .10222 | .09918 | .09616 | .09316 | .09018 | .08722 | .08428 | .08136 |
| 16 | .10832 | .10523 | .10217 | .09913 | .09611 | .09311 | .09013 | .08717 | .08423 | .08131 |
| 17 | .10827 | .10518 | .10212 | .09908 | .09606 | .09306 | .09008 | .08712 | .08418 | .08126 |
| 18 | .10821 | .10513 | .10207 | .09903 | .09601 | .09301 | .09003 | .08707 | .08413 | .08121 |
| 19 | .10816 | .10508 | .10202 | .09898 | .09596 | .09296 | .08998 | .08702 | .08408 | .08116 |
| 20 | .10811 | .10503 | .10197 | .09893 | .09591 | .09291 | .08993 | .08697 | .08403 | .08112 |
| 21 | .10806 | .10498 | .10192 | .09887 | .09586 | .09286 | .08988 | .08692 | .08398 | .08107 |
| 22 | .10801 | .10493 | .10186 | .09882 | .09581 | .09281 | .08983 | .08687 | .08394 | .08102 |
| 23 | .10796 | .10487 | .10181 | .09877 | .09576 | .09276 | .08978 | .08682 | .08389 | .08097 |
| 24 | .10791 | .10482 | .10176 | .09872 | .09571 | .09271 | .08973 | .08678 | .08384 | .08092 |
| 25 | .10785 | .10477 | .10171 | .09867 | .09566 | .09266 | .08968 | .08673 | .08379 | .08087 |
| 26 | .10780 | .10472 | .10166 | .09862 | .09561 | .09261 | .08963 | .08668 | .08374 | .08083 |
| 27 | .10775 | .10467 | .10161 | .09857 | .09556 | .09256 | .08958 | .08663 | .08369 | .08078 |
| 28 | .10770 | .10462 | .10156 | .09852 | .09550 | .09251 | .08953 | .08658 | .08364 | .08073 |
| 29 | .10765 | .10457 | .10151 | .09847 | .09545 | .09246 | .08948 | .08653 | .08359 | .08068 |
| 30 | .10760 | .10452 | .10146 | .09842 | .09540 | .09241 | .08943 | .08648 | .08355 | .08063 |
| 31 | .10754 | .10447 | .10141 | .09837 | .09535 | .09236 | .08939 | .08643 | .08350 | .08058 |
| 32 | .10749 | .10441 | .10136 | .09832 | .09530 | .09231 | .08934 | .08638 | .08345 | .08053 |
| 33 | .10744 | .10436 | .10131 | .09827 | .09525 | .09226 | .08929 | .08633 | .08340 | .08049 |
| 34 | .10739 | .10431 | .10126 | .09822 | .09520 | .09221 | .08924 | .08628 | .08335 | .08044 |
| 35 | .10734 | .10426 | .10120 | .09817 | .09515 | .09216 | .08919 | .08624 | .08330 | .08039 |
| 36 | .10729 | .10421 | .10115 | .09812 | .09510 | .09211 | .08914 | .08619 | .08325 | .08034 |
| 37 | .10724 | .10416 | .10110 | .09807 | .09505 | .09206 | .08909 | .08614 | .08320 | .08029 |
| 38 | .10718 | .10411 | .10105 | .09802 | .09500 | .09201 | .08904 | .08609 | .08316 | .08024 |
| 39 | .10713 | .10406 | .10100 | .09797 | .09495 | .09196 | .08899 | .08604 | .08311 | .08020 |
| 40 | .10708 | .10400 | .10095 | .09792 | .09490 | .09191 | .08894 | .08599 | .08306 | .08015 |
| 41 | .10703 | .10395 | .10090 | .09787 | .09485 | .09186 | .08889 | .08594 | .08301 | .08010 |
| 42 | .10698 | .10390 | .10085 | .09782 | .09480 | .09181 | .08884 | .08589 | .08296 | .08005 |
| 43 | .10693 | .10385 | .10080 | .09777 | .09475 | .09176 | .08879 | .08584 | .08291 | .08000 |
| 44 | .10688 | .10380 | .10075 | .09772 | .09470 | .09171 | .08874 | .08579 | .08286 | .07995 |
| 45 | .10682 | .10375 | .10070 | .09766 | .09465 | .09166 | .08869 | .08575 | .08282 | .07991 |
| 46 | .10677 | .10370 | .10065 | .09761 | .09460 | .09161 | .08865 | .08570 | .08277 | .07986 |
| 47 | .10672 | .10365 | .10059 | .09756 | .09455 | .09156 | .08860 | .08565 | .08272 | .07981 |
| 48 | .10667 | .10360 | .10054 | .09751 | .09450 | .09151 | .08855 | .08560 | .08267 | .07976 |
| 49 | .10662 | .10355 | .10049 | .09746 | .09445 | .09147 | .08850 | .08555 | .08262 | .07971 |
| 50 | .10657 | .10349 | .10044 | .09741 | .09440 | .09142 | .08845 | .08550 | .08257 | .07966 |
| 51 | .10652 | .10344 | .10039 | .09736 | .09435 | .09137 | .08840 | .08545 | .08252 | .07962 |
| 52 | .10646 | .10339 | .10034 | .09731 | .09430 | .09132 | .08835 | .08540 | .08248 | .07957 |
| 53 | .10641 | .10334 | .10029 | .09726 | .09425 | .09127 | .08830 | .08535 | .08243 | .07952 |
| 54 | .10636 | .10329 | .10024 | .09721 | .09420 | .09122 | .08825 | .08530 | .08238 | .07947 |
| 55 | .10631 | .10324 | .10019 | .09716 | .09415 | .09117 | .08820 | .08526 | .08233 | .07942 |
| 56 | .10626 | .10319 | .10014 | .09711 | .09410 | .09112 | .08815 | .08521 | .08228 | .07937 |
| 57 | .10621 | .10314 | .10009 | .09706 | .09405 | .09107 | .08810 | .08516 | .08223 | .07933 |
| 58 | .10616 | .10309 | .10004 | .09701 | .09400 | .09102 | .08805 | .08511 | .08218 | .07928 |
| 59 | .10610 | .10304 | .09999 | .09696 | .09395 | .09097 | .08800 | .08506 | .08213 | .07923 |

| 2" or 2° | PROP. LOGARITHMS. (r.) | 2" or 2°. |
|---|---|---|

| ′ | 30′ | 31′ | 32′ | 33′ | 34′ | 35′ | 36′ | 37′ | 38′ | 39′ |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | .07918 | .07630 | .07343 | .07058 | .06775 | .06494 | .06215 | .05937 | .05662 | .05388 |
| 1 | .07913 | .07625 | .07338 | .07053 | .06770 | .06489 | .06210 | .05933 | .05657 | .05383 |
| 2 | .07908 | .07620 | .07333 | .07049 | .06766 | .06485 | .06206 | .05928 | .05652 | .05378 |
| 3 | .07904 | .07615 | .07329 | .07044 | .06761 | .06480 | .06201 | .05923 | .05648 | .05374 |
| 4 | .07899 | .07610 | .07324 | .07039 | .06756 | .06475 | .06196 | .05919 | .05643 | .05369 |
| 5 | .07894 | .07606 | .07319 | .07034 | .06752 | .06471 | .06192 | .05914 | .05639 | .05365 |
| 6 | .07889 | .07601 | .07314 | .07030 | .06747 | .06466 | .06187 | .05910 | .05634 | .05360 |
| 7 | .07884 | .07596 | .07310 | .07025 | .06742 | .06461 | .06182 | .05905 | .05629 | .05356 |
| 8 | .07880 | .07591 | .07305 | .07020 | .06738 | .06457 | .06178 | .05900 | .05625 | .05351 |
| 9 | .07875 | .07586 | .07300 | .07016 | .06733 | .06452 | .06173 | .05896 | .05620 | .05347 |
| 10 | .07870 | .07582 | .07295 | .07011 | .06728 | .06447 | .06168 | .05891 | .05616 | .05342 |
| 11 | .07865 | .07577 | .07291 | .07006 | .06724 | .06443 | .06164 | .05887 | .05611 | .05337 |
| 12 | .07860 | .07572 | .07286 | .07001 | .06719 | .06438 | .06159 | .05882 | .05607 | .05333 |
| 13 | .07855 | .07567 | .07281 | .06997 | .06714 | .06433 | .06155 | .05877 | .05602 | .05328 |
| 14 | .07851 | .07562 | .07276 | .06992 | .06709 | .06429 | .06150 | .05873 | .05597 | .05324 |
| 15 | .07846 | .07558 | .07272 | .06987 | .06705 | .06424 | .06145 | .05868 | .05593 | .05319 |
| 16 | .07841 | .07553 | .07267 | .06982 | .06700 | .06419 | .06141 | .05864 | .05588 | .05315 |
| 17 | .07836 | .07548 | .07262 | .06978 | .06695 | .06415 | .06136 | .05859 | .05584 | .05310 |
| 18 | .07831 | .07543 | .07257 | .06973 | .06691 | .06410 | .06131 | .05854 | .05579 | .05306 |
| 19 | .07827 | .07539 | .07253 | .06968 | .06686 | .06405 | .06127 | .05850 | .05575 | .05301 |
| 20 | .07822 | .07534 | .07248 | .06964 | .06681 | .06401 | .06122 | .05845 | .05570 | .05297 |
| 21 | .07817 | .07529 | .07243 | .06959 | .06677 | .06396 | .06117 | .05841 | .05565 | .05292 |
| 22 | .07812 | .07524 | .07238 | .06954 | .06672 | .06391 | .06113 | .05836 | .05561 | .05288 |
| 23 | .07807 | .07519 | .07234 | .06949 | .06667 | .06387 | .06108 | .05831 | .05556 | .05283 |
| 24 | .07802 | .07515 | .07229 | .06945 | .06663 | .06382 | .06104 | .05827 | .05552 | .05278 |
| 25 | .07798 | .07510 | .07224 | .06940 | .06658 | .06377 | .06099 | .05822 | .05547 | .05274 |
| 26 | .07793 | .07505 | .07219 | .06935 | .06653 | .06373 | .06094 | .05818 | .05543 | .05269 |
| 27 | .07788 | .07500 | .07215 | .06931 | .06648 | .06368 | .06090 | .05813 | .05538 | .05265 |
| 28 | .07783 | .07496 | .07210 | .06926 | .06644 | .06364 | .06085 | .05808 | .05533 | .05260 |
| 29 | .07778 | .07491 | .07205 | .06921 | .06639 | .06359 | .06080 | .05804 | .05529 | .05256 |
| 30 | .07774 | .07486 | .07200 | .06916 | .06634 | .06354 | .06076 | .05799 | .05524 | .05251 |
| 31 | .07769 | .07481 | .07196 | .06912 | .06630 | .06350 | .06071 | .05795 | .05520 | .05247 |
| 32 | .07764 | .07476 | .07191 | .06907 | .06625 | .06345 | .06067 | .05790 | .05515 | .05242 |
| 33 | .07759 | .07472 | .07186 | .06902 | .06620 | .06340 | .06062 | .05785 | .05511 | .05238 |
| 34 | .07754 | .07467 | .07181 | .06898 | .06616 | .06336 | .06057 | .05781 | .05506 | .05233 |
| 35 | .07750 | .07462 | .07177 | .06893 | .06611 | .06331 | .06053 | .05776 | .05501 | .05229 |
| 36 | .07745 | .07457 | .07172 | .06888 | .06606 | .06326 | .06048 | .05772 | .05497 | .05224 |
| 37 | .07740 | .07453 | .07167 | .06883 | .06602 | .06322 | .06043 | .05767 | .05492 | .05219 |
| 38 | .07735 | .07448 | .07162 | .06879 | .06597 | .06317 | .06039 | .05762 | .05488 | .05215 |
| 39 | .07730 | .07443 | .07158 | .06874 | .06592 | .06312 | .06034 | .05758 | .05483 | .05210 |
| 40 | .07726 | .07438 | .07153 | .06869 | .06588 | .06308 | .06030 | .05753 | .05479 | .05206 |
| 41 | .07721 | .07433 | .07148 | .06865 | .06583 | .06303 | .06025 | .05749 | .05474 | .05201 |
| 42 | .07716 | .07429 | .07143 | .06860 | .06578 | .06298 | .06020 | .05744 | .05470 | .05197 |
| 43 | .07711 | .07424 | .07139 | .06855 | .06574 | .06294 | .06016 | .05739 | .05465 | .05192 |
| 44 | .07706 | .07419 | .07134 | .06850 | .06569 | .06289 | .06011 | .05735 | .05460 | .05188 |
| 45 | .07702 | .07414 | .07129 | .06846 | .06564 | .06284 | .06006 | .05730 | .05456 | .05183 |
| 46 | .07697 | .07410 | .07124 | .06841 | .06559 | .06280 | .06002 | .05726 | .05451 | .05179 |
| 47 | .07692 | .07405 | .07120 | .06836 | .06555 | .06275 | .05997 | .05721 | .05447 | .05174 |
| 48 | .07687 | .07400 | .07115 | .06832 | .06550 | .06271 | .05993 | .05717 | .05442 | .05170 |
| 49 | .07682 | .07395 | .07110 | .06827 | .06545 | .06266 | .05988 | .05712 | .05438 | .05165 |
| 50 | .07678 | .07391 | .07105 | .06822 | .06541 | .06261 | .05983 | .05707 | .05433 | .05161 |
| 51 | .07673 | .07386 | .07101 | .06817 | .06536 | .06257 | .05979 | .05703 | .05429 | .05156 |
| 52 | .07668 | .07381 | .07096 | .06813 | .06531 | .06252 | .05974 | .05698 | .05424 | .05151 |
| 53 | .07663 | .07376 | .07091 | .06808 | .06527 | .06247 | .05970 | .05694 | .05419 | .05147 |
| 54 | .07658 | .07371 | .07087 | .06803 | .06522 | .06243 | .05965 | .05689 | .05415 | .05142 |
| 55 | .07654 | .07367 | .07082 | .06799 | .06517 | .06238 | .05960 | .05684 | .05410 | .05138 |
| 56 | .07649 | .07362 | .07077 | .06794 | .06513 | .06233 | .05956 | .05680 | .05406 | .05133 |
| 57 | .07644 | .07357 | .07072 | .06789 | .06508 | .06229 | .05951 | .05675 | .05401 | .05129 |
| 58 | .07639 | .07352 | .07068 | .06784 | .06503 | .06224 | .05947 | .05671 | .05397 | .05124 |
| 59 | .07634 | .07348 | .07063 | .06780 | .06499 | .06219 | .05942 | .05666 | .05392 | .05120 |

| 2ⁿ or 2°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 2ⁿ or 2°. |
|---|---|---|---|---|---|---|---|---|---|---|
| " | 40′ | 41′ | 42′ | 43′ | 44′ | 45′ | 46′ | 47′ | 48′ | 49′ |
| 0 | .05115 | .04845 | .04576 | .04308 | .04043 | .03779 | .03516 | .03256 | .02996 | .02739 |
| 1 | .05111 | .04840 | .04571 | .04304 | .04038 | .03774 | .03512 | .03251 | .02992 | .02734 |
| 2 | .05106 | .04836 | .04567 | .04300 | .04034 | .03770 | .03508 | .03247 | .02988 | .02730 |
| 3 | .05102 | .04831 | .04562 | .04295 | .04030 | .03766 | .03503 | .03243 | .02983 | .02726 |
| 4 | .05097 | .04827 | .04558 | .04291 | .04025 | .03761 | .03499 | .03238 | .02979 | .02721 |
| 5 | .05093 | .04822 | .04553 | .04286 | .04021 | .03757 | .03495 | .03234 | .02975 | .02717 |
| 6 | .05088 | .04818 | .04549 | .04282 | .04016 | .03753 | .03490 | .03230 | .02970 | .02713 |
| 7 | .05084 | .04813 | .04544 | .04277 | .04012 | .03748 | .03486 | .03225 | .02966 | .02709 |
| 8 | .05079 | .04809 | .04540 | .04273 | .04008 | .03744 | .03482 | .03221 | .02962 | .02704 |
| 9 | .05075 | .04804 | .04536 | .04269 | .04003 | .03739 | .03477 | .03217 | .02958 | .02700 |
| 10 | .05070 | .04800 | .04531 | .04264 | .03999 | .03735 | .03473 | .03212 | .02953 | .02696 |
| 11 | .05066 | .04795 | .04527 | .04260 | .03994 | .03731 | .03469 | .03208 | .02949 | .02691 |
| 12 | .05061 | .04791 | .04522 | .04255 | .03990 | .03726 | .03464 | .03204 | .02945 | .02687 |
| 13 | .05056 | .04786 | .04518 | .04251 | .03986 | .03722 | .03460 | .03199 | .02940 | .02683 |
| 14 | .05052 | .04782 | .04513 | .04246 | .03981 | .03717 | .03455 | .03195 | .02936 | .02679 |
| 15 | .05047 | .04777 | .04509 | .04242 | .03977 | .03713 | .03451 | .03191 | .02932 | .02674 |
| 16 | .05043 | .04773 | .04504 | .04237 | .03972 | .03709 | .03447 | .03186 | .02927 | .02670 |
| 17 | .05038 | .04768 | .04500 | .04233 | .03968 | .03704 | .03442 | .03182 | .02923 | .02666 |
| 18 | .05034 | .04764 | .04495 | .04229 | .03963 | .03700 | .03438 | .03178 | .02919 | .02662 |
| 19 | .05029 | .04759 | .04491 | .04224 | .03959 | .03696 | .03434 | .03173 | .02915 | .02657 |
| 20 | .05025 | .04755 | .04486 | .04220 | .03955 | .03691 | .03429 | .03169 | .02910 | .02653 |
| 21 | .05020 | .04750 | .04482 | .04215 | .03950 | .03687 | .03425 | .03165 | .02906 | .02649 |
| 22 | .05016 | .04746 | .04478 | .04211 | .03946 | .03682 | .03421 | .03160 | .02902 | .02644 |
| 23 | .05011 | .04741 | .04473 | .04206 | .03941 | .03678 | .03416 | .03156 | .02897 | .02640 |
| 24 | .05007 | .04737 | .04469 | .04202 | .03937 | .03674 | .03412 | .03152 | .02893 | .02636 |
| 25 | .05002 | .04732 | .04464 | .04198 | .03933 | .03669 | .03408 | .03147 | .02889 | .02632 |
| 26 | .04998 | .04728 | .04460 | .04193 | .03928 | .03665 | .03403 | .03143 | .02884 | .02627 |
| 27 | .04993 | .04723 | .04455 | .04189 | .03924 | .03661 | .03399 | .03139 | .02880 | .02623 |
| 28 | .04989 | .04719 | .04451 | .04184 | .03919 | .03656 | .03395 | .03134 | .02876 | .02619 |
| 29 | .04984 | .04714 | .04446 | .04180 | .03915 | .03652 | .03390 | .03130 | .02872 | .02615 |
| 30 | .04980 | .04710 | .04442 | .04175 | .03911 | .03647 | .03386 | .03126 | .02867 | .02610 |
| 31 | .04975 | .04706 | .04437 | .04171 | .03906 | .03643 | .03381 | .03121 | .02863 | .02606 |
| 32 | .04971 | .04701 | .04433 | .04167 | .03902 | .03639 | .03377 | .03117 | .02859 | .02602 |
| 33 | .04966 | .04697 | .04429 | .04162 | .03897 | .03634 | .03373 | .03113 | .02854 | .02598 |
| 34 | .04962 | .04692 | .04424 | .04158 | .03893 | .03630 | .03368 | .03108 | .02850 | .02593 |
| 35 | .04957 | .04688 | .04420 | .04153 | .03889 | .03626 | .03364 | .03104 | .02846 | .02589 |
| 36 | .04953 | .04683 | .04415 | .04149 | .03884 | .03621 | .03360 | .03100 | .02841 | .02585 |
| 37 | .04948 | .04679 | .04411 | .04144 | .03880 | .03617 | .03355 | .03096 | .02837 | .02580 |
| 38 | .04944 | .04674 | .04406 | .04140 | .03875 | .03612 | .03351 | .03091 | .02833 | .02576 |
| 39 | .04939 | .04670 | .04402 | .04136 | .03871 | .03608 | .03347 | .03087 | .02829 | .02572 |
| 40 | .04935 | .04665 | .04397 | .04131 | .03867 | .03604 | .03342 | .03083 | .02824 | .02568 |
| 41 | .04930 | .04661 | .04393 | .04127 | .03862 | .03599 | .03338 | .03078 | .02820 | .02563 |
| 42 | .04926 | .04656 | .04388 | .04122 | .03858 | .03595 | .03334 | .03074 | .02816 | .02559 |
| 43 | .04921 | .04652 | .04384 | .04118 | .03853 | .03591 | .03329 | .03070 | .02811 | .02555 |
| 44 | .04917 | .04647 | .04380 | .04114 | .03849 | .03586 | .03325 | .03065 | .02807 | .02551 |
| 45 | .04912 | .04643 | .04375 | .04109 | .03845 | .03582 | .03321 | .03061 | .02803 | .02546 |
| 46 | .04908 | .04638 | .04371 | .04105 | .03840 | .03578 | .03316 | .03057 | .02799 | .02542 |
| 47 | .04903 | .04634 | .04366 | .04100 | .03836 | .03573 | .03312 | .03052 | .02794 | .02538 |
| 48 | .04899 | .04629 | .04362 | .04096 | .03832 | .03569 | .03308 | .03048 | .02790 | .02533 |
| 49 | .04894 | .04625 | .04357 | .04091 | .03827 | .03564 | .03303 | .03044 | .02786 | .02529 |
| 50 | .04890 | .04620 | .04353 | .04087 | .03823 | .03560 | .03299 | .03039 | .02781 | .02525 |
| 51 | .04885 | .04616 | .04348 | .04083 | .03818 | .03556 | .03295 | .03035 | .02777 | .02521 |
| 52 | .04881 | .04612 | .04344 | .04078 | .03814 | .03551 | .03290 | .03031 | .02773 | .02516 |
| 53 | .04876 | .04607 | .04340 | .04074 | .03810 | .03547 | .03286 | .03026 | .02769 | .02512 |
| 54 | .04872 | .04603 | .04335 | .04069 | .03805 | .03543 | .03282 | .03022 | .02764 | .02508 |
| 55 | .04867 | .04598 | .04331 | .04065 | .03801 | .03538 | .03277 | .03018 | .02760 | .02504 |
| 56 | .04863 | .04594 | .04326 | .04061 | .03796 | .03534 | .03273 | .03014 | .02756 | .02499 |
| 57 | .04858 | .04589 | .04322 | .04056 | .03792 | .03530 | .03269 | .03009 | .02751 | .02495 |
| 58 | .04854 | .04585 | .04317 | .04052 | .03788 | .03525 | .03264 | .03005 | .02747 | .02491 |
| 59 | .04849 | .04580 | .04313 | .04047 | .03783 | .03521 | .03260 | .03001 | .02743 | .02487 |

| 2h or 2°. | PROP. LOGARITHMS. (r.) | | | | | | | | | 2h or 2°. |
|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 50′ | 51′ | 52′ | 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ |
| 0 | .02482 | .02228 | .01974 | .01723 | .01472 | .01223 | .00976 | .00730 | .00485 | .00242 |
| 1 | .02478 | .02223 | .01970 | .01718 | .01468 | .01219 | .00972 | .00726 | .00481 | .00238 |
| 2 | .02474 | .02219 | .01966 | .01714 | .01464 | .01215 | .00968 | .00722 | .00477 | .00234 |
| 3 | .02470 | .02215 | .01962 | .01710 | .01460 | .01211 | .00964 | .00718 | .00473 | .00230 |
| 4 | .02465 | .02211 | .01958 | .01706 | .01456 | .01207 | .00960 | .00714 | .00469 | .00226 |
| 5 | .02461 | .02206 | .01953 | .01702 | .01452 | .01203 | .00955 | .00709 | .00465 | .00222 |
| 6 | .02457 | .02202 | .01949 | .01698 | .01447 | .01199 | .00951 | .00705 | .00461 | .00218 |
| 7 | .02453 | .02198 | .01945 | .01693 | .01443 | .01195 | .00947 | .00701 | .00457 | .00214 |
| 8 | .02448 | .02194 | .01941 | .01689 | .01439 | .01190 | .00943 | .00697 | .00453 | .00210 |
| 9 | .02444 | .02190 | .01937 | .01685 | .01435 | .01186 | .00939 | .00693 | .00449 | .00206 |
| 10 | .02440 | .02185 | .01932 | .01681 | .01431 | .01182 | .00935 | .00689 | .00445 | .00202 |
| 11 | .02436 | .02181 | .01928 | .01677 | .01427 | .01178 | .00931 | .00685 | .00441 | .00197 |
| 12 | .02431 | .02177 | .01924 | .01672 | .01422 | .01174 | .00927 | .00681 | .00436 | .00193 |
| 13 | .02427 | .02173 | .01920 | .01668 | .01418 | .01170 | .00923 | .00677 | .00432 | .00189 |
| 14 | .02423 | .02168 | .01916 | .01664 | .01414 | .01166 | .00918 | .00673 | .00428 | .00185 |
| 15 | .02419 | .02164 | .01911 | .01660 | .01410 | .01161 | .00914 | .00669 | .00424 | .00181 |
| 16 | .02414 | .02160 | .01907 | .01656 | .01406 | .01157 | .00910 | .00665 | .00420 | .00177 |
| 17 | .02410 | .02156 | .01903 | .01652 | .01402 | .01153 | .00906 | .00660 | .00416 | .00173 |
| 18 | .02406 | .02152 | .01899 | .01647 | .01398 | .01149 | 00902 | .00656 | .00412 | .00169 |
| 19 | .02402 | .02147 | .01895 | .01643 | .01393 | .01145 | .00898 | .00652 | .00408 | .00165 |
| 20 | .02397 | .02143 | .01890 | .01639 | .01389 | .01141 | .00894 | .00648 | .00404 | .00161 |
| 21 | .02393 | .02139 | .01886 | .01635 | .01385 | .01137 | .00890 | .00644 | .00400 | .00157 |
| 22 | .02389 | .02135 | .01882 | .01631 | .01381 | .01133 | .00886 | .00640 | .00396 | .00153 |
| 23 | .02385 | .02130 | .01878 | .01627 | .01377 | .01128 | .00882 | .00636 | .00392 | .00149 |
| 24 | .02380 | .02126 | .01874 | .01622 | .01373 | .01124 | .00877 | .00632 | .00388 | .00145 |
| 25 | .02376 | .02122 | .01869 | .01618 | .01368 | .01120 | .00873 | .00628 | .00384 | .00141 |
| 26 | .02372 | .02118 | .01865 | .01614 | .01364 | .01116 | .00869 | .00624 | .00380 | .00137 |
| 27 | .02368 | .02114 | .01861 | .01610 | .01360 | .01112 | .00865 | .00620 | .00376 | .00133 |
| 28 | .02363 | .02109 | .01857 | .01606 | .01356 | .01108 | .00861 | .00616 | .00372 | .00129 |
| 29 | .02359 | .02105 | .01853 | .01601 | .01352 | .01104 | .00857 | .00611 | .00367 | .00125 |
| 30 | .02355 | .02101 | .01848 | .01597 | .01348 | .01100 | .00853 | .00607 | .00363 | .00121 |
| 31 | .02351 | .02097 | .01844 | .01593 | .01344 | .01095 | .00849 | .00603 | .00359 | .00117 |
| 32 | .02346 | .02092 | .01840 | .01589 | .01339 | .01091 | .00845 | .00599 | .00355 | .00113 |
| 33 | .02342 | .02088 | .01836 | .01585 | .01335 | .01087 | .00840 | .00595 | .00351 | .00109 |
| 34 | .02338 | .02084 | .01832 | .01581 | .01331 | .01083 | .00836 | .00591 | .00347 | .00105 |
| 35 | .02334 | .02080 | .01827 | .01576 | .01327 | .01079 | .00832 | .00587 | .00343 | .00101 |
| 36 | .02329 | .02076 | .01823 | .01572 | .01323 | .01075 | .00828 | .00583 | .00339 | .00097 |
| 37 | .02325 | .02071 | .01819 | .01568 | .01319 | .01071 | .00824 | .00579 | .00335 | .00093 |
| 38 | .02321 | .02067 | .01815 | .01564 | .01315 | .01067 | .00820 | .00575 | .00331 | .00089 |
| 39 | .02317 | .02063 | .01811 | .01560 | .01310 | .01062 | .00816 | .00571 | .00327 | .00085 |
| 40 | .02312 | .02059 | .01806 | .01556 | .01306 | .01058 | .00812 | .00567 | .00323 | .00080 |
| 41 | .02308 | .02054 | .01802 | .01551 | .01302 | .01054 | .00808 | .00563 | .00319 | .00076 |
| 42 | .02304 | .02050 | .01798 | .01547 | .01298 | .01050 | .00804 | .00559 | .00315 | .00072 |
| 43 | .02300 | .02046 | .01794 | .01543 | .01294 | .01046 | .00799 | .00554 | .00311 | .00068 |
| 44 | .02295 | .02042 | .01790 | .01539 | .01290 | .01042 | .00795 | .00550 | .00307 | .00064 |
| 45 | .02291 | .02038 | .01785 | .01535 | .01286 | .01038 | .00791 | .00546 | .00303 | .00060 |
| 46 | .02287 | .02033 | .01781 | .01531 | .01281 | .01034 | 00787 | .00542 | .00299 | .00056 |
| 47 | .02283 | .02029 | .01777 | .01526 | .01277 | .01029 | .00783 | .00538 | .00295 | .00052 |
| 48 | .02278 | .02025 | .01773 | .01522 | .01273 | .01025 | .00779 | .00534 | .00290 | .00048 |
| 49 | .02274 | .02021 | .01769 | .01518 | .01269 | .01021 | .00775 | .00530 | .00286 | .00044 |
| 50 | .02270 | .02017 | .01764 | .01514 | .01265 | .01017 | .00771 | .00526 | .00282 | .00040 |
| 51 | .02266 | .02012 | .01760 | .01510 | .01261 | .01013 | .00767 | .00522 | .00278 | .00036 |
| 52 | .02262 | .02008 | .01756 | .01506 | .01257 | .01009 | .00763 | .00518 | .00274 | .00032 |
| 53 | .02257 | .02004 | .01752 | .01501 | .01252 | .01005 | .00759 | .00514 | .00270 | .00028 |
| 54 | .02253 | .02000 | .01748 | .01497 | .01248 | .01001 | .00754 | .00510 | .00266 | .00024 |
| 55 | .02249 | .01995 | .01744 | .01493 | .01244 | .00997 | .00750 | .00506 | .00262 | .00020 |
| 56 | .02245 | .01991 | .01739 | .01489 | .01240 | .00992 | .00746 | .00502 | .00258 | .00016 |
| 57 | .02240 | .01987 | .01735 | .01485 | .01236 | .00988 | .00742 | .00497 | .00254 | .00012 |
| 58 | .02236 | .01983 | .01731 | .01481 | .01232 | .00984 | .00738 | .00493 | .00250 | .00008 |
| 59 | .02232 | .01979 | .01727 | .01476 | .01228 | .00980 | .00734 | .00489 | .00246 | .00004 |

## LOG. SINE TO SECONDS. (S.)

| ″ | 0° 0′ | 0° 1′ | 0° 2′ | 0° 3′ | 0° 4′ | 0° 5′ | 0° 6′ | 0° 7′ | 0° 8′ | 0° 9′ | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | | 6.463726 | 6.764756 | 6.940847 | 7.065786 | 7.162696 | 7.241877 | 7.308824 | 7.366816 | 7.417968 | 60 |
| 1 | 4.685575 | 6.470905 | 6.768360 | 6.943253 | 7.067592 | 7.164141 | 7.243082 | 7.309857 | 7.367719 | 7.418772 | 59 |
| 2 | 4.986605 | 6.477966 | 6.771935 | 6.945646 | 7.069390 | 7.165582 | 7.244283 | 7.310887 | 7.368621 | 7.419574 | 58 |
| 3 | 5.162696 | 6.484915 | 6.775480 | 6.948026 | 7.071181 | 7.167017 | 7.245481 | 7.311915 | 7.369522 | 7.420374 | 57 |
| 4 | 5.287635 | 6.491755 | 6.778996 | 6.950393 | 7.072965 | 7.168448 | 7.246676 | 7.312940 | 7.370420 | 7.421173 | 56 |
| 5 | 5.384545 | 6.498488 | 6.782485 | 6.952746 | 7.074741 | 7.169874 | 7.247867 | 7.313963 | 7.371316 | 7.421971 | 55 |
| 6 | 5.463726 | 6.505119 | 6.785945 | 6.955088 | 7.076510 | 7.171296 | 7.249056 | 7.314984 | 7.372211 | 7.422767 | 54 |
| 7 | 5.530673 | 6.511650 | 6.789379 | 6.957416 | 7.078272 | 7.172713 | 7.250241 | 7.316002 | 7.373103 | 7.423562 | 53 |
| 8 | 5.588665 | 6.518084 | 6.792785 | 6.959733 | 7.080026 | 7.174125 | 7.251422 | 7.317018 | 7.373994 | 7.424355 | 52 |
| 9 | 5.639817 | 6.524424 | 6.796164 | 6.962037 | 7.081774 | 7.175533 | 7.252601 | 7.318032 | 7.374883 | 7.425147 | 51 |
| 10 | 5.685575 | 6.530673 | 6.799518 | 6.964328 | 7.083515 | 7.176936 | 7.253776 | 7.319043 | 7.375770 | 7.425937 | 50 |
| 11 | 5.726968 | 6.536833 | 6.802846 | 6.966608 | 7.085248 | 7.178335 | 7.254948 | 7.320052 | 7.376656 | 7.426726 | 49 |
| 12 | 5.764756 | 6.542907 | 6.806149 | 6.968876 | 7.086975 | 7.179729 | 7.256118 | 7.321058 | 7.377540 | 7.427513 | 48 |
| 13 | 5.799518 | 6.548898 | 6.809426 | 6.971132 | 7.088695 | 7.181119 | 7.257283 | 7.322062 | 7.378421 | 7.428299 | 47 |
| 14 | 5.831703 | 6.554807 | 6.812680 | 6.973376 | 7.090408 | 7.182504 | 7.258446 | 7.323064 | 7.379301 | 7.429084 | 46 |
| 15 | 5.861666 | 6.560636 | 6.815909 | 6.975609 | 7.092115 | 7.183885 | 7.259606 | 7.324064 | 7.380180 | 7.429867 | 45 |
| 16 | 5.889695 | 6.566388 | 6.819114 | 6.977831 | 7.093815 | 7.185262 | 7.260762 | 7.325061 | 7.381056 | 7.430649 | 44 |
| 17 | 5.916024 | 6.572066 | 6.822295 | 6.980041 | 7.095508 | 7.186634 | 7.261916 | 7.326056 | 7.381931 | 7.431429 | 43 |
| 18 | 5.940847 | 6.577669 | 6.825454 | 6.982240 | 7.097194 | 7.188002 | 7.263066 | 7.327049 | 7.382804 | 7.432208 | 42 |
| 19 | 5.964328 | 6.583202 | 6.828590 | 6.984428 | 7.098874 | 7.189365 | 7.264214 | 7.328039 | 7.383675 | 7.432986 | 41 |
| 20 | 5.986605 | 6.588665 | 6.831703 | 6.986605 | 7.100548 | 7.190725 | 7.265358 | 7.329027 | 7.384544 | 7.433762 | 40 |
| 21 | 6.007794 | 6.594060 | 6.834794 | 6.988771 | 7.102215 | 7.192080 | 7.266500 | 7.330013 | 7.385412 | 7.434537 | 39 |
| 22 | 6.027997 | 6.599389 | 6.837863 | 6.990926 | 7.103876 | 7.193431 | 7.267638 | 7.330997 | 7.386278 | 7.435311 | 38 |
| 23 | 6.047303 | 6.604653 | 6.840911 | 6.993071 | 7.105530 | 7.194777 | 7.268773 | 7.331978 | 7.387142 | 7.436083 | 37 |
| 24 | 6.065786 | 6.609854 | 6.843937 | 6.995205 | 7.107179 | 7.196120 | 7.269906 | 7.332957 | 7.388005 | 7.436853 | 36 |
| 25 | 6.083515 | 6.614994 | 6.846943 | 6.997329 | 7.108821 | 7.197458 | 7.271035 | 7.333934 | 7.388866 | 7.437623 | 35 |
| 26 | 6.100548 | 6.620073 | 6.849928 | 6.999442 | 7.110456 | 7.198792 | 7.272162 | 7.334909 | 7.389725 | 7.438391 | 34 |
| 27 | 6.116939 | 6.625094 | 6.852892 | 7.001545 | 7.112086 | 7.200122 | 7.273286 | 7.335882 | 7.390582 | 7.439157 | 33 |
| 28 | 6.132733 | 6.630057 | 6.855836 | 7.003638 | 7.113709 | 7.201448 | 7.274406 | 7.336852 | 7.391438 | 7.439923 | 32 |
| 29 | 6.147973 | 6.634965 | 6.858761 | 7.005721 | 7.115327 | 7.202771 | 7.275524 | 7.337821 | 7.392292 | 7.440687 | 31 |
| 30 | 6.162696 | 6.639817 | 6.861666 | 7.007794 | 7.116938 | 7.204089 | 7.276639 | 7.338787 | 7.393145 | 7.441449 | 30 |
| 31 | 6.176937 | 6.644616 | 6.864552 | 7.009857 | 7.118544 | 7.205403 | 7.277751 | 7.339751 | 7.393995 | 7.442210 | 29 |
| 32 | 6.190725 | 6.649363 | 6.867418 | 7.011911 | 7.120144 | 7.206713 | 7.278861 | 7.340713 | 7.394844 | 7.442970 | 28 |
| 33 | 6.204089 | 6.654058 | 6.870266 | 7.013954 | 7.121737 | 7.208019 | 7.279967 | 7.341673 | 7.395692 | 7.443729 | 27 |
| 34 | 6.217054 | 6.658703 | 6.873095 | 7.015989 | 7.123325 | 7.209321 | 7.281071 | 7.342630 | 7.396537 | 7.444486 | 26 |
| 35 | 6.229643 | 6.663298 | 6.875906 | 7.018013 | 7.124907 | 7.210619 | 7.282172 | 7.343586 | 7.397382 | 7.445242 | 25 |
| 36 | 6.241877 | 6.667846 | 6.878699 | 7.020028 | 7.126484 | 7.211914 | 7.283270 | 7.344539 | 7.398224 | 7.445997 | 24 |
| 37 | 6.253777 | 6.672347 | 6.881474 | 7.022034 | 7.128054 | 7.213205 | 7.284365 | 7.345491 | 7.399065 | 7.446750 | 23 |
| 38 | 6.265358 | 6.676801 | 6.884232 | 7.024031 | 7.129619 | 7.214491 | 7.285458 | 7.346440 | 7.399904 | 7.447502 | 22 |
| 39 | 6.276639 | 6.681210 | 6.886972 | 7.026019 | 7.131179 | 7.215774 | 7.286547 | 7.347387 | 7.400742 | 7.448253 | 21 |
| 40 | 6.287635 | 6.685575 | 6.889695 | 7.027997 | 7.132733 | 7.217054 | 7.287635 | 7.348332 | 7.401578 | 7.449002 | 20 |
| 41 | 6.298359 | 6.689896 | 6.892401 | 7.029967 | 7.134281 | 7.218329 | 7.288719 | 7.349275 | 7.402412 | 7.449750 | 19 |
| 42 | 6.308824 | 6.694175 | 6.895090 | 7.031928 | 7.135824 | 7.219601 | 7.289801 | 7.350216 | 7.403245 | 7.450497 | 18 |
| 43 | 6.319043 | 6.698412 | 6.897762 | 7.033880 | 7.137361 | 7.220869 | 7.290880 | 7.351155 | 7.404076 | 7.451243 | 17 |
| 44 | 6.329027 | 6.702608 | 6.900419 | 7.035823 | 7.138893 | 7.222133 | 7.291956 | 7.352092 | 7.404906 | 7.451987 | 16 |
| 45 | 6.338787 | 6.706764 | 6.903059 | 7.037757 | 7.140420 | 7.223394 | 7.293030 | 7.353027 | 7.405734 | 7.452730 | 15 |
| 46 | 6.348333 | 6.710881 | 6.905683 | 7.039683 | 7.141941 | 7.224651 | 7.294101 | 7.353960 | 7.406560 | 7.453472 | 14 |
| 47 | 6.357673 | 6.714959 | 6.908291 | 7.041601 | 7.143457 | 7.225904 | 7.295169 | 7.354891 | 7.407385 | 7.454212 | 13 |
| 48 | 6.366816 | 6.718999 | 6.910884 | 7.043510 | 7.144967 | 7.227154 | 7.296235 | 7.355820 | 7.408208 | 7.454952 | 12 |
| 49 | 6.375771 | 6.723001 | 6.913461 | 7.045410 | 7.146473 | 7.228400 | 7.297298 | 7.356747 | 7.409030 | 7.455690 | 11 |
| 50 | 6.384545 | 6.726967 | 6.916024 | 7.047303 | 7.147973 | 7.229643 | 7.298358 | 7.357672 | 7.409850 | 7.456426 | 10 |
| 51 | 6.393145 | 6.730898 | 6.918571 | 7.049187 | 7.149468 | 7.230882 | 7.299416 | 7.358595 | 7.410669 | 7.457162 | 9 |
| 52 | 6.401578 | 6.734793 | 6.921103 | 7.051063 | 7.150958 | 7.232117 | 7.300472 | 7.359516 | 7.411486 | 7.457896 | 8 |
| 53 | 6.409851 | 6.738653 | 6.923621 | 7.052931 | 7.152442 | 7.233349 | 7.301525 | 7.360436 | 7.412302 | 7.458629 | 7 |
| 54 | 6.417969 | 6.742480 | 6.926124 | 7.054791 | 7.153922 | 7.234578 | 7.302575 | 7.361353 | 7.413116 | 7.459361 | 6 |
| 55 | 6.425938 | 6.746273 | 6.928613 | 7.056643 | 7.155397 | 7.235803 | 7.303623 | 7.362268 | 7.413928 | 7.460091 | 5 |
| 56 | 6.433763 | 6.750033 | 6.931087 | 7.058487 | 7.156866 | 7.237025 | 7.304668 | 7.363181 | 7.414739 | 7.460822 | 4 |
| 57 | 6.441450 | 6.753761 | 6.933548 | 7.060323 | 7.158331 | 7.238243 | 7.305711 | 7.364093 | 7.415549 | 7.461549 | 3 |
| 58 | 6.449003 | 6.757457 | 6.935995 | 7.062152 | 7.159791 | 7.239458 | 7.306751 | 7.365002 | 7.416357 | 7.462275 | 2 |
| 59 | 6.456427 | 6.761122 | 6.938428 | 7.063973 | 7.161246 | 7.240669 | 7.307789 | 7.365910 | 7.417163 | 7.463003 | 1 |
| 60 | 6.463726 | 6.764756 | 6.940847 | 7.065786 | 7.162696 | 7.241877 | 7.308824 | 7.366816 | 7.417968 | 7.463725 | 0 |
| ″ | 89° 59′ | 89° 58′ | 89° 57′ | 89° 56′ | 89° 55′ | 89° 54′ | 89° 53′ | 89° 52′ | 89° 51′ | 89° 50′ | ′ |

LOG. COSINE TO SECONDS.

## LOG. SINE TO SECONDS. (S.)

| ′ | 0° 10′ | 0° 11′ | 0° 12′ | 0° 13′ | 0° 14′ | 0° 15′ | 0° 16′ | 0° 17′ | 0° 18′ | 0° 19′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.463725 | 7.505118 | 7.542906 | 7.577668 | 7.609853 | 7.639816 | 7.667844 | 7.694173 | 7.718997 | 7.742477 | 60 |
| 1 | 7.464449 | 7.505776 | 7.543509 | 7.578225 | 7.610370 | 7.640298 | 7.668297 | 7.694599 | 7.719399 | 7.742858 | 59 |
| 2 | 7.465171 | 7.506432 | 7.544111 | 7.578781 | 7.610886 | 7.640780 | 7.668748 | 7.695024 | 7.719800 | 7.743239 | 58 |
| 3 | 7.465892 | 7.507088 | 7.544712 | 7.579336 | 7.611401 | 7.641261 | 7.669200 | 7.695449 | 7.720201 | 7.743619 | 57 |
| 4 | 7.466611 | 7.507742 | 7.545312 | 7.579890 | 7.611916 | 7.641742 | 7.669650 | 7.695873 | 7.720602 | 7.743999 | 56 |
| 5 | 7.467330 | 7.508396 | 7.545912 | 7.580443 | 7.612430 | 7.642222 | 7.670101 | 7.696297 | 7.721003 | 7.744378 | 55 |
| 6 | 7.468047 | 7.509048 | 7.546511 | 7.580996 | 7.612944 | 7.642702 | 7.670550 | 7.696720 | 7.721403 | 7.744757 | 54 |
| 7 | 7.468763 | 7.509700 | 7.547108 | 7.581548 | 7.613457 | 7.643181 | 7.671000 | 7.697143 | 7.721802 | 7.745136 | 53 |
| 8 | 7.469478 | 7.510351 | 7.547705 | 7.582100 | 7.613969 | 7.643659 | 7.671449 | 7.697566 | 7.722202 | 7.745514 | 52 |
| 9 | 7.470191 | 7.511000 | 7.548301 | 7.582651 | 7.614481 | 7.644137 | 7.671897 | 7.697988 | 7.722601 | 7.745893 | 51 |
| 10 | 7.470904 | 7.511649 | 7.548897 | 7.583201 | 7.614993 | 7.644615 | 7.672345 | 7.698410 | 7.722999 | 7.746270 | 50 |
| 11 | 7.471615 | 7.512297 | 7.549491 | 7.583750 | 7.615503 | 7.645092 | 7.672792 | 7.698832 | 7.723398 | 7.746648 | 49 |
| 12 | 7.472326 | 7.512943 | 7.550085 | 7.584299 | 7.616013 | 7.645568 | 7.673239 | 7.699253 | 7.723795 | 7.747025 | 48 |
| 13 | 7.473035 | 7.513589 | 7.550678 | 7.584847 | 7.616523 | 7.646044 | 7.673686 | 7.699673 | 7.724193 | 7.747402 | 47 |
| 14 | 7.473743 | 7.514234 | 7.551270 | 7.585394 | 7.617031 | 7.646520 | 7.674132 | 7.700094 | 7.724590 | 7.747778 | 46 |
| 15 | 7.474449 | 7.514878 | 7.551861 | 7.585941 | 7.617540 | 7.646994 | 7.674578 | 7.700513 | 7.724987 | 7.748155 | 45 |
| 16 | 7.475155 | 7.515521 | 7.552452 | 7.586487 | 7.618047 | 7.647469 | 7.675023 | 7.700933 | 7.725383 | 7.748530 | 44 |
| 17 | 7.475859 | 7.516163 | 7.553041 | 7.587032 | 7.618554 | 7.647943 | 7.675468 | 7.701352 | 7.725779 | 7.748906 | 43 |
| 18 | 7.476563 | 7.516804 | 7.553630 | 7.587577 | 7.619061 | 7.648416 | 7.675912 | 7.701770 | 7.726175 | 7.749281 | 42 |
| 19 | 7.477265 | 7.517444 | 7.554218 | 7.588121 | 7.619567 | 7.648889 | 7.676356 | 7.702189 | 7.726570 | 7.749656 | 41 |
| 20 | 7.477966 | 7.518083 | 7.554806 | 7.588664 | 7.620072 | 7.649361 | 7.676799 | 7.702606 | 7.726965 | 7.750031 | 40 |
| 21 | 7.478666 | 7.518721 | 7.555392 | 7.589206 | 7.620577 | 7.649833 | 7.677242 | 7.703024 | 7.727360 | 7.750405 | 39 |
| 22 | 7.479365 | 7.519358 | 7.555978 | 7.589748 | 7.621081 | 7.650304 | 7.677685 | 7.703441 | 7.727754 | 7.750779 | 38 |
| 23 | 7.480062 | 7.519995 | 7.556563 | 7.590289 | 7.621584 | 7.650775 | 7.678127 | 7.703857 | 7.728148 | 7.751152 | 37 |
| 24 | 7.480759 | 7.520630 | 7.557147 | 7.590830 | 7.622087 | 7.651245 | 7.678568 | 7.704273 | 7.728542 | 7.751525 | 36 |
| 25 | 7.481454 | 7.521265 | 7.557730 | 7.591370 | 7.622590 | 7.651715 | 7.679009 | 7.704689 | 7.728935 | 7.751898 | 35 |
| 26 | 7.482148 | 7.521898 | 7.558313 | 7.591909 | 7.623091 | 7.652184 | 7.679450 | 7.705105 | 7.729328 | 7.752271 | 34 |
| 27 | 7.482842 | 7.522531 | 7.558894 | 7.592447 | 7.623593 | 7.652653 | 7.679890 | 7.705520 | 7.729720 | 7.752643 | 33 |
| 28 | 7.483534 | 7.523162 | 7.559475 | 7.592985 | 7.624093 | 7.653121 | 7.680330 | 7.705934 | 7.730112 | 7.753015 | 32 |
| 29 | 7.484225 | 7.523793 | 7.560056 | 7.593522 | 7.624593 | 7.653589 | 7.680769 | 7.706348 | 7.730504 | 7.753387 | 31 |
| 30 | 7.484915 | 7.524423 | 7.560635 | 7.594059 | 7.625093 | 7.654056 | 7.681208 | 7.706762 | 7.730896 | 7.753758 | 30 |
| 31 | 7.485603 | 7.525052 | 7.561214 | 7.594595 | 7.625592 | 7.654523 | 7.681647 | 7.707176 | 7.731287 | 7.754129 | 29 |
| 32 | 7.486291 | 7.525680 | 7.561792 | 7.595130 | 7.626090 | 7.654989 | 7.682085 | 7.707589 | 7.731678 | 7.754500 | 28 |
| 33 | 7.486978 | 7.526307 | 7.562369 | 7.595664 | 7.626588 | 7.655455 | 7.682522 | 7.708001 | 7.732068 | 7.754870 | 27 |
| 34 | 7.487663 | 7.526933 | 7.562945 | 7.596198 | 7.627085 | 7.655920 | 7.682960 | 7.708414 | 7.732458 | 7.755241 | 26 |
| 35 | 7.488348 | 7.527559 | 7.563521 | 7.596731 | 7.627582 | 7.656385 | 7.683396 | 7.708825 | 7.732848 | 7.755610 | 25 |
| 36 | 7.489031 | 7.528183 | 7.564096 | 7.597264 | 7.628078 | 7.656849 | 7.683832 | 7.709237 | 7.733237 | 7.755980 | 24 |
| 37 | 7.489714 | 7.528807 | 7.564670 | 7.597796 | 7.628573 | 7.657313 | 7.684268 | 7.709648 | 7.733626 | 7.756349 | 23 |
| 38 | 7.490395 | 7.529429 | 7.565243 | 7.598327 | 7.629068 | 7.657776 | 7.684704 | 7.710059 | 7.734014 | 7.756718 | 22 |
| 39 | 7.491075 | 7.530051 | 7.565816 | 7.598858 | 7.629562 | 7.658239 | 7.685139 | 7.710469 | 7.734403 | 7.757086 | 21 |
| 40 | 7.491754 | 7.530672 | 7.566387 | 7.599388 | 7.630056 | 7.658701 | 7.685573 | 7.710879 | 7.734791 | 7.757454 | 20 |
| 41 | 7.492432 | 7.531292 | 7.566958 | 7.599917 | 7.630549 | 7.659163 | 7.686007 | 7.711288 | 7.735178 | 7.757822 | 19 |
| 42 | 7.493109 | 7.531911 | 7.567529 | 7.600445 | 7.631042 | 7.659624 | 7.686441 | 7.711697 | 7.735566 | 7.758190 | 18 |
| 43 | 7.493785 | 7.532529 | 7.568098 | 7.600973 | 7.631534 | 7.660085 | 7.686874 | 7.712106 | 7.735952 | 7.758557 | 17 |
| 44 | 7.494460 | 7.533147 | 7.568667 | 7.601501 | 7.632026 | 7.660545 | 7.687307 | 7.712515 | 7.736339 | 7.758924 | 16 |
| 45 | 7.495134 | 7.533763 | 7.569235 | 7.602028 | 7.632517 | 7.661005 | 7.687739 | 7.712922 | 7.736725 | 7.759291 | 15 |
| 46 | 7.495807 | 7.534379 | 7.569803 | 7.602554 | 7.633007 | 7.661464 | 7.688171 | 7.713330 | 7.737111 | 7.759657 | 14 |
| 47 | 7.496478 | 7.534993 | 7.570369 | 7.603079 | 7.633497 | 7.661923 | 7.688603 | 7.713737 | 7.737497 | 7.760023 | 13 |
| 48 | 7.497149 | 7.535607 | 7.570935 | 7.603604 | 7.633986 | 7.662382 | 7.689034 | 7.714144 | 7.737882 | 7.760389 | 12 |
| 49 | 7.497819 | 7.536220 | 7.571500 | 7.604128 | 7.634475 | 7.662839 | 7.689464 | 7.714551 | 7.738267 | 7.760754 | 11 |
| 50 | 7.498487 | 7.536832 | 7.572065 | 7.604652 | 7.634963 | 7.663297 | 7.689894 | 7.714957 | 7.738651 | 7.761119 | 10 |
| 51 | 7.499155 | 7.537444 | 7.572628 | 7.605175 | 7.635451 | 7.663754 | 7.690324 | 7.715362 | 7.739035 | 7.761484 | 9 |
| 52 | 7.499822 | 7.538054 | 7.573191 | 7.605697 | 7.635938 | 7.664210 | 7.690754 | 7.715768 | 7.739419 | 7.761849 | 8 |
| 53 | 7.500487 | 7.538663 | 7.573753 | 7.606219 | 7.636425 | 7.664666 | 7.691183 | 7.716173 | 7.739803 | 7.762213 | 7 |
| 54 | 7.501152 | 7.539272 | 7.574315 | 7.606740 | 7.636911 | 7.665122 | 7.691611 | 7.716577 | 7.740186 | 7.762577 | 6 |
| 55 | 7.501815 | 7.539880 | 7.574875 | 7.607260 | 7.637396 | 7.665577 | 7.692039 | 7.716981 | 7.740568 | 7.762940 | 5 |
| 56 | 7.502478 | 7.540487 | 7.575436 | 7.607780 | 7.637881 | 7.666031 | 7.692467 | 7.717385 | 7.740951 | 7.763304 | 4 |
| 57 | 7.503139 | 7.541093 | 7.575995 | 7.608299 | 7.638366 | 7.666485 | 7.692894 | 7.717789 | 7.741333 | 7.763667 | 3 |
| 58 | 7.503800 | 7.541698 | 7.576553 | 7.608818 | 7.638850 | 7.666939 | 7.693321 | 7.718192 | 7.741715 | 7.764029 | 2 |
| 59 | 7.504459 | 7.542303 | 7.577111 | 7.609336 | 7.639333 | 7.667392 | 7.693747 | 7.718594 | 7.742096 | 7.764392 | 1 |
| 60 | 7.505118 | 7.542906 | 7.577668 | 7.609853 | 7.639816 | 7.667844 | 7.694173 | 7.718997 | 7.742477 | 7.764754 | 0 |
| | 89° 49′ | 89° 48′ | 89° 47′ | 89° 46′ | 89° 45′ | 89° 44′ | 89° 43′ | 89° 42′ | 89° 41′ | 89° 40′ | ′ |

## LOG. SINE TO SECONDS. (a.)

| ′ | 0° 20′ | 0° 21′ | 0° 22′ | 0° 23′ | 0° 24′ | 0° 25′ | 0° 26′ | 0° 27′ | 0° 28′ | 0° 29′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.764754 | 7.785943 | 7.806146 | 7.825451 | 7.843934 | 7.861662 | 7.878695 | 7.895085 | 7.910879 | 7.926119 | 60 |
| 1 | 7.765115 | 7.786287 | 7.806475 | 7.825765 | 7.844235 | 7.861952 | 7.878974 | 7.8 5353 | 7.911138 | 7.926368 | 59 |
| 2 | 7.765477 | 7.786631 | 7.806803 | 7.826080 | 7.844537 | 7.862241 | 7.879252 | 7.895621 | 7.911396 | 7.926618 | 58 |
| 3 | 7.765838 | 7.786975 | 7.807132 | 7.826394 | 7.844838 | 7.862530 | 7.879530 | 7.895889 | 7.911654 | 7.926867 | 57 |
| 4 | 7.766199 | 7.787319 | 7.807460 | 7.826708 | 7.845138 | 7.862819 | 7.879807 | 7.896156 | 7.911912 | 7.927116 | 56 |
| 5 | 7.766559 | 7.787663 | 7.807788 | 7.827021 | 7.845439 | 7.863107 | 7.880085 | 7.896424 | 7.912170 | 7.927365 | 55 |
| 6 | 7.766920 | 7.788006 | 7.808115 | 7.827335 | 7.845740 | 7.863396 | 7.880362 | 7.896691 | 7.912428 | 7.927614 | 54 |
| 7 | 7.767280 | 7.788349 | 7.808443 | 7.827648 | 7.846040 | 7.863684 | 7.880640 | 7.896958 | 7.912685 | 7.927863 | 53 |
| 8 | 7.767639 | 7.788691 | 7.808770 | 7.827961 | 7.846340 | 7.863972 | 7.880917 | 7.897225 | 7.912942 | 7.928111 | 52 |
| 9 | 7.767999 | 7.789034 | 7.809097 | 7.828274 | 7.846640 | 7.864260 | 7.881194 | 7.897491 | 7.913200 | 7.928359 | 51 |
| 10 | 7.768358 | 7.789376 | 7.809423 | 7.828586 | 7.846939 | 7.864548 | 7.881470 | 7.897758 | 7.913457 | 7.928608 | 50 |
| 11 | 7.768716 | 7.789718 | 7.809750 | 7.828899 | 7.847239 | 7.864835 | 7.881747 | 7.898024 | 7.913714 | 7.928856 | 49 |
| 12 | 7.769075 | 7.790059 | 7.810076 | 7.829211 | 7.847538 | 7.865123 | 7.882023 | 7.898290 | 7.913970 | 7.929104 | 48 |
| 13 | 7.769433 | 7.790400 | 7.810402 | 7.829523 | 7.847837 | 7.865410 | 7 882299 | 7.898556 | 7.914227 | 7.929352 | 47 |
| 14 | 7.769791 | 7.790741 | 7.810728 | 7.829834 | 7.848136 | 7.865697 | 7.882575 | 7.898822 | 7.914483 | 7.929599 | 46 |
| 15 | 7.770149 | 7.791082 | 7.811053 | 7.830146 | 7.848434 | 7.865984 | 7.882851 | 7.899088 | 7.914740 | 7.929847 | 45 |
| 16 | 7.770506 | 7.791423 | 7.811378 | 7.830457 | 7.848733 | 7.866270 | 7.883127 | 7.899354 | 7.914996 | 7.930094 | 44 |
| 17 | 7.770863 | 7.791763 | 7.811703 | 7.830768 | 7.849031 | 7.866556 | 7.883402 | 7.899619 | 7.915252 | 7.930341 | 43 |
| 18 | 7.771220 | 7.792103 | 7.812028 | 7.831079 | 7.849329 | 7.866843 | 7.883678 | 7.899884 | 7.915508 | 7.930588 | 42 |
| 19 | 7.771576 | 7.792443 | 7.812352 | 7.831389 | 7.849626 | 7.867129 | 7.883953 | 7.900149 | 7.915763 | 7.930835 | 41 |
| 20 | 7.771932 | 7.792782 | 7.812677 | 7.831700 | 7.849924 | 7.867414 | 7.884228 | 7.900414 | 7.916019 | 7.931082 | 40 |
| 21 | 7.772288 | 7.793121 | 7.813001 | 7.832010 | 7.850221 | 7.867700 | 7.884502 | 7.900679 | 7.916274 | 7.931329 | 39 |
| 22 | 7.772643 | 7.793460 | 7.813324 | 7.832319 | 7.850519 | 7.867986 | 7.884777 | 7.900943 | 7.916529 | 7.931575 | 38 |
| 23 | 7.772999 | 7.793799 | 7.813648 | 7.832629 | 7.850816 | 7.868271 | 7.885051 | 7.901208 | 7.916785 | 7.931822 | 37 |
| 24 | 7.773354 | 7.794137 | 7.813971 | 7.832939 | 7.851112 | 7.868556 | 7.885326 | 7.901472 | 7.917039 | 7.932068 | 36 |
| 25 | 7.773708 | 7.794475 | 7.814291 | 7.833248 | 7.851409 | 7.868841 | 7.885600 | 7.901736 | 7.917294 | 7.932314 | 35 |
| 26 | 7.774063 | 7 794813 | 7.814617 | 7.833557 | 7.851705 | 7.869125 | 7.885874 | 7.902000 | 7.917549 | 7.932560 | 34 |
| 27 | 7.774417 | 7.795151 | 7.814939 | 7.833866 | 7.852001 | 7.869410 | 7.886147 | 7.902264 | 7.917803 | 7.932806 | 33 |
| 28 | 7.774771 | 7.795488 | 7.815262 | 7.834174 | 7.852297 | 7.869694 | 7.886421 | 7.902527 | 7.918058 | 7.933052 | 32 |
| 29 | 7.775124 | 7.795825 | 7.815584 | 7.834482 | 7.852593 | 7.869978 | 7.886694 | 7.902791 | 7.918312 | 7.933297 | 31 |
| 30 | 7.775477 | 7.796162 | 7.815905 | 7.834791 | 7.852888 | 7.870262 | 7.886968 | 7.903054 | 7.918566 | 7.933543 | 30 |
| 31 | 7.775830 | 7.796498 | 7.816227 | 7.835098 | 7.853184 | 7.870546 | 7.887241 | 7.903317 | 7.918820 | 7.933788 | 29 |
| 32 | 7.776183 | 7.796834 | 7.816548 | 7.835406 | 7.853479 | 7.870830 | 7.887514 | 7.903580 | 7.919074 | 7.934033 | 28 |
| 33 | 7.776535 | 7.797170 | 7.816869 | 7.835714 | 7.853774 | 7.871113 | 7.887786 | 7.903843 | 7.919327 | 7.934278 | 27 |
| 34 | 7.776887 | 7.797506 | 7.817190 | 7.836021 | 7.854069 | 7.871396 | 7.888059 | 7.904106 | 7.919581 | 7.934523 | 26 |
| 35 | 7.777239 | 7.797842 | 7.817511 | 7.836328 | 7.854363 | 7.871679 | 7.888331 | 7.904368 | 7.919834 | 7.934768 | 25 |
| 36 | 7.777591 | 7.798177 | 7.817831 | 7.836635 | 7.854657 | 7.871962 | 7.888603 | 7.904630 | 7.920087 | 7.935012 | 24 |
| 37 | 7.777942 | 7.798512 | 7.818152 | 7.836941 | 7.854952 | 7.872245 | 7.888875 | 7.904895 | 7.920340 | 7.935257 | 23 |
| 38 | 7.778293 | 7 798847 | 7.818471 | 7.837248 | 7.855246 | 7.872527 | 7.889147 | 7.905155 | 7.920593 | 7.935501 | 22 |
| 39 | 7.778644 | 7.799181 | 7.818791 | 7.837554 | 7.855539 | 7.872809 | 7.889419 | 7.905417 | 7.920846 | 7.935745 | 21 |
| 40 | 7.778994 | 7.799515 | 7.819111 | 7.837860 | 7.855833 | 7.873092 | 7.889690 | 7.905678 | 7.921098 | 7.935989 | 20 |
| 41 | 7.779344 | 7.799849 | 7.819430 | 7.838165 | 7.856126 | 7.873373 | 7.889962 | 7.905940 | 7.921351 | 7.936233 | 19 |
| 42 | 7.779694 | 7.800183 | 7.819749 | 7.838471 | 7.856419 | 7.873655 | 7.890233 | 7.906201 | 7.921603 | 7.936477 | 18 |
| 43 | 7.780043 | 7.800516 | 7.820068 | 7.838776 | 7.856712 | 7.873937 | 7.890504 | 7.906462 | 7.921855 | 7.936721 | 17 |
| 44 | 7.780391 | 7.800850 | 7.820386 | 7.839081 | 7.857005 | 7.874218 | 7.890775 | 7.906723 | 7.922107 | 7.936964 | 16 |
| 45 | 7.780742 | 7.801182 | 7.820704 | 7.839386 | 7.857298 | 7.874499 | 7.891045 | 7.906984 | 7.922359 | 7.937208 | 15 |
| 46 | 7.781090 | 7.801515 | 7.821022 | 7.839691 | 7.857590 | 7.874780 | 7.891316 | 7.907245 | 7.922611 | 7.937451 | 14 |
| 47 | 7.781439 | 7.801847 | 7.821340 | 7.839995 | 7.857882 | 7.875061 | 7.891586 | 7.907506 | 7.922862 | 7.937694 | 13 |
| 48 | 7.781787 | 7.802180 | 7.821658 | 7.840300 | 7.858174 | 7.875342 | 7.891856 | 7.907766 | 7.923113 | 7.937937 | 12 |
| 49 | 7.782135 | 7.802512 | 7.821975 | 7.840604 | 7.858466 | 7.875622 | 7.892126 | 7.908026 | 7.923366 | 7.938180 | 11 |
| 50 | 7.782482 | 7.802843 | 7.822292 | 7.840907 | 7.858757 | 7.875902 | 7.892396 | 7.908287 | 7.923616 | 7.938422 | 10 |
| 51 | 7.782829 | 7.803175 | 7.822609 | 7.841211 | 7.859049 | 7.876183 | 7.892666 | 7.908547 | 7.923867 | 7.938665 | 9 |
| 52 | 7.783176 | 7.803506 | 7.822926 | 7.841514 | 7.859340 | 7.876462 | 7.892935 | 7.908806 | 7.924118 | 7.938907 | 8 |
| 53 | 7.783523 | 7.803837 | 7.823242 | 7.841818 | 7.859631 | 7.876742 | 7.893205 | 7.909066 | 7.924368 | 7.939150 | 7 |
| 54 | 7.783870 | 7.804167 | 7.823558 | 7.842120 | 7.859922 | 7.877022 | 7.893474 | 7.909326 | 7.924619 | 7.939392 | 6 |
| 55 | 7.784216 | 7.804498 | 7.823874 | 7.842423 | 7.860212 | 7.877301 | 7.893743 | 7.909585 | 7.924869 | 7.939634 | 5 |
| 56 | 7.784562 | 7.804828 | 7.824190 | 7.842726 | 7.860503 | 7.877580 | 7.894012 | 7.909844 | 7.925119 | 7.939876 | 4 |
| 57 | 7.784907 | 7.805158 | 7.824506 | 7.843028 | 7.860793 | 7.877859 | 7.894280 | 7.910103 | 7.925370 | 7.940117 | 3 |
| 58 | 7.785253 | 7.805487 | 7.824821 | 7.843330 | 7.861083 | 7.878138 | 7.894549 | 7.910362 | 7.925619 | 7.940359 | 2 |
| 59 | 7.785598 | 7.805817 | 7.825136 | 7.843632 | 7.861373 | 7.878417 | 7.894817 | 7.910621 | 7.925869 | 7.940600 | 1 |
| 60 | 7.785943 | 7.806146 | 7.825451 | 7.843934 | 7.861662 | 7.878695 | 7.895085 | 7.9108. 9 | 7.926119 | 7.940842 | 0 |
| ″ | 89° 39′ | 89° 38′ | 89° 37′ | 89° 36′ | 89° 35′ | 89° 34′ | 89° 33 | 89° 32′ | 89° 31′ | 89° 30′ | ″ |

LOG. COSINE TO SECONDS.

LOG. SINE TO SECONDS. (S:)

| ″ | 0° 30′ | 0° 31′ | 0° 32′ | 0° 33′ | 0° 34′ | 0° 35′ | 0 36′ | 0° 37 | 0° 38′ | 0° 39′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 7.940842 | 7.955082 | 7.968870 | 7.982233 | 7.995198 | 8.007787 | 8.020021 | 8.031919 | 8.043501 | 8.054781 | 60 |
| 1 | 7.941083 | 7.955315 | 7.969096 | 7.982453 | 7.995411 | 8.007993 | 8.020222 | 8.032115 | 8.043691 | 8.054967 | 59 |
| 2 | 7.941324 | 7.955549 | 7.969322 | 7.982672 | 7.995623 | 8.008200 | 8.020423 | 8.032310 | 8.043892 | 8.055152 | 58 |
| 3 | 7.941565 | 7.955782 | 7.969548 | 7.982891 | 7.995836 | 8.008407 | 8.020623 | 8.032506 | 8.044072 | 8.055338 | 57 |
| 4 | 7.941806 | 7.956015 | 7.969774 | 7.983110 | 7 996049 | 8.008613 | 8.020824 | 8.032701 | 8.044262 | 8.055523 | 56 |
| 5 | 7.942046 | 7.956248 | 7.969999 | 7.983329 | 7.996261 | 8.008819 | 8.021025 | 8.032896 | 8.044452 | 8.055708 | 55 |
| 6 | 7.942287 | 7.956481 | 7.970225 | 7.983547 | 7.996473 | 8.009026 | 8.021225 | 8.033092 | 8.044642 | 8.055893 | 54 |
| 7 | 7.942527 | 7.956713 | 7.970450 | 7.983766 | 7.996686 | 8.009232 | 8.021426 | 8.033287 | 8.044832 | 8.056079 | 53 |
| 8 | 7.942768 | 7.956946 | 7.970676 | 7.983984 | 7.996898 | 8.009438 | 8.021626 | 8.033482 | 8.045022 | 8.056264 | 52 |
| 9 | 7.943008 | 7.957178 | 7.970901 | 7.984203 | 7.997110 | 8.009644 | 8.021826 | 8.033676 | 8.045212 | 8.056448 | 51 |
| 10 | 7.943248 | 7.957410 | 7.971126 | 7.984421 | 7.997322 | 8.009850 | 8.022027 | 8.033871 | 8.045401 | 8.056633 | 50 |
| 11 | 7.943488 | 7.957643 | 7.971351 | 7.984639 | 7.997533 | 8.010055 | 8.022227 | 8.034066 | 8.045591 | 8.056818 | 49 |
| 12 | 7.943727 | 7.957875 | 7.971576 | 7.984857 | 7.997745 | 8.010261 | 8.022427 | 8.034261 | 8.045780 | 8.057003 | 48 |
| 13 | 7.943967 | 7.958107 | 7.971800 | 7.985075 | 7.997957 | 8.010467 | 8.022627 | 8.034455 | 8.045970 | 8.057187 | 47 |
| 14 | 7.944207 | 7.958338 | 7.972025 | 7.985293 | 7.998168 | 8.010672 | 8.022826 | 8.034649 | 8.046159 | 8.057372 | 46 |
| 15 | 7.944446 | 7.958570 | 7.972249 | 7.985511 | 7.998379 | 8.010878 | 8.023026 | 8.034844 | 8.046349 | 8.057556 | 45 |
| 16 | 7.944685 | 7.958802 | 7.972474 | 7.985729 | 7.998591 | 8.011083 | 8.023226 | 8.035038 | 8.046538 | 8.057741 | 44 |
| 17 | 7.944924 | 7.959033 | 7.972698 | 7.985946 | 7.998802 | 8.011288 | 8.023425 | 8.035232 | 8.046727 | 8.057925 | 43 |
| 18 | 7.945163 | 7.959264 | 7.972922 | 7.986164 | 7.999013 | 8.011493 | 8.023625 | 8.035426 | 8.046916 | 8.058109 | 42 |
| 19 | 7.945402 | 7.959496 | 7.973146 | 7.986381 | 7.999224 | 8.011698 | 8.023824 | 8.035620 | 8.047105 | 8.058293 | 41 |
| 20 | 7.945641 | 7.959727 | 7.973370 | 7.986598 | 7.999435 | 8.011903 | 8.024023 | 8.035814 | 8.047294 | 8.058477 | 40 |
| 21 | 7.945879 | 7.959958 | 7.973594 | 7.986815 | 7.999646 | 8.012108 | 8.024222 | 8.036008 | 8.047482 | 8.058661 | 39 |
| 22 | 7.946118 | 7.960188 | 7.973818 | 7.987032 | 7.999856 | 8.012313 | 8.024421 | 8.036202 | 8.047671 | 8.058845 | 38 |
| 23 | 7.946356 | 7.960419 | 7.974041 | 7.98 249 | 8.000067 | 8.012517 | 8.024620 | 8.036 96 | 8.047860 | 8.059029 | 37 |
| 24 | 7.946594 | 7.960650 | 7.974265 | 7.98746. | 8.000277 | 8.012722 | 8.024819 | 8.036589 | 8.048048 | 8.0. 9212 | 36 |
| 25 | 7.946832 | 7.960880 | 7.974488 | 7.987682 | 8.000488 | 8.012926 | 8.025018 | 8.036783 | 8.048237 | 8.059396 | 35 |
| 26 | 7.947070 | 7.961110 | 7.974711 | 7.987899 | 8.000698 | 8.013130 | 8.025217 | 8.036976 | 8.048425 | 8.059580 | 34 |
| 27 | 7.947308 | 7.961341 | 7.974934 | 7.988115 | 8.000908 | 8.013335 | 8.025415 | 8.037169 | 8.048613 | 8.059764 | 33 |
| 28 | 7.947545 | 7.961571 | 7.975157 | 7.988332 | 8.001118 | 8.013539 | 8.025614 | 8.037363 | 8.048802 | 8.059947 | 32 |
| 29 | 7.947783 | 7.961801 | 7.975380 | 7.988548 | 8.001328 | 8.013743 | 8.025812 | 8.037556 | 8.048990 | 8.060130 | 31 |
| 30 | 7.948020 | 7.962031 | 7.975603 | 7.988764 | 8.001538 | 8.013947 | 8.026011 | 8.037749 | 8.049178 | 8.060314 | 30 |
| 31 | 7.948257 | 7.962260 | 7.975826 | 7.988980 | 8.001748 | 8.014151 | 8.026209 | 8.037942 | 8 049366 | 8.060497 | 29 |
| 32 | 7.948495 | 7.962490 | 7.976048 | 7.989196 | 8.001957 | 8.014354 | 8.026407 | 8.038135 | 9.049554 | 8.060680 | 28 |
| 33 | 7.948732 | 7.962719 | 7.976271 | 7.989412 | 8.002167 | 8.014558 | 8.026605 | 8.038327 | 8.049741 | 8.060863 | 27 |
| 34 | 7.948968 | 7.962949 | 7.976493 | 7.989627 | 8.002376 | 8.014761 | 8.026803 | 8.038520 | 8.049929 | 8.061046 | 26 |
| 35 | 7.949205 | 7.963178 | 7.976715 | 7.989843 | 8.002586 | 8.014965 | 8.027001 | 8.038713 | 8.050117 | 8.061229 | 25 |
| 36 | 7.949442 | 7.963407 | 7.976937 | 7.990058 | 8.002795 | 8.015168 | 8.027199 | 8.038905 | 8.050304 | 8.061412 | 24 |
| 37 | 7.949678 | 7.963636 | 7.977159 | 7.990274 | 8.003004 | 8.015372 | 8.027397 | 8.039098 | 8.050492 | 8.061594 | 23 |
| 38 | 7.949915 | 7.963865 | 7.977381 | 7.990489 | 8.003213 | 8.015575 | 8.027594 | 8.039290 | 8.050679 | 8.061777 | 22 |
| 39 | 7.950151 | 7.964094 | 7.977603 | 7.990704 | 8.003422 | 8.015778 | 8.027792 | 8.039482 | 8.050866 | 8.061960 | 21 |
| 40 | 7.950387 | 7.964322 | 7.977824 | 7.990919 | 8.003631 | 8.015981 | 8.027989 | 8.039675 | 8.051054 | 8.062142 | 20 |
| 41 | 7.950623 | 7.964551 | 7.978046 | 7.991134 | 8.003840 | 8.016184 | 8.028187 | 8.039867 | 8.051241 | 8.062325 | 19 |
| 42 | 7.950859 | 7.964779 | 7.978267 | 7.991349 | 8.004048 | 8.016386 | 8.028384 | 8.040059 | 8.051428 | 8.062507 | 18 |
| 43 | 7.951094 | 7.965007 | 7.978489 | 7.991564 | 8.004257 | 8.016589 | 8.028581 | 8.040251 | 8.051615 | 8.062689 | 17 |
| 44 | 7.951330 | 7.965236 | 7.978710 | 7.991778 | 8.004465 | 8.016792 | 8.028778 | 8.040443 | 8.051802 | 8.062871 | 16 |
| 45 | 7.951565 | 7.965464 | 7.978931 | 7.991993 | 8.004673 | 8.016994 | 8.028975 | 8.040634 | 8.051989 | 8.063054 | 15 |
| 46 | 7.951801 | 7.965692 | 7.979152 | 7.992207 | 8.004882 | 8.017197 | 8.029172 | 8.040826 | 8.052175 | 8.063236 | 14 |
| 47 | 7.952036 | 7.965919 | 7.979373 | 7.992422 | 8.005090 | 8.017399 | 8.029369 | 8.041018 | 8.052362 | 8.063418 | 13 |
| 48 | 7.952271 | 7.966147 | 7.979593 | 7.992636 | 8.005298 | 8.017601 | 8.029566 | 8.041209 | 8.052549 | 8.063599 | 12 |
| 49 | 7.952506 | 7.966375 | 7.979814 | 7.992850 | 8.005506 | 8.017803 | 8.029762 | 8.041401 | 8.052735 | 8.063781 | 11 |
| 50 | 7.952741 | 7.966602 | 7.980034 | 7.993064 | 8.005714 | 8.018005 | 8.029959 | 8.041592 | 8.052922 | 8.063963 | 10 |
| 51 | 7.952975 | 7.966829 | 7.980255 | 7.993278 | 8.005921 | 8.018207 | 8.030155 | 8.041783 | 8.053108 | 8.064145 | 9 |
| 52 | 7.953210 | 7.967056 | 7.980475 | 7.993491 | 8.006129 | 8.018409 | 8.030352 | 8.041974 | 8.053294 | 8.064326 | 8 |
| 53 | 7.953444 | 7.967284 | 7.980695 | 7.993705 | 8.006337 | 8.018611 | 8.030548 | 8.042165 | 8.053480 | 8.064508 | 7 |
| 54 | 7.953679 | 7.967511 | 7.980915 | 7.993919 | 8.006544 | 8.018813 | 8.030744 | 8.042356 | 8.053666 | 8.064689 | 6 |
| 55 | 7.953913 | 7.967737 | 7.981135 | 7.994132 | 8.006751 | 8.019014 | 8.030940 | 8.042547 | 8.053852 | 8.064871 | 5 |
| 56 | 7.954147 | 7.96796 | 7.981355 | 7.994346 | 8.006959 | 8.019216 | 8.031136 | 8.042738 | 8.054038 | 8.065052 | 4 |
| 57 | 7.954381 | 7.968191 | 7.981575 | 7.994559 | 8.007166 | 8.019417 | 8.031332 | 8.042929 | 8.054224 | 8.065233 | 3 |
| 58 | 7.954615 | 7.968417 | 7.981794 | 7.994772 | 8.007373 | 8.019618 | 8.031528 | 8.043120 | 8.054410 | 8.065414 | 2 |
| 59 | 7.954848 | 7.968644 | 7.982014 | 7.994985 | 8.007580 | 8.019820 | 8.031724 | 8.043310 | 8.054596 | 8.065595 | 1 |
| 60 | 7.955082 | 7.968870 | 7.982233 | 7.995198 | 8.007787 | 8.020021 | 8.031919 | 8.043501 | 8.051781 | 8.065776 | 0 |
| ″ | 89° 29′ | 89° 28′ | 89° 27′ | 89° 26′ | 89° 25′ | 89° 24′ | 89° 23′ | 89° 22′ | 89° 21′ | 99° 20′ | ″ |

LOG. COSINE TO SECONDS.

## LOG. SINE TO SECONDS. (S.)

| ″ | 0° 40′ | 0° 41′ | 0° 42′ | 0° 43′ | 0° 44′ | 0° 45′ | 0° 46′ | 0° 47′ | 0° 48′ | 0° 49′ | ″ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 8.065776 | 8.076500 | 8.086965 | 8.097183 | 8.107167 | 8.116926 | 8.126471 | 8.135810 | 8.144953 | 8.153907 | 60 |
| 1 | 8.065957 | 8.076676 | 8.087137 | 8.097351 | 8.107331 | 8.117087 | 8.126628 | 8.135964 | 8.145104 | 8.154055 | 59 |
| 2 | 8.066138 | 8.076853 | 8.087309 | 8.097520 | 8.107496 | 8.117248 | 8.126786 | 8.136118 | 8.145255 | 8.154203 | 58 |
| 3 | 8.066319 | 8.077029 | 8.087481 | 8.097688 | 8.107660 | 8.117408 | 8.126943 | 8.136272 | 8.145405 | 8.154350 | 57 |
| 4 | 8.066499 | 8.077205 | 8.087653 | 8.097856 | 8.107824 | 8.117569 | 8.127100 | 8.136426 | 8.145556 | 8.154498 | 56 |
| 5 | 8.066680 | 8.077381 | 8.087825 | 8.098024 | 8.107989 | 8.117730 | 8.127257 | 8.136580 | 8.145706 | 8.154645 | 55 |
| 6 | 8.066861 | 8.077558 | 8.087997 | 8.098192 | 8.108153 | 8.117890 | 8.127414 | 8.136733 | 8.145857 | 8.154794 | 54 |
| 7 | 8.067041 | 8.077734 | 8.088169 | 8.098360 | 8.108317 | 8.118051 | 8.127571 | 8.136887 | 8.146007 | 8.154940 | 53 |
| 8 | 8.067221 | 8.077910 | 8.088341 | 8.098528 | 8.108481 | 8.118211 | 8.127728 | 8.137041 | 8.146155 | 8.155088 | 52 |
| 9 | 8.067402 | 8.078086 | 8.088513 | 8.098695 | 8.108645 | 8.118371 | 8.127885 | 8.137194 | 8.146308 | 8.155235 | 51 |
| 10 | 8.067582 | 8.078261 | 8.088684 | 8.098863 | 8.108809 | 8.118532 | 8.128042 | 8.137348 | 8.146458 | 8.155382 | 50 |
| 11 | 8.067762 | 8.078437 | 8.088856 | 8.099031 | 8.108973 | 8.118692 | 8.128198 | 8.137501 | 8.146609 | 8.155529 | 49 |
| 12 | 8.067942 | 8.078613 | 8.089028 | 8.099198 | 8.109136 | 8.118852 | 8.128355 | 8.137654 | 8.146759 | 8.155676 | 48 |
| 13 | 8.068122 | 8.078789 | 8.089199 | 8.099366 | 8.109300 | 8.119012 | 8.128512 | 8.137808 | 8.146909 | 8.155823 | 47 |
| 14 | 8.068302 | 8.078964 | 8.089371 | 8.099533 | 8.109464 | 8.119172 | 8.128668 | 8.137961 | 8.147059 | 8.155970 | 46 |
| 15 | 8.068482 | 8.079140 | 8.089542 | 8.099701 | 8.109627 | 8.119332 | 8.128825 | 8.138114 | 8.147209 | 8.156117 | 45 |
| 16 | 8.068662 | 8.079315 | 8.089713 | 8.099868 | 8.109791 | 8.119492 | 8.128981 | 8.138267 | 8.147359 | 8.156264 | 44 |
| 17 | 8.068842 | 8.079490 | 8.089884 | 8.100035 | 8.109954 | 8.119652 | 8.129138 | 8.138420 | 8.147509 | 8.156411 | 43 |
| 18 | 8.069021 | 8.079666 | 8.090055 | 8.100202 | 8.110118 | 8.119812 | 8.129294 | 8.138574 | 8.147659 | 8.156558 | 42 |
| 19 | 8.069201 | 8.079841 | 8.090227 | 8.100370 | 8.110281 | 8.119971 | 8.129450 | 8.138726 | 8.147809 | 8.156705 | 41 |
| 20 | 8.069380 | 8.080016 | 8.090398 | 8.100537 | 8.110444 | 8.120131 | 8.129606 | 8.138879 | 8.147959 | 8.156852 | 40 |
| 21 | 8.069560 | 8.080191 | 8.090568 | 8.100704 | 8.110608 | 8.120291 | 8.129763 | 8.139032 | 8.148108 | 8.156998 | 39 |
| 22 | 8.069739 | 8.080366 | 8.090739 | 8.100871 | 8.110771 | 8.120450 | 8.129919 | 8.139185 | 8.148258 | 8.157145 | 38 |
| 23 | 8.069918 | 8.080541 | 8.090910 | 8.101037 | 8.110934 | 8.120610 | 8.130075 | 8.139338 | 8.148408 | 8.157292 | 37 |
| 24 | 8.070097 | 8.080716 | 8.091081 | 8.101204 | 8.111097 | 8.120769 | 8.130231 | 8.139491 | 8.148557 | 8.157438 | 36 |
| 25 | 8.070277 | 8.080891 | 8.091252 | 8.101371 | 8.111260 | 8.120929 | 8.130387 | 8.139643 | 8.148707 | 8.157585 | 35 |
| 26 | 8.070456 | 8.081065 | 8.091422 | 8.101538 | 8.111423 | 8.121088 | 8.130543 | 8.139796 | 8.148856 | 8.157731 | 34 |
| 27 | 8.070635 | 8.081240 | 8.091593 | 8.101704 | 8.111586 | 8.121247 | 8.130699 | 8.139948 | 8.149005 | 8.157877 | 33 |
| 28 | 8.070813 | 8.081415 | 8.091763 | 8.101871 | 8.111749 | 8.121407 | 8.130854 | 8.140101 | 8.149155 | 8.158024 | 32 |
| 29 | 8.070992 | 8.081589 | 8.091934 | 8.102037 | 8.111911 | 8.121566 | 8.131010 | 8.140253 | 8.149304 | 8.158170 | 31 |
| 30 | 8.071171 | 8.081764 | 8.092104 | 8.102204 | 8.112074 | 8.121725 | 8.131166 | 8.140406 | 8.149453 | 8.158316 | 30 |
| 31 | 8.071350 | 8.081938 | 8.092274 | 8.102370 | 8.112237 | 8.121884 | 8.131321 | 8.140558 | 8.149603 | 8.158462 | 29 |
| 32 | 8.071528 | 8.082112 | 8.092444 | 8.102536 | 8.112399 | 8.122043 | 8.131477 | 8.140710 | 8.149752 | 8.158608 | 28 |
| 33 | 8.071707 | 8.082287 | 8.092615 | 8.102703 | 8.112562 | 8.122202 | 8.131632 | 8.140863 | 8.149901 | 8.158755 | 27 |
| 34 | 8.071885 | 8.082461 | 8.092785 | 8.102869 | 8.112724 | 8.122361 | 8.131788 | 8.141015 | 8.150050 | 8.158901 | 26 |
| 35 | 8.072064 | 8.082635 | 8.092955 | 8.103035 | 8.112886 | 8.122519 | 8.131943 | 8.141167 | 8.150199 | 8.159047 | 25 |
| 36 | 8.072242 | 8.082809 | 8.093125 | 8.103201 | 8.113049 | 8.122678 | 8.132099 | 8.141319 | 8.150348 | 8.159193 | 24 |
| 37 | 8.072420 | 8.082983 | 8.093294 | 8.103367 | 8.113211 | 8.122837 | 8.132254 | 8.141471 | 8.150497 | 8.159339 | 23 |
| 38 | 8.072598 | 8.083157 | 8.093464 | 8.103533 | 8.113373 | 8.122996 | 8.132409 | 8.141623 | 8.150646 | 8.159484 | 22 |
| 39 | 8.072776 | 8.083330 | 8.093634 | 8.103699 | 8.113535 | 8.123154 | 8.132564 | 8.141775 | 8.150794 | 8.159630 | 21 |
| 40 | 8.072955 | 8.083504 | 8.093804 | 8.103864 | 8.113697 | 8.123313 | 8.132720 | 8.141927 | 8.150943 | 8.159776 | 20 |
| 41 | 8.073132 | 8.083678 | 8.093973 | 8.104030 | 8.113859 | 8.123471 | 8.132875 | 8.142079 | 8.151092 | 8.159922 | 19 |
| 42 | 8.073310 | 8.083851 | 8.094143 | 8.104196 | 8.114021 | 8.123629 | 8.133030 | 8.142231 | 8.151241 | 8.160067 | 18 |
| 43 | 8.073488 | 8.084025 | 8.094312 | 8.104361 | 8.114183 | 8.123788 | 8.133185 | 8.142382 | 8.151389 | 8.160213 | 17 |
| 44 | 8.073666 | 8.084198 | 8.094482 | 8.104527 | 8.114345 | 8.123946 | 8.133339 | 8.142534 | 8.151538 | 8.160358 | 16 |
| 45 | 8.073844 | 8.084372 | 8.094651 | 8.104692 | 8.114507 | 8.124104 | 8.133494 | 8.142685 | 8.151686 | 8.160504 | 15 |
| 46 | 8.074021 | 8.084545 | 8.094820 | 8.104858 | 8.114669 | 8.124263 | 8.133649 | 8.142837 | 8.151835 | 8.160649 | 14 |
| 47 | 8.074199 | 8.084718 | 8.094989 | 8.105023 | 8.114830 | 8.124421 | 8.133804 | 8.142989 | 8.151983 | 8.160795 | 13 |
| 48 | 8.074376 | 8.084892 | 8.095159 | 8.105188 | 8.114992 | 8.124579 | 8.133959 | 8.143140 | 8.152131 | 8.160940 | 12 |
| 49 | 8.074553 | 8.085065 | 8.095328 | 8.105354 | 8.115153 | 8.124737 | 8.134113 | 8.143291 | 8.152280 | 8.161086 | 11 |
| 50 | 8.074731 | 8.085238 | 8.095497 | 8.105519 | 8.115315 | 8.124895 | 8.134268 | 8.143443 | 8.152428 | 8.161231 | 10 |
| 51 | 8.074908 | 8.085411 | 8.095666 | 8.105684 | 8.115476 | 8.125053 | 8.134422 | 8.143594 | 8.152576 | 8.161376 | 9 |
| 52 | 8.075085 | 8.085584 | 8.095835 | 8.105849 | 8.115638 | 8.125210 | 8.134577 | 8.143745 | 8.152724 | 8.161521 | 8 |
| 53 | 8.075262 | 8.085757 | 8.096003 | 8.106014 | 8.115799 | 8.125368 | 8.134731 | 8.143896 | 8.152872 | 8.161666 | 7 |
| 54 | 8.075439 | 8.085929 | 8.096172 | 8.106179 | 8.115960 | 8.125526 | 8.134885 | 8.144045 | 8.153020 | 8.161811 | 6 |
| 55 | 8.075616 | 8.086102 | 8.096341 | 8.106344 | 8.116121 | 8.125684 | 8.135040 | 8.144199 | 8.153168 | 8.161956 | 5 |
| 56 | 8.075793 | 8.086275 | 8.096509 | 8.106508 | 8.116282 | 8.125841 | 8.135194 | 8.144350 | 8.153316 | 8.162101 | 4 |
| 57 | 8.075970 | 8.086447 | 8.096678 | 8.106673 | 8.116443 | 8.125999 | 8.135348 | 8.144501 | 8.153464 | 8.162246 | 3 |
| 58 | 8.076146 | 8.086620 | 8.096846 | 8.106838 | 8.116604 | 8.126156 | 8.135502 | 8.144652 | 8.153612 | 8.162391 | 2 |
| 59 | 8.076323 | 8.086792 | 8.097015 | 8.107002 | 8.116765 | 8.126314 | 8.135656 | 8.144802 | 8.153760 | 8.162536 | 1 |
| 60 | 8.076500 | 8.086965 | 8.097183 | 8.107167 | 8.116926 | 8.126471 | 8.135810 | 8.144953 | 8.153907 | 8.162681 | 0 |
| ″ | 89° 19′ | 89° 18′ | 89° 17′ | 89° 16′ | 89° 15′ | 89° 14′ | 89° 13′ | 89° 12′ | 89° 11′ | 89° 10′ | ″ |

LOG. COSINE TO SECONDS.

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | | 0ʰ or 0ᵐ. | | LOG. SINES, &c. (t.) | | | | 0 deg. | |
| 0 | 0 | 0.000000 | Infinite. | 0.000000 | Infinite. | 10.000000 | 10.000000 | 60 | 60 |
| 1 | 15 | 5.861666 | 14.138334 | 5.861666 | 14.138334 | 10.000000 | 10.000000 | 45 | 59 |
| 2 | 30 | 6.162696 | 13.837304 | 6.162696 | 13.837304 | 10.000000 | 10.000000 | 30 | 58 |
| 3 | 45 | 6.338787 | 13.661213 | 6.338787 | 13.661213 | 10.000000 | 10.000000 | 15 | 57 |
| 4 | 1 | 6.463726 | 13.536274 | 6.463726 | 13.536274 | 10.000000 | 10.000000 | 59 | 56 |
| 5 | 15 | 6.560636 | 13.439364 | 6.560636 | 13.439364 | 10.000000 | 10.000000 | 45 | 55 |
| 6 | 30 | 6.639817 | 13.360183 | 6.639817 | 13.360183 | 10.000000 | 10.000000 | 30 | 54 |
| 7 | 45 | 6.706764 | 13.293236 | 6.706764 | 13.293236 | 10.000000 | 10.000000 | 15 | 53 |
| 8 | 2 | 6.764756 | 13.235244 | 6.764756 | 13.235244 | 10.000000 | 10.000000 | 58 | 52 |
| 9 | 15 | 6.815909 | 13.184091 | 6.815909 | 13.184091 | 10.000000 | 10.000000 | 45 | 51 |
| 10 | 30 | 6.861666 | 13.138334 | 6.861666 | 13.138334 | 10.000000 | 10.000000 | 30 | 50 |
| 11 | 45 | 6.903059 | 13.096941 | 6.903059 | 13.096941 | 10.000000 | 10.000000 | 15 | 49 |
| 12 | 3 | 6.940847 | 13.059153 | 6.940847 | 13.059153 | 10.000000 | 10.000000 | 57 | 48 |
| 13 | 15 | 6.975609 | 13.024391 | 6.975610 | 13.024390 | 10.000000 | 10.000000 | 45 | 47 |
| 14 | 30 | 7.007794 | 12.992206 | 7.007794 | 12.992206 | 10.000000 | 10.000000 | 30 | 46 |
| 15 | 45 | 7.037757 | 12.962243 | 7.037758 | 12.962242 | 10.000000 | 10.000000 | 15 | 45 |
| 16 | 4 | 7.065786 | 12.934214 | 7.065786 | 12.934214 | 10.000000 | 10.000000 | 56 | 44 |
| 17 | 15 | 7.092115 | 12.907885 | 7.092115 | 12.907885 | 10.000000 | 10.000000 | 45 | 43 |
| 18 | 30 | 7.116938 | 12.883062 | 7.116939 | 12.883061 | 10.000000 | 10.000000 | 30 | 42 |
| 19 | 45 | 7.140420 | 12.859580 | 7.140420 | 12.859580 | 10.000000 | 10.000000 | 15 | 41 |
| 20 | 5 | 7.162696 | 12.837304 | 7.162696 | 12.837304 | 10.000000 | 10.000000 | 55 | 40 |
| 21 | 15 | 7.183885 | 12.816115 | 7.183886 | 12.816114 | 10.000000 | 10.000000 | 45 | 39 |
| 22 | 30 | 7.204089 | 12.795911 | 7.204089 | 12.795911 | 10.000000 | 10.000000 | 30 | 38 |
| 23 | 45 | 7.223394 | 12.776606 | 7.223394 | 12.776606 | 10.000001 | 9.999999 | 15 | 37 |
| 24 | 6 | 7.241877 | 12.758123 | 7.241878 | 12.758122 | 10.000001 | 9.999999 | 54 | 36 |
| 25 | 15 | 7.259606 | 12.740394 | 7.259607 | 12.740393 | 10.000001 | 9.999999 | 45 | 35 |
| 26 | 30 | 7.276639 | 12.723361 | 7.276640 | 12.723360 | 10.000001 | 9.999999 | 30 | 34 |
| 27 | 45 | 7.293030 | 12.706970 | 7.293030 | 12.706970 | 10.000001 | 9.999999 | 15 | 33 |
| 28 | 7 | 7.308824 | 12.691176 | 7.308825 | 12.691175 | 10.000001 | 9.999999 | 53 | 32 |
| 29 | 15 | 7.324064 | 12.675936 | 7.324065 | 12.675935 | 10.000001 | 9.999999 | 45 | 31 |
| 30 | 30 | 7.338787 | 12.661213 | 7.338788 | 12.661212 | 10.000001 | 9.999999 | 30 | 30 |
| 31 | 45 | 7.353027 | 12.646973 | 7.353029 | 12.646971 | 10.000001 | 9.999999 | 15 | 29 |
| 32 | 8 | 7.366816 | 12.633184 | 7.366817 | 12.633183 | 10.000001 | 9.999999 | 52 | 28 |
| 33 | 15 | 7.380180 | 12.619820 | 7.380181 | 12.619819 | 10.000001 | 9.999999 | 45 | 27 |
| 34 | 30 | 7.393145 | 12.606855 | 7.393146 | 12.606854 | 10.000001 | 9.999999 | 30 | 26 |
| 35 | 45 | 7.405734 | 12.594266 | 7.405735 | 12.594265 | 10.000002 | 9.999999 | 15 | 25 |
| 36 | 9 | 7.417968 | 12.582032 | 7.417970 | 12.582030 | 10.000002 | 9.999998 | 51 | 24 |
| 37 | 15 | 7.429867 | 12.570133 | 7.429869 | 12.570131 | 10.000002 | 9.999998 | 45 | 23 |
| 38 | 30 | 7.441449 | 12.558551 | 7.441451 | 12.558549 | 10.000002 | 9.999998 | 30 | 22 |
| 39 | 45 | 7.452730 | 12.547270 | 7.452732 | 12.547268 | 10.000002 | 9.999998 | 15 | 21 |
| 40 | 10 | 7.463725 | 12.536275 | 7.463727 | 12.536273 | 10.000002 | 9.999998 | 50 | 20 |
| 41 | 15 | 7.474449 | 12.525551 | 7.474451 | 12.525549 | 10.000002 | 9.999998 | 45 | 19 |
| 42 | 30 | 7.484915 | 12.515085 | 7.484917 | 12.515083 | 10.000002 | 9.999998 | 30 | 18 |
| 43 | 45 | 7.495134 | 12.504866 | 7.495136 | 12.504864 | 10.000002 | 9.999998 | 15 | 17 |
| 44 | 11 | 7.505118 | 12.494882 | 7.505120 | 12.494880 | 10.000002 | 9.999998 | 49 | 16 |
| 45 | 15 | 7.514878 | 12.485122 | 7.514880 | 12.485120 | 10.000002 | 9.999998 | 45 | 15 |
| 46 | 30 | 7.524423 | 12.475577 | 7.524426 | 12.475574 | 10.000002 | 9.999998 | 30 | 14 |
| 47 | 45 | 7.533763 | 12.466237 | 7.533766 | 12.466234 | 10.000003 | 9.999997 | 15 | 13 |
| 48 | 12 | 7.542906 | 12.457094 | 7.542909 | 12.457091 | 10.000003 | 9.999997 | 48 | 12 |
| 49 | 15 | 7.551861 | 12.448139 | 7.551864 | 12.448136 | 10.000003 | 9.999997 | 45 | 11 |
| 50 | 30 | 7.560635 | 12.439365 | 7.560638 | 12.439362 | 10.000003 | 9.999997 | 30 | 10 |
| 51 | 45 | 7.569235 | 12.430765 | 7.569238 | 12.430762 | 10.000003 | 9.999997 | 15 | 9 |
| 52 | 13 | 7.577668 | 12.422332 | 7.577671 | 12.422329 | 10.000003 | 9.999997 | 47 | 8 |
| 53 | 15 | 7.585941 | 12.414059 | 7.585944 | 12.414056 | 10.000003 | 9.999997 | 45 | 7 |
| 54 | 30 | 7.594059 | 12.405941 | 7.594062 | 12.405938 | 10.000004 | 9.999996 | 30 | 6 |
| 55 | 45 | 7.602028 | 12.397972 | 7.602031 | 12.397969 | 10.000004 | 9.999996 | 15 | 5 |
| 56 | 14 | 7.609853 | 12.390147 | 7.609857 | 12.390143 | 10.000004 | 9.999996 | 46 | 4 |
| 57 | 15 | 7.617540 | 12.382460 | 7.617543 | 12.382457 | 10.000004 | 9.999996 | 45 | 3 |
| 58 | 30 | 7.625093 | 12.374907 | 7.625097 | 12.374903 | 10.000004 | 9.999996 | 30 | 2 |
| 59 | 45 | 7.632517 | 12.367483 | 7.632521 | 12.367479 | 10.000004 | 9.999996 | 15 | 1 |
| 60 | 15 | 7.639816 | 12.360184 | 7.639820 | 12.360189 | 10.000004 | 9 999996 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant | sine. | ″ ′ | sec. |
| | | 5ʰ 59ᵐ. | | LOG. SINES, &c. | | | | 89 deg. | |

| 0h 1m. | | LOG. SINES, &c. (t.) | | | | | 0 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine | co-secant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 7.639816 | 12.360184 | 7.639820 | 12.360180 | 10.000004 | 9.999996 | 45 | 60 |
| 1 | 15 | 7.646994 | 12.353006 | 7.646999 | 12.353001 | 10.000004 | 9.999996 | 45 | 59 |
| 2 | 30 | 7.654056 | 12.345944 | 7.654061 | 12.345939 | 10.000004 | 9.999996 | 30 | 58 |
| 3 | 45 | 7.661005 | 12.338995 | 7.661010 | 12.338990 | 10.000005 | 9.999995 | 15 | 57 |
| 4 | 16 | 7.667844 | 12.332156 | 7.667849 | 12.332151 | 10.000005 | 9.999995 | 44 | 56 |
| 5 | 15 | 7.674578 | 12.325422 | 7.674583 | 12.325417 | 10.000005 | 9.999995 | 45 | 55 |
| 6 | 30 | 7.681208 | 12.318792 | 7.681213 | 12.318787 | 10.000005 | 9.999995 | 30 | 54 |
| 7 | 45 | 7.687739 | 12.312261 | 7.687744 | 12.312256 | 10.000005 | 9.999995 | 15 | 53 |
| 8 | 17 | 7.694173 | 12.305827 | 7.694179 | 12.305821 | 10.000005 | 9.999995 | 43 | 52 |
| 9 | 15 | 7.700513 | 12.299487 | 7.700519 | 12.299481 | 10.000006 | 9.999994 | 45 | 51 |
| 10 | 30 | 7.706762 | 12.293238 | 7.706768 | 12.293232 | 10.000006 | 9.999994 | 30 | 50 |
| 11 | 45 | 7.712922 | 12.287078 | 7.712928 | 12.287072 | 10.000006 | 9.999994 | 15 | 49 |
| 12 | 18 | 7.718997 | 12.281003 | 7.719003 | 12.280997 | 10.000006 | 9.999994 | 42 | 48 |
| 13 | 15 | 7.724987 | 12.275013 | 7.724993 | 12.275007 | 10.000006 | 9.999994 | 45 | 47 |
| 14 | 30 | 7.730896 | 12.269104 | 7.730902 | 12.269098 | 10.000006 | 9.999994 | 30 | 46 |
| 15 | 45 | 7.736725 | 12.263275 | 7.736732 | 12.263268 | 10.000007 | 9.999993 | 15 | 45 |
| 16 | 19 | 7.742477 | 12.257523 | 7.742484 | 12.257516 | 10.000007 | 9.999993 | 41 | 44 |
| 17 | 15 | 7.748155 | 12.251845 | 7.748161 | 12.251839 | 10.000007 | 9.999993 | 45 | 43 |
| 18 | 30 | 7.753758 | 12.246242 | 7.753765 | 12.246235 | 10.000007 | 9.999993 | 30 | 42 |
| 19 | 45 | 7.759291 | 12.240709 | 7.759298 | 12.240702 | 10.000007 | 9.999993 | 15 | 41 |
| 20 | 20 | 7.764754 | 12.235246 | 7.764761 | 12.235239 | 10.000007 | 9.999993 | 40 | 40 |
| 21 | 15 | 7.770149 | 12.229851 | 7.770156 | 12.229844 | 10.000008 | 9.999992 | 45 | 39 |
| 22 | 30 | 7.775477 | 12.224523 | 7.775485 | 12.224515 | 10.000008 | 9.999992 | 30 | 38 |
| 23 | 45 | 7.780742 | 12.219258 | 7.780749 | 12.219251 | 10.000008 | 9.999992 | 15 | 37 |
| 24 | 21 | 7.785943 | 12.214057 | 7.785951 | 12.214049 | 10.000008 | 9.999992 | 39 | 36 |
| 25 | 15 | 7.791082 | 12.208918 | 7.791091 | 12.208909 | 10.000008 | 9.999992 | 45 | 35 |
| 26 | 30 | 7.796162 | 12.203838 | 7.796170 | 12.203830 | 10.000009 | 9.999991 | 30 | 34 |
| 27 | 45 | 7.801182 | 12.198818 | 7.801191 | 12.198809 | 10.000009 | 9.999991 | 15 | 33 |
| 28 | 22 | 7.806146 | 12.193854 | 7.806155 | 12.193845 | 10.000009 | 9.999991 | 38 | 32 |
| 29 | 15 | 7.811053 | 12.188947 | 7.811062 | 12.188938 | 10.000009 | 9.999991 | 45 | 31 |
| 30 | 30 | 7.815905 | 12.184095 | 7.815915 | 12.184085 | 10.000009 | 9.999991 | 30 | 30 |
| 31 | 45 | 7.820704 | 12.179296 | 7.820714 | 12.179286 | 10.000010 | 9.999990 | 15 | 29 |
| 32 | 23 | 7.825451 | 12.174549 | 7.825460 | 12.174540 | 10.000010 | 9.999990 | 37 | 28 |
| 33 | 15 | 7.830146 | 12.169854 | 7.830156 | 12.169844 | 10.000010 | 9.999990 | 45 | 27 |
| 34 | 30 | 7.834791 | 12.165209 | 7.834801 | 12.165199 | 10.000010 | 9.999990 | 30 | 26 |
| 35 | 45 | 7.839386 | 12.160614 | 7.839397 | 12.160603 | 10.000010 | 9.999990 | 15 | 25 |
| 36 | 24 | 7.843934 | 12.156066 | 7.843944 | 12.156056 | 10.000011 | 9.999989 | 36 | 24 |
| 37 | 15 | 7.848434 | 12.151566 | 7.848445 | 12.151555 | 10.000011 | 9.999989 | 45 | 23 |
| 38 | 30 | 7.852888 | 12.147112 | 7.852900 | 12.147100 | 10.000011 | 9.999989 | 30 | 22 |
| 39 | 45 | 7.857298 | 12.142702 | 7.857309 | 12.142691 | 10.000011 | 9.999989 | 15 | 21 |
| 40 | 25 | 7.861662 | 12.138338 | 7.861674 | 12.138326 | 10.000012 | 9.999988 | 35 | 20 |
| 41 | 15 | 7.865984 | 12.134016 | 7.865995 | 12.134005 | 10.000012 | 9.999988 | 45 | 19 |
| 42 | 30 | 7.870262 | 12.129738 | 7.870274 | 12.129726 | 10.000012 | 9.999988 | 30 | 18 |
| 43 | 45 | 7.874499 | 12.125501 | 7.874511 | 12.125489 | 10.000012 | 9.999988 | 15 | 17 |
| 44 | 26 | 7.878695 | 12.121305 | 7.878708 | 12.121292 | 10.000012 | 9.999988 | 34 | 16 |
| 45 | 15 | 7.882851 | 12.117149 | 7.882864 | 12.117136 | 10.000013 | 9.999987 | 45 | 15 |
| 46 | 30 | 7.886968 | 12.113032 | 7.886981 | 12.113019 | 10.000013 | 9.999987 | 30 | 14 |
| 47 | 45 | 7.891045 | 12.108955 | 7.891059 | 12.108941 | 10.000013 | 9.999987 | 15 | 13 |
| 48 | 27 | 7.895085 | 12.104915 | 7.895099 | 12.104901 | 10.000013 | 9.999987 | 33 | 12 |
| 49 | 15 | 7.899088 | 12.100912 | 7.899102 | 12.100898 | 10.000014 | 9.999986 | 45 | 11 |
| 50 | 30 | 7.903054 | 12.096946 | 7.903068 | 12.096932 | 10.000014 | 9.999986 | 30 | 10 |
| 51 | 45 | 7.906984 | 12.093016 | 7.906998 | 12.093002 | 10.000014 | 9.999986 | 15 | 9 |
| 52 | 28 | 7.910879 | 12.089121 | 7.910895 | 12.089106 | 10.000014 | 9.999986 | 32 | 8 |
| 53 | 15 | 7.914740 | 12.085260 | 7.914754 | 12.085246 | 10.000015 | 9.999985 | 45 | 7 |
| 54 | 30 | 7.918566 | 12.081434 | 7.918581 | 12.081419 | 10.000015 | 9.999985 | 30 | 6 |
| 55 | 45 | 7.922359 | 12.077641 | 7.922374 | 12.077626 | 10.000015 | 9.999985 | 15 | 5 |
| 56 | 29 | 7.926119 | 12.073881 | 7.926134 | 12.073866 | 10.000016 | 9.999984 | 31 | 4 |
| 57 | 15 | 7.929847 | 12.070153 | 7.929862 | 12.070138 | 10.000016 | 9.999984 | 45 | 3 |
| 58 | 30 | 7.933543 | 12.066457 | 7.933559 | 12.066441 | 10.000016 | 9.999984 | 30 | 2 |
| 59 | 45 | 7.937208 | 12.062792 | 7.937224 | 12.062776 | 10.000016 | 9.999984 | 15 | 1 |
| 60 | 30 | 7.940842 | 12.059158 | 7.940858 | 12.059142 | 10.000017 | 9.999983 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 58m. | | | LOG. SINES, &c. | | | | 89 deg. | | |

| sec. | ′ ″ | sine. | cosecant. | tangent | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $0^h\ 2^m$. | LOG. SINES, &c. (t.) | | | | | | 0 deg. | |
| 0 | 30 | 7.940842 | 12.059158 | 7.940858 | 12.059142 | 10.000017 | 9.999983 | 30 | 60 |
| 1 | 15 | 7.944446 | 12.055554 | 7.944463 | 12.055537 | 10.000017 | 9.999983 | 45 | 59 |
| 2 | 30 | 7.948020 | 12.051980 | 7.948037 | 12.051963 | 10.000017 | 9.999983 | 30 | 58 |
| 3 | 45 | 7.951565 | 12.048435 | 7.951583 | 12.048417 | 10.000017 | 9.999983 | 15 | 57 |
| 4 | 31 | 7.955082 | 12.044918 | 7.955100 | 12.044900 | 10.000018 | 9.999982 | 29 | 56 |
| 5 | 15 | 7.958570 | 12.041430 | 7.958588 | 12.041412 | 10.000018 | 9.999982 | 45 | 55 |
| 6 | 30 | 7.962031 | 12.037969 | 7.962049 | 12.037951 | 10.000018 | 9.999982 | 30 | 54 |
| 7 | 45 | 7.965464 | 12.034536 | 7.965482 | 12.034518 | 10.000019 | 9.999981 | 15 | 53 |
| 8 | 32 | 7.968870 | 12.031130 | 7.968889 | 12.031111 | 10.000019 | 9.999981 | 28 | 52 |
| 9 | 15 | 7.972249 | 12.027751 | 7.972269 | 12.027731 | 10.000019 | 9.999981 | 45 | 51 |
| 10 | 30 | 7.975603 | 12.024397 | 7.975622 | 12.024378 | 10.000019 | 9.999981 | 30 | 50 |
| 11 | 45 | 7.978931 | 12.021069 | 7.978951 | 12.021049 | 10.000020 | 9.999980 | 15 | 49 |
| 12 | 33 | 7.982233 | 12.017767 | 7.982253 | 12.017747 | 10.000020 | 9.999980 | 27 | 48 |
| 13 | 15 | 7.985511 | 12.014489 | 7.985531 | 12.014469 | 10.000020 | 9.999980 | 45 | 47 |
| 14 | 30 | 7.988764 | 12.011236 | 7.988785 | 12.011215 | 10.000021 | 9.999979 | 30 | 46 |
| 15 | 45 | 7.991993 | 12.008007 | 7.992014 | 12.007986 | 10.000021 | 9.999979 | 15 | 45 |
| 16 | 34 | 7.995198 | 12.004802 | 7.995219 | 12.004781 | 10.000021 | 9.999979 | 26 | 44 |
| 17 | 15 | 7.998379 | 12.001621 | 7.998401 | 12.001599 | 10.000022 | 9.999978 | 45 | 43 |
| 18 | 30 | 8.001538 | 11.998462 | 8.001560 | 11.998440 | 10.000022 | 9.999978 | 30 | 42 |
| 19 | 45 | 8.004673 | 11.995327 | 8.004696 | 11.995304 | 10.000022 | 9.999978 | 15 | 41 |
| 20 | 35 | 8.007787 | 11.992213 | 8.007809 | 11.992191 | 10.000023 | 9.999977 | 25 | 40 |
| 21 | 15 | 8.010878 | 11.989122 | 8.010900 | 11.989099 | 10.000023 | 9.999977 | 45 | 39 |
| 22 | 30 | 8.013947 | 11.986053 | 8.013970 | 11.986030 | 10.000023 | 9.999977 | 30 | 38 |
| 23 | 45 | 8.016994 | 11.983006 | 8.017018 | 11.982982 | 10.000024 | 9.999976 | 15 | 37 |
| 24 | 36 | 8.020021 | 11.979979 | 8.020044 | 11.979955 | 10.000024 | 9.999976 | 24 | 36 |
| 25 | 15 | 8.023026 | 11.976974 | 8.023050 | 11.976950 | 10.000024 | 9.999976 | 45 | 35 |
| 26 | 30 | 8.026011 | 11.973989 | 8.026035 | 11.973965 | 10.000025 | 9.999975 | 30 | 34 |
| 27 | 45 | 8.028975 | 11.971025 | 8.029000 | 11.971000 | 10.000025 | 9.999975 | 15 | 33 |
| 28 | 37 | 8.031919 | 11.968081 | 8.031945 | 11.968055 | 10.000025 | 9.999975 | 23 | 32 |
| 29 | 15 | 8.034844 | 11.965156 | 8.034869 | 11.965131 | 10.000026 | 9.999974 | 45 | 31 |
| 30 | 30 | 8.037749 | 11.962251 | 8.037775 | 11.962225 | 10.000026 | 9.999974 | 30 | 30 |
| 31 | 45 | 8.040634 | 11.959366 | 8.040660 | 11.959339 | 10.000026 | 9.999974 | 15 | 29 |
| 32 | 38 | 8.043501 | 11.956499 | 8.043527 | 11.956473 | 10.000027 | 9.999973 | 22 | 28 |
| 33 | 15 | 8.046349 | 11.953651 | 8.046375 | 11.953624 | 10.000027 | 9.999973 | 45 | 27 |
| 34 | 30 | 8.049178 | 11.950822 | 8.049205 | 11.950795 | 10.000027 | 9.999973 | 30 | 26 |
| 35 | 45 | 8.051989 | 11.948011 | 8.052016 | 11.947984 | 10.000028 | 9.999972 | 15 | 25 |
| 36 | 39 | 8.054781 | 11.945219 | 8.054809 | 11.945191 | 10.000028 | 9.999972 | 21 | 24 |
| 37 | 15 | 8.057556 | 11.942444 | 8.057585 | 11.942415 | 10.000028 | 9.999972 | 45 | 23 |
| 38 | 30 | 8.060314 | 11.939686 | 8.060342 | 11.939658 | 10.000029 | 9.999971 | 30 | 22 |
| 39 | 45 | 8.063054 | 11.936946 | 8.063083 | 11.936917 | 10.000029 | 9.999971 | 15 | 21 |
| 40 | 40 | 8.065776 | 11.934224 | 8.065806 | 11.934194 | 10.000029 | 9.999971 | 20 | 20 |
| 41 | 15 | 8.068482 | 11.931518 | 8.068512 | 11.931488 | 10.000030 | 9.999970 | 45 | 19 |
| 42 | 30 | 8.071171 | 11.928829 | 8.071201 | 11.928799 | 10.000030 | 9.999970 | 30 | 18 |
| 43 | 45 | 8.073844 | 11.926156 | 8.073874 | 11.926126 | 10.000031 | 9.999969 | 15 | 17 |
| 44 | 41 | 8.076500 | 11.923500 | 8.076531 | 11.923469 | 10.000031 | 9.999969 | 19 | 16 |
| 45 | 15 | 8.079140 | 11.920860 | 8.079171 | 11.920829 | 10.000031 | 9.999969 | 45 | 15 |
| 46 | 30 | 8.081764 | 11.918236 | 8.081795 | 11.918205 | 10.000032 | 9.999968 | 30 | 14 |
| 47 | 45 | 8.084372 | 11.915628 | 8.084404 | 11.915596 | 10.000032 | 9.999968 | 15 | 13 |
| 48 | 42 | 8.086965 | 11.913035 | 8.086997 | 11.913003 | 10.000032 | 9.999968 | 18 | 12 |
| 49 | 15 | 8.089542 | 11.910458 | 8.089575 | 11.910425 | 10.000033 | 9.999967 | 45 | 11 |
| 50 | 30 | 8.092104 | 11.907896 | 8.092137 | 11.907863 | 10.000033 | 9.999967 | 30 | 10 |
| 51 | 45 | 8.094651 | 11.905349 | 8.094685 | 11.905315 | 10.000034 | 9.999966 | 15 | 9 |
| 52 | 43 | 8.097183 | 11.902817 | 8.097217 | 11.902783 | 10.000034 | 9.999966 | 17 | 8 |
| 53 | 15 | 8.099701 | 11.900299 | 8.099735 | 11.900265 | 10.000034 | 9.999966 | 45 | 7 |
| 54 | 30 | 8.102204 | 11.897796 | 8.102239 | 11.897761 | 10.000035 | 9.999965 | 30 | 6 |
| 55 | 45 | 8.104692 | 11.895308 | 8.104728 | 11.895272 | 10.000035 | 9.999965 | 15 | 5 |
| 56 | 44 | 8.107167 | 11.892833 | 8.107202 | 11.892797 | 10.000036 | 9.999964 | 16 | 4 |
| 57 | 15 | 8.109627 | 11.890373 | 8.109663 | 11.890337 | 10.000036 | 9.999964 | 45 | 3 |
| 58 | 30 | 8.112074 | 11.887926 | 8.112110 | 11.887890 | 10.000036 | 9.999964 | 30 | 2 |
| 59 | 45 | 8.114507 | 11.885493 | 8.114544 | 11.885456 | 10.000037 | 9.999963 | 15 | 1 |
| 60 | 45 | 8.116926 | 11.883074 | 8.116963 | 11.883037 | 10.000037 | 9.999963 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent | cosecant. | sine. | ″ ′ | sec. |
| | $5^h\ 57^m$. | LOG. SINES, &c. | | | | | | 89 deg. | |

| 0h 3m | | LOG. SINES, &c. (t) | | | | | 0 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 8.116926 | 11.883074 | 8.116963 | 11.883037 | 10.000037 | 9.999963 | 15 | 60 |
| 1 | 15 | 8.119332 | 11.880668 | 8.119370 | 11.880630 | 10.000038 | 9.999962 | 45 | 59 |
| 2 | 30 | 8.121725 | 11.878275 | 8.121763 | 11.878237 | 10.000038 | 9.999962 | 30 | 58 |
| 3 | 45 | 8.124104 | 11.875896 | 8.124143 | 11.875857 | 10.000039 | 9.999961 | 15 | 57 |
| 4 | 46 | 8.126471 | 11.873529 | 8.126510 | 11.873490 | 10.000039 | 9.999961 | 14 | 56 |
| 5 | 15 | 8.128825 | 11.871175 | 8.128864 | 11.871136 | 10.000039 | 9.999961 | 45 | 55 |
| 6 | 30 | 8.131166 | 11.868834 | 8.131206 | 11.868794 | 10.000040 | 9.999960 | 30 | 54 |
| 7 | 45 | 8.133494 | 11.866506 | 8.133534 | 11.866465 | 10.000040 | 9.999960 | 15 | 53 |
| 8 | 47 | 8.135810 | 11.864190 | 8.135851 | 11.864149 | 10.000041 | 9.999959 | 13 | 52 |
| 9 | 15 | 8.138114 | 11.861886 | 8.138155 | 11.861845 | 10.000041 | 9.999959 | 45 | 51 |
| 10 | 30 | 8.140406 | 11.859594 | 8.140447 | 11.859553 | 10.000042 | 9.999958 | 30 | 50 |
| 11 | 45 | 8.142685 | 11.857315 | 8.142727 | 11.857273 | 10.000042 | 9.999958 | 15 | 49 |
| 12 | 48 | 8.144953 | 11.855047 | 8.144996 | 11.855004 | 10.000042 | 9.999958 | 12 | 48 |
| 13 | 15 | 8.147209 | 11.852791 | 8.147252 | 11.852748 | 10.000043 | 9.999957 | 45 | 47 |
| 14 | 30 | 8.149453 | 11.850547 | 8.149497 | 11.850503 | 10.000043 | 9.999957 | 30 | 46 |
| 15 | 45 | 8.151686 | 11.848314 | 8.151730 | 11.848270 | 10.000044 | 9.999956 | 15 | 45 |
| 16 | 49 | 8.153907 | 11.846093 | 8.153952 | 11.846048 | 10.000044 | 9.999956 | 11 | 44 |
| 17 | 15 | 8.156117 | 11.843883 | 8.156162 | 11.843838 | 10.000045 | 9.999955 | 45 | 43 |
| 18 | 30 | 8.158316 | 11.841684 | 8.158361 | 11.841639 | 10.000045 | 9.999955 | 30 | 42 |
| 19 | 45 | 8.160504 | 11.839496 | 8.160549 | 11.839450 | 10.000046 | 9.999954 | 15 | 41 |
| 20 | 50 | 8.162681 | 11.837319 | 8.162727 | 11.837273 | 10.000046 | 9.999954 | 10 | 40 |
| 21 | 15 | 8.164847 | 11.835153 | 8.164893 | 11.835107 | 10.000046 | 9.999954 | 45 | 39 |
| 22 | 30 | 8.167002 | 11.832998 | 8.167049 | 11.832951 | 10.000047 | 9.999953 | 30 | 38 |
| 23 | 45 | 8.169146 | 11.830854 | 8.169194 | 11.830806 | 10.000047 | 9.999953 | 15 | 37 |
| 24 | 51 | 8.171280 | 11.828720 | 8.171328 | 11.828672 | 10.000048 | 9.999952 | 9 | 36 |
| 25 | 15 | 8.173404 | 11.826596 | 8.173452 | 11.826548 | 10.000048 | 9.999952 | 45 | 35 |
| 26 | 30 | 8.175517 | 11.824483 | 8.175566 | 11.824434 | 10.000049 | 9.999951 | 30 | 34 |
| 27 | 45 | 8.177620 | 11.822380 | 8.177669 | 11.822331 | 10.000049 | 9.999951 | 15 | 33 |
| 28 | 52 | 8.179713 | 11.820287 | 8.179763 | 11.820237 | 10.000050 | 9.999950 | 8 | 32 |
| 29 | 15 | 8.181796 | 11.818204 | 8.181846 | 11.818154 | 10.000050 | 9.999950 | 45 | 31 |
| 30 | 30 | 8.183868 | 11.816132 | 8.183919 | 11.816081 | 10.000051 | 9.999949 | 30 | 30 |
| 31 | 45 | 8.185931 | 11.814069 | 8.185983 | 11.814017 | 10.000051 | 9.999949 | 15 | 29 |
| 32 | 53 | 8.187985 | 11.812015 | 8.188036 | 11.811964 | 10.000052 | 9.999948 | 7 | 28 |
| 33 | 15 | 8.190028 | 11.809972 | 8.190080 | 11.809919 | 10.000052 | 9.999948 | 45 | 27 |
| 34 | 30 | 8.192062 | 11.807938 | 8.192115 | 11.807885 | 10.000053 | 9.999947 | 30 | 26 |
| 35 | 45 | 8.194087 | 11.805913 | 8.194140 | 11.805860 | 10.000053 | 9.999947 | 15 | 25 |
| 36 | 54 | 8.196102 | 11.803898 | 8.196156 | 11.803844 | 10.000054 | 9.999946 | 6 | 24 |
| 37 | 15 | 8.198108 | 11.801892 | 8.198162 | 11.801838 | 10.000054 | 9.999946 | 45 | 23 |
| 38 | 30 | 8.200104 | 11.799896 | 8.200159 | 11.799841 | 10.000055 | 9.999945 | 30 | 22 |
| 39 | 45 | 8.202092 | 11.797908 | 8.202147 | 11.797853 | 10.000055 | 9.999945 | 15 | 21 |
| 40 | 55 | 8.204070 | 11.795930 | 8.204126 | 11.795874 | 10.000056 | 9.999944 | 5 | 20 |
| 41 | 15 | 8.206040 | 11.793960 | 8.206096 | 11.793904 | 10.000056 | 9.999944 | 45 | 19 |
| 42 | 30 | 8.208000 | 11.792000 | 8.208057 | 11.791943 | 10.000057 | 9.999943 | 30 | 18 |
| 43 | 45 | 8.209952 | 11.790048 | 8.210009 | 11.789991 | 10.000057 | 9.999943 | 15 | 17 |
| 44 | 56 | 8.211895 | 11.788105 | 8.211953 | 11.788047 | 10.000058 | 9.999942 | 4 | 16 |
| 45 | 15 | 8.213829 | 11.786171 | 8.213887 | 11.786113 | 10.000058 | 9.999942 | 45 | 15 |
| 46 | 30 | 8.215755 | 11.784245 | 8.215814 | 11.784186 | 10.000059 | 9.999941 | 30 | 14 |
| 47 | 45 | 8.217672 | 11.782328 | 8.217731 | 11.782269 | 10.000059 | 9.999941 | 15 | 13 |
| 48 | 57 | 8.219581 | 11.780419 | 8.219641 | 11.780359 | 10.000060 | 9.999940 | 3 | 12 |
| 49 | 15 | 8.221481 | 11.778519 | 8.221542 | 11.778458 | 10.000060 | 9.999940 | 45 | 11 |
| 50 | 30 | 8.223374 | 11.776626 | 8.223434 | 11.776565 | 10.000061 | 9.999939 | 30 | 10 |
| 51 | 45 | 8.225258 | 11.774742 | 8.225319 | 11.774681 | 10.000061 | 9.999939 | 15 | 9 |
| 52 | 58 | 8.227133 | 11.772867 | 8.227195 | 11.772805 | 10.000062 | 9.999938 | 2 | 8 |
| 53 | 15 | 8.229001 | 11.770999 | 8.229064 | 11.770936 | 10.000062 | 9.999938 | 45 | 7 |
| 54 | 30 | 8.230861 | 11.769139 | 8.230924 | 11.769076 | 10.000063 | 9.999937 | 30 | 6 |
| 55 | 45 | 8.232713 | 11.767287 | 8.232776 | 11.767224 | 10.000063 | 9.999937 | 15 | 5 |
| 56 | 59 | 8.234557 | 11.765443 | 8.234621 | 11.765379 | 10.000064 | 9.999936 | 1 | 4 |
| 57 | 15 | 8.236393 | 11.763607 | 8.236457 | 11.763542 | 10.000065 | 9.999935 | 45 | 3 |
| 58 | 30 | 8.238221 | 11.761779 | 8.238286 | 11.761713 | 10.000065 | 9.999935 | 30 | 2 |
| 59 | 45 | 8.240042 | 11.759958 | 8.240108 | 11.759892 | 10.000066 | 9.999934 | 15 | 1 |
| 60 | 60 | 8.241855 | 11.758145 | 8.241921 | 11.758078 | 10.000066 | 9.999934 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 56m | | LOG SINES, &c. | | | | | 89 deg. | | |

| 0h 4m | | LOG. SINES, &c. (t) | | | | | 1 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 8.241855 | 11.758145 | 8.241921 | 11.758079 | 10.000066 | 9.999934 | 60 | 60 |
| 1 | 15 | 8.243661 | 11.756339 | 8.243728 | 11.756272 | 10.000067 | 9.999933 | 45 | 59 |
| 2 | 30 | 8.245459 | 11.754541 | 8.245526 | 11.754474 | 10.000067 | 9.999933 | 30 | 58 |
| 3 | 45 | 8.247250 | 11.752750 | 8.247318 | 11.752682 | 10.000068 | 9.999932 | 15 | 57 |
| 4 | 1 | 8.249033 | 11.750967 | 8.249101 | 11.750899 | 10.000068 | 9.999932 | 59 | 56 |
| 5 | 15 | 8.250809 | 11.749191 | 8.250878 | 11.749122 | 10.000069 | 9.999931 | 45 | 55 |
| 6 | 30 | 8.252578 | 11.747422 | 8.252648 | 11.747352 | 10.000070 | 9.999930 | 30 | 54 |
| 7 | 45 | 8.254340 | 11.745660 | 8.254410 | 11.745590 | 10.000070 | 9.999930 | 15 | 53 |
| 8 | 2 | 8.256094 | 11.743906 | 8.256165 | 11.743835 | 10.000071 | 9.999929 | 58 | 52 |
| 9 | 15 | 8.257842 | 11.742158 | 8.257913 | 11.742087 | 10.000071 | 9.999929 | 45 | 51 |
| 10 | 30 | 8.259582 | 11.740418 | 8.259654 | 11.740346 | 10.000072 | 9.999928 | 30 | 50 |
| 11 | 45 | 8.261316 | 11.738684 | 8.261388 | 11.738612 | 10.000072 | 9.999928 | 15 | 49 |
| 12 | 3 | 8.263042 | 11.736958 | 8.263115 | 11.736885 | 10.000073 | 9.999927 | 57 | 48 |
| 13 | 15 | 8.264762 | 11.735238 | 8.264836 | 11.735164 | 10.000074 | 9.999926 | 45 | 47 |
| 14 | 30 | 8.266475 | 11.733525 | 8.266549 | 11.733451 | 10.000074 | 9.999926 | 30 | 46 |
| 15 | 45 | 8.268181 | 11.731819 | 8.268256 | 11.731744 | 10.000075 | 9.999925 | 15 | 45 |
| 16 | 4 | 8.269881 | 11.730119 | 8.269956 | 11.730044 | 10.000075 | 9.999925 | 56 | 44 |
| 17 | 15 | 8.271574 | 11.728426 | 8.271650 | 11.728350 | 10.000076 | 9.999924 | 45 | 43 |
| 18 | 30 | 8.273260 | 11.726740 | 8.273337 | 11.726663 | 10.000076 | 9.999924 | 30 | 42 |
| 19 | 45 | 8.274940 | 11.725060 | 8.275017 | 11.724983 | 10.000077 | 9.999923 | 15 | 41 |
| 20 | 5 | 8.276614 | 11.723386 | 8.276691 | 11.723309 | 10.000078 | 9.999922 | 55 | 40 |
| 21 | 15 | 8.278281 | 11.721719 | 8.278359 | 11.721641 | 10.000078 | 9.999922 | 45 | 39 |
| 22 | 30 | 8.279941 | 11.720059 | 8.280020 | 11.719980 | 10.000079 | 9.999921 | 30 | 38 |
| 23 | 45 | 8.281595 | 11.718405 | 8.281675 | 11.718325 | 10.000080 | 9.999921 | 15 | 37 |
| 24 | 6 | 8.283243 | 11.716757 | 8.283323 | 11.716677 | 10.000080 | 9.999920 | 54 | 36 |
| 25 | 15 | 8.284885 | 11.715115 | 8.284966 | 11.715034 | 10.000081 | 9.999919 | 45 | 35 |
| 26 | 30 | 8.286521 | 11.713479 | 8.286602 | 11.713398 | 10.000081 | 9.999919 | 30 | 34 |
| 27 | 45 | 8.288150 | 11.711850 | 8.288232 | 11.711768 | 10.000082 | 9.999918 | 15 | 33 |
| 28 | 7 | 8.289773 | 11.710227 | 8.289856 | 11.710144 | 10.000083 | 9.999917 | 53 | 32 |
| 29 | 15 | 8.291391 | 11.708609 | 8.291474 | 11.708526 | 10.000083 | 9.999917 | 45 | 31 |
| 30 | 30 | 8.293002 | 11.706998 | 8.293086 | 11.706914 | 10.000084 | 9.999916 | 30 | 30 |
| 31 | 45 | 8.294607 | 11.705393 | 8.294692 | 11.705308 | 10.000084 | 9.999916 | 15 | 29 |
| 32 | 8 | 8.296207 | 11.703793 | 8.296292 | 11.703708 | 10.000085 | 9.999915 | 52 | 28 |
| 33 | 15 | 8.297800 | 11.702200 | 8.297886 | 11.702114 | 10.000086 | 9.999914 | 45 | 27 |
| 34 | 30 | 8.299388 | 11.700612 | 8.299474 | 11.700526 | 10.000086 | 9.999914 | 30 | 26 |
| 35 | 45 | 8.300970 | 11.699030 | 8.301057 | 11.698943 | 10.000087 | 9.999913 | 15 | 25 |
| 36 | 9 | 8.302546 | 11.697454 | 8.302633 | 11.697367 | 10.000088 | 9.999912 | 51 | 24 |
| 37 | 15 | 8.304116 | 11.695884 | 8.304205 | 11.695795 | 10.000088 | 9.999912 | 45 | 23 |
| 38 | 30 | 8.305681 | 11.694319 | 8.305770 | 11.694230 | 10.000089 | 9.999911 | 30 | 22 |
| 39 | 45 | 8.307240 | 11.692760 | 8.307330 | 11.692670 | 10.000090 | 9.999911 | 15 | 21 |
| 40 | 10 | 8.308794 | 11.691206 | 8.308884 | 11.691116 | 10.000090 | 9.999910 | 50 | 20 |
| 41 | 15 | 8.310342 | 11.689658 | 8.310433 | 11.689567 | 10.000091 | 9.999909 | 45 | 19 |
| 42 | 30 | 8.311885 | 11.688115 | 8.311976 | 11.688024 | 10.000091 | 9.999909 | 30 | 18 |
| 43 | 45 | 8.313422 | 11.686578 | 8.313514 | 11.686486 | 10.000092 | 9.999908 | 15 | 17 |
| 44 | 11 | 8.314954 | 11.685046 | 8.315046 | 11.684954 | 10.000093 | 9.999907 | 49 | 16 |
| 45 | 15 | 8.316480 | 11.683520 | 8.316573 | 11.683427 | 10.000093 | 9.999907 | 45 | 15 |
| 46 | 30 | 8.318001 | 11.681999 | 8.318095 | 11.681905 | 10.000094 | 9.999906 | 30 | 14 |
| 47 | 45 | 8.319516 | 11.680484 | 8.319611 | 11.680389 | 10.000095 | 9.999905 | 15 | 13 |
| 48 | 12 | 8.321027 | 11.678973 | 8.321122 | 11.678878 | 10.000095 | 9.999905 | 48 | 12 |
| 49 | 15 | 8.322532 | 11.677468 | 8.322628 | 11.677372 | 10.000096 | 9.999904 | 45 | 11 |
| 50 | 30 | 8.324032 | 11.675968 | 8.324128 | 11.675872 | 10.000097 | 9.999903 | 30 | 10 |
| 51 | 45 | 8.325527 | 11.674473 | 8.325624 | 11.674376 | 10.000097 | 9.999903 | 15 | 9 |
| 52 | 13 | 8.327016 | 11.672984 | 8.327114 | 11.672886 | 10.000098 | 9.999902 | 47 | 8 |
| 53 | 15 | 8.328501 | 11.671499 | 8.328599 | 11.671400 | 10.000099 | 9.999901 | 45 | 7 |
| 54 | 30 | 8.329980 | 11.670020 | 8.330080 | 11.669920 | 10.000099 | 9.999901 | 30 | 6 |
| 55 | 45 | 8.331455 | 11.668545 | 8.331555 | 11.668445 | 10.000100 | 9.999900 | 15 | 5 |
| 56 | 14 | 8.332924 | 11.667076 | 8.333025 | 11.666975 | 10.000101 | 9.999899 | 46 | 4 |
| 57 | 15 | 8.334389 | 11.665611 | 8.334490 | 11.665510 | 10.000101 | 9.999899 | 45 | 3 |
| 58 | 30 | 8.335848 | 11.664152 | 8.335950 | 11.664050 | 10.000102 | 9.999898 | 30 | 2 |
| 59 | 45 | 8.337303 | 11.662697 | 8.337406 | 11.662594 | 10.000103 | 9.999897 | 15 | 1 |
| 60 | 15 | 8.338753 | 11.661247 | 8.338856 | 11.661144 | 10.000103 | 9.999897 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 55m | | | | LOG. SINES, &c. | | | | 88 deg. | |

| 0h 5m. | | LOG. SINES, &c. (t) | | | | | | 1 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 8.338753 | 11.661247 | 8.338856 | 11.661144 | 10.000103 | 9.999897 | 45 | 60 |
| 1 | 15 | 8.340198 | 11.659802 | 8.340302 | 11.659698 | 10.000104 | 9.999896 | 45 | 59 |
| 2 | 30 | 8.341638 | 11.658362 | 8.341743 | 11.658257 | 10.000105 | 9.999895 | 30 | 58 |
| 3 | 45 | 8.343074 | 11.656926 | 8.343179 | 11.656821 | 10.000105 | 9.999895 | 15 | 57 |
| 4 | 16 | 8 344504 | 11.655496 | 8.344610 | 11.655390 | 10.000106 | 9.999894 | 44 | 56 |
| 5 | 15 | 8.345930 | 11.654070 | 8.346037 | 11.653963 | 10.000107 | 9.999893 | 45 | 55 |
| 6 | 30 | 8.347352 | 11.652648 | 8.347459 | 11.652541 | 10.000108 | 9.999892 | 30 | 54 |
| 7 | 45 | 8.348768 | 11.651232 | 8.348877 | 11.651123 | 10.000108 | 9.999892 | 15 | 53 |
| 8 | 17 | 8.350180 | 11.649820 | 8.350289 | 11.649711 | 10.000109 | 9.999891 | 43 | 52 |
| 9 | 15 | 8.351588 | 11.648412 | 8.351698 | 11.648302 | 10.000110 | 9.999890 | 45 | 51 |
| 10 | 30 | 8.352991 | 11.647009 | 8.353101 | 11.646899 | 10 000110 | 9.999890 | 30 | 50 |
| 11 | 45 | 8.354389 | 11.645611 | 8.354501 | 11.645499 | 10.000111 | 9.999889 | 15 | 49 |
| 12 | 18 | 8.355783 | 11.644217 | 8.355895 | 11.644105 | 10.000112 | 9.999888 | 42 | 48 |
| 13 | 15 | 8.357173 | 11.642827 | 8.357285 | 11.642715 | 10.000113 | 9.999887 | 45 | 47 |
| 14 | 30 | 8.358558 | 11.641442 | 8.358671 | 11.641329 | 10.000113 | 9.999887 | 30 | 46 |
| 15 | 45 | 8.359939 | 11.640061 | 8.360053 | 11.639947 | 10.000114 | 9.999886 | 15 | 45 |
| 16 | 19 | 8.361315 | 11.638685 | 8.361430 | 11.638570 | 10.000115 | 9.999885 | 41 | 44 |
| 17 | 15 | 8.362687 | 11.637313 | 8.362802 | 11.637198 | 10.000115 | 9.999885 | 45 | 43 |
| 18 | 30 | 8.364054 | 11.635946 | 8.364171 | 11.635829 | 10.000116 | 9.999884 | 30 | 42 |
| 19 | 45 | 8.365418 | 11.634582 | 8.365535 | 11.634465 | 10.000117 | 9.999883 | 15 | 41 |
| 20 | 20 | 8.366777 | 11.633223 | 8.366894 | 11.633106 | 10.000118 | 9.999882 | 40 | 40 |
| 21 | 15 | 8.368132 | 11.631868 | 8.368250 | 11 631750 | 10.000118 | 9.999882 | 45 | 39 |
| 22 | 30 | 8.369482 | 11.630518 | 8.369601 | 11.630399 | 10.000119 | 9.999881 | 30 | 38 |
| 23 | 45 | 8.370829 | 11.629171 | 8.370948 | 11.629052 | 10.000120 | 9.999880 | 15 | 37 |
| 24 | 21 | 8.372171 | 11.627829 | 8.372291 | 11.627709 | 10.000121 | 9.999879 | 39 | 36 |
| 25 | 15 | 8.373509 | 11.626491 | 8.373630 | 11.626370 | 10.000121 | 9.999879 | 45 | 35 |
| 26 | 30 | 8.374843 | 11.625157 | 8.374965 | 11.625035 | 10.000122 | 9.999878 | 30 | 34 |
| 27 | 45 | 8.376173 | 11.623827 | 8.376296 | 11 623704 | 10.000123 | 9.999877 | 15 | 33 |
| 28 | 22 | 8.377499 | 11.622501 | 8.377622 | 11.622378 | 10.000124 | 9.999876 | 38 | 32 |
| 29 | 15 | 8.378821 | 11.621179 | 8.378945 | 11.621055 | 10.000124 | 9.999876 | 45 | 31 |
| 30 | 30 | 8.380138 | 11.619862 | 8.380263 | 11.619737 | 10.000125 | 9.999875 | 30 | 30 |
| 31 | 45 | 8.381452 | 11.618548 | 8.381578 | 11.618422 | 10.000126 | 9.999874 | 15 | 29 |
| 32 | 23 | 8.382762 | 11.617238 | 8.382889 | 11.617111 | 10.000127 | 9.999873 | 37 | 28 |
| 33 | 15 | 8.384068 | 11.615932 | 8.384195 | 11.615805 | 10.000127 | 9.999873 | 45 | 27 |
| 34 | 30 | 8.385370 | 11.614630 | 8.385498 | 11.614502 | 10.000128 | 9.999872 | 30 | 26 |
| 35 | 45 | 8.386668 | 11.613332 | 8.386797 | 11.613203 | 10.000129 | 9.999871 | 15 | 25 |
| 36 | 24 | 8.387962 | 11.612038 | 8.388092 | 11.611908 | 10.000130 | 9.999870 | 36 | 24 |
| 37 | 15 | 8.389253 | 11.610747 | 8.389383 | 11.610617 | 10.000130 | 9.999870 | 45 | 23 |
| 38 | 30 | 8.390539 | 11.609461 | 8.390670 | 11.609330 | 10.000131 | 9.999869 | 30 | 22 |
| 39 | 45 | 8.391822 | 11.608178 | 8.391954 | 11.608046 | 10.000132 | 9.999868 | 15 | 21 |
| 40 | 25 | 8.393101 | 11.606899 | 8.393234 | 11.606766 | 10.000133 | 9.999867 | 35 | 20 |
| 41 | 15 | 8.394376 | 11.605624 | 8.394509 | 11.605491 | 10.000134 | 9.999866 | 45 | 19 |
| 42 | 30 | 8.395647 | 11.604353 | 8.395782 | 11.604218 | 10.000134 | 9.999866 | 30 | 18 |
| 43 | 45 | 8.396915 | 11.603085 | 8.397050 | 11.602950 | 10.000135 | 9.999865 | 15 | 17 |
| 44 | 26 | 8.398179 | 11.601821 | 8.398315 | 11.601685 | 10.000136 | 9.999864 | 34 | 16 |
| 45 | 15 | 8.399440 | 11.600560 | 8.399576 | 11.600424 | 10.000137 | 9.999863 | 45 | 15 |
| 46 | 30 | 8.400696 | 11.599304 | 8.400834 | 11.599166 | 10.000138 | 9.999862 | 30 | 14 |
| 47 | 45 | 8.401949 | 11.598051 | 8.402088 | 11.597912 | 10.000138 | 9.999862 | 15 | 13 |
| 48 | 27 | 8.403199 | 11.596801 | 8.403338 | 11.596662 | 10.000139 | 9.999861 | 33 | 12 |
| 49 | 15 | 8.404445 | 11.595555 | 8.404585 | 11.595415 | 10.000140 | 9.999860 | 45 | 11 |
| 50 | 30 | 8.405687 | 11.594313 | 8.405828 | 11.594172 | 10.000141 | 9.999859 | 30 | 10 |
| 51 | 45 | 8.406926 | 11.593074 | 8.407068 | 11.592932 | 10.000142 | 9.999858 | 15 | 9 |
| 52 | 28 | 8.408161 | 11.591839 | 8.408304 | 11.591696 | 10.000142 | 9.999858 | 32 | 8 |
| 53 | 15 | 8.409393 | 11.590607 | 8.409536 | 11.590464 | 10.000143 | 9.999857 | 45 | 7 |
| 54 | 30 | 8.410621 | 11.589379 | 8.410765 | 11.589235 | 10.000144 | 9.999856 | 30 | 6 |
| 55 | 45 | 8.411846 | 11.588154 | 8.411991 | 11.588009 | 10.000145 | 9.999855 | 15 | 5 |
| 56 | 29 | 8.413068 | 11.586932 | 8.413213 | 11.586787 | 10.000146 | 9.999854 | 31 | 4 |
| 57 | 15 | 8.414286 | 11.585714 | 8.414432 | 11.585568 | 10.000146 | 9.999854 | 45 | 3 |
| 58 | 30 | 8.415500 | 11.584509 | 8.415647 | 11.584353 | 10.000147 | 9.999853 | 30 | 2 |
| 59 | 45 | 8.416711 | 11.583289 | 8.416859 | 11.583141 | 10.000148 | 9.999852 | 15 | 1 |
| 60 | 30 | 8.417919 | 11.582081 | 8.418068 | 11.581932 | 10.000149 | 9.999851 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 54m. | | | | LOG. SINES, &c. | | | | 88 deg. | |

| 0h 6m. | | LOG. SINES, &c. (t.) | | | | | 1 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 8.417919 | 11.582081 | 8.418068 | 11.581932 | 10.000149 | 9.999851 | 30 | 60 |
| 1 | 15 | 8.419123 | 11.580877 | 8.419273 | 11.580727 | 10.000150 | 9.999850 | 45 | 59 |
| 2 | 30 | 8.420324 | 11.579676 | 8.420475 | 11.579525 | 10.000151 | 9.999849 | 30 | 58 |
| 3 | 45 | 8.421522 | 11.578478 | 8.421674 | 11.578326 | 10.000151 | 9.999849 | 15 | 57 |
| 4 | 31 | 8.422717 | 11.577283 | 8.422869 | 11.577131 | 10.000152 | 9.999848 | 29 | 56 |
| 5 | 15 | 8.423908 | 11.576092 | 8.424061 | 11.575939 | 10.000153 | 9.999847 | 45 | 55 |
| 6 | 30 | 8.425096 | 11.574904 | 8.425250 | 11.574750 | 10.000154 | 9.999846 | 30 | 54 |
| 7 | 45 | 8.426281 | 11.573719 | 8.426435 | 11.573565 | 10.000155 | 9.999845 | 15 | 53 |
| 8 | 32 | 8.427462 | 11.572538 | 8.427618 | 11.572382 | 10.000156 | 9.999844 | 28 | 52 |
| 9 | 15 | 8.428640 | 11.571360 | 8.428797 | 11.571203 | 10.000156 | 9.999844 | 45 | 51 |
| 10 | 30 | 8.429815 | 11.570185 | 8.429973 | 11.570027 | 10.000157 | 9.999843 | 30 | 50 |
| 11 | 45 | 8.430987 | 11.569013 | 8.431145 | 11.568855 | 10.000158 | 9.999842 | 15 | 49 |
| 12 | 33 | 8.432156 | 11.567844 | 8.432315 | 11.567685 | 10.000159 | 9.999841 | 27 | 48 |
| 13 | 15 | 8.433322 | 11.566678 | 8.433481 | 11.566519 | 10.000160 | 9.999840 | 45 | 47 |
| 14 | 30 | 8.434484 | 11.565516 | 8.434645 | 11.565355 | 10.000161 | 9.999839 | 30 | 46 |
| 15 | 45 | 8.435644 | 11.564356 | 8.435805 | 11.564195 | 10.000162 | 9.999838 | 15 | 45 |
| 16 | 34 | 8.436800 | 11.563200 | 8.436962 | 11.563038 | 10.000162 | 9.999838 | 26 | 44 |
| 17 | 15 | 8.437953 | 11.562047 | 8.438116 | 11.561884 | 10.000163 | 9.999837 | 45 | 43 |
| 18 | 30 | 8.439103 | 11.560897 | 8.439267 | 11.560733 | 10.000164 | 9.999836 | 30 | 42 |
| 19 | 45 | 8.440250 | 11.559750 | 8.440415 | 11.559585 | 10.000165 | 9.999835 | 15 | 41 |
| 20 | 35 | 8.441394 | 11.558606 | 8.441560 | 11.558440 | 10.000166 | 9.999834 | 25 | 40 |
| 21 | 15 | 8.442535 | 11.557465 | 8.442702 | 11.557298 | 10.000167 | 9.999833 | 45 | 39 |
| 22 | 30 | 8.443674 | 11.556326 | 8.443841 | 11.556159 | 10.000168 | 9.999832 | 30 | 38 |
| 23 | 45 | 8.444809 | 11.555191 | 8.444977 | 11.555023 | 10.000169 | 9.999831 | 15 | 37 |
| 24 | 36 | 8.445941 | 11.554059 | 8.446110 | 11.553890 | 10.000169 | 9.999831 | 24 | 36 |
| 25 | 15 | 8.447070 | 11.552930 | 8.447240 | 11.552760 | 10.000170 | 9.999830 | 45 | 35 |
| 26 | 30 | 8.448196 | 11.551804 | 8.448367 | 11.551633 | 10.000171 | 9.999829 | 30 | 34 |
| 27 | 45 | 8.449320 | 11.550680 | 8.449492 | 11.550508 | 10.000172 | 9.999828 | 15 | 33 |
| 28 | 37 | 8.450440 | 11.549560 | 8.450613 | 11.549387 | 10.000173 | 9.999827 | 23 | 32 |
| 29 | 15 | 8.451558 | 11.548442 | 8.451732 | 11.548268 | 10.000174 | 9.999826 | 45 | 31 |
| 30 | 30 | 8.452672 | 11.547328 | 8.452847 | 11.547153 | 10.000175 | 9.999825 | 30 | 30 |
| 31 | 45 | 8.453784 | 11.546216 | 8.453960 | 11.546040 | 10.000176 | 9.999824 | 15 | 29 |
| 32 | 38 | 8.454893 | 11.545107 | 8.455070 | 11.544930 | 10.000177 | 9.999823 | 22 | 28 |
| 33 | 15 | 8.456000 | 11.544000 | 8.456177 | 11.543823 | 10.000177 | 9.999823 | 45 | 27 |
| 34 | 30 | 8.457103 | 11.542897 | 8.457281 | 11.542719 | 10.000178 | 9.999822 | 30 | 26 |
| 35 | 45 | 8.458203 | 11.541797 | 8.458383 | 11.541617 | 10.000179 | 9.999821 | 15 | 25 |
| 36 | 39 | 8.459301 | 11.540699 | 8.459481 | 11.540519 | 10.000180 | 9.999820 | 21 | 24 |
| 37 | 15 | 8.460396 | 11.539604 | 8.460577 | 11.539423 | 10.000181 | 9.999819 | 45 | 23 |
| 38 | 30 | 8.461489 | 11.538511 | 8.461670 | 11.538330 | 10.000182 | 9.999818 | 30 | 22 |
| 39 | 45 | 8.462578 | 11.537422 | 8.462761 | 11.537239 | 10.000183 | 9.999817 | 15 | 21 |
| 40 | 40 | 8.463665 | 11.536335 | 8.463849 | 11.536151 | 10.000184 | 9.999816 | 20 | 20 |
| 41 | 15 | 8.464749 | 11.535251 | 8.464934 | 11.535066 | 10.000185 | 9.999815 | 45 | 19 |
| 42 | 30 | 8.465830 | 11.534170 | 8.466016 | 11.533984 | 10.000186 | 9.999814 | 30 | 18 |
| 43 | 45 | 8.466909 | 11.533091 | 8.467095 | 11.532905 | 10.000187 | 9.999813 | 15 | 17 |
| 44 | 41 | 8.467985 | 11.532015 | 8.468172 | 11.531828 | 10.000188 | 9.999812 | 19 | 16 |
| 45 | 15 | 8.469058 | 11.530942 | 8.469247 | 11.530753 | 10.000188 | 9.999812 | 45 | 15 |
| 46 | 30 | 8.470129 | 11.529871 | 8.470318 | 11.529682 | 10.000189 | 9.999811 | 30 | 14 |
| 47 | 45 | 8.471197 | 11.528803 | 8.471387 | 11.528613 | 10.000190 | 9.999810 | 15 | 13 |
| 48 | 42 | 8.472263 | 11.527737 | 8.472454 | 11.527546 | 10.000191 | 9.999809 | 18 | 12 |
| 49 | 15 | 8.473325 | 11.526675 | 8.473517 | 11.526483 | 10.000192 | 9.999808 | 45 | 11 |
| 50 | 30 | 8.474386 | 11.525614 | 8.474579 | 11.525421 | 10.000193 | 9.999807 | 30 | 10 |
| 51 | 45 | 8.475443 | 11.524557 | 8.475637 | 11.524363 | 10.000194 | 9.999806 | 15 | 9 |
| 52 | 43 | 8.476498 | 11.523502 | 8.476693 | 11.523307 | 10.000195 | 9.999805 | 17 | 8 |
| 53 | 15 | 8.477551 | 11.522449 | 8.477747 | 11.522253 | 10.000196 | 9.999804 | 45 | 7 |
| 54 | 30 | 8.478601 | 11.521399 | 8.478798 | 11.521202 | 10.000197 | 9.999803 | 30 | 6 |
| 55 | 45 | 8.479648 | 11.520352 | 8.479846 | 11.520154 | 10.000198 | 9.999802 | 15 | 5 |
| 56 | 44 | 8.480693 | 11.519307 | 8.480892 | 11.519108 | 10.000199 | 9.999801 | 16 | 4 |
| 57 | 15 | 8.481736 | 11.518264 | 8.481935 | 11.518065 | 10.000200 | 9.999800 | 45 | 3 |
| 58 | 30 | 8.482775 | 11.517225 | 8.482976 | 11.517024 | 10.000201 | 9.999799 | 30 | 2 |
| 59 | 45 | 8.483813 | 11.516187 | 8.484015 | 11.515985 | 10.000202 | 9.999798 | 15 | 1 |
| 60 | 45 | 8.484848 | 11.515152 | 8.485050 | 11.514950 | 10.000203 | 9.999797 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec |
| 5h 53m. | | | | LOG. SINES, &c. | | | | 88 deg. | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 0h 7m. | | LOG. SINES, &c. (t) | | | | 1 deg. | | |
| 0 | 45 | 8.484848 | 11.515152 | 8.485050 | 11.514950 | 10.000203 | 9.999797 | 15 | 60 |
| 1 | 15 | 8.485880 | 11.514120 | 8.486084 | 11 513916 | 10.000204 | 9.999796 | 45 | 59 |
| 2 | 30 | 8.486910 | 11.513090 | 8.487115 | 11.512885 | 10.000205 | 9.999795 | 30 | 58 |
| 3 | 45 | 8.487938 | 11.512062 | 8.488143 | 11.511857 | 10.000206 | 9.999794 | 15 | 57 |
| 4 | 46 | 8.488963 | 11.511037 | 8.489170 | 11.510830 | 10.000207 | 9.999793 | 14 | 56 |
| 5 | 15 | 8.489986 | 11.510014 | 8.490193 | 11.509807 | 10.000208 | 9.999792 | 45 | 55 |
| 6 | 30 | 8.491006 | 11.508994 | 8.491215 | 11.508785 | 10.000208 | 9.999792 | 30 | 54 |
| 7 | 45 | 8.492024 | 11.507976 | 8.492234 | 11.507766 | 10.000209 | 9.999791 | 15 | 53 |
| 8 | 47 | 8.493040 | 11.506960 | 8.493250 | 11.506750 | 10.000210 | 9.999790 | 13 | 52 |
| 9 | 15 | 8.494053 | 11.505947 | 8.494264 | 11.505736 | 10.000211 | 9.999789 | 45 | 51 |
| 10 | 30 | 8.495064 | 11.504936 | 8.495276 | 11.504724 | 10.000212 | 9.999788 | 30 | 50 |
| 11 | 45 | 8.496072 | 11.503928 | 8.496286 | 11.503714 | 10.000213 | 9.999787 | 15 | 49 |
| 12 | 48 | 8.497078 | 11.502922 | 8.497293 | 11.502707 | 10.000214 | 9.999786 | 12 | 48 |
| 13 | 15 | 8.498082 | 11.501918 | 8.498298 | 11.501702 | 10.000215 | 9.999785 | 45 | 47 |
| 14 | 30 | 8.499084 | 11.500916 | 8.499300 | 11.500700 | 10.000216 | 9.999784 | 30 | 46 |
| 15 | 45 | 8.500083 | 11.499917 | 8.500300 | 11.499700 | 10.000217 | 9.999783 | 15 | 45 |
| 16 | 49 | 8.501080 | 11.498920 | 8.501298 | 11.498702 | 10.000218 | 9.999782 | 11 | 44 |
| 17 | 15 | 8.502074 | 11.497926 | 8.502294 | 11.497706 | 10.000219 | 9.999781 | 45 | 43 |
| 18 | 30 | 8.503067 | 11.496933 | 8.503287 | 11.496713 | 10.000220 | 9.999780 | 30 | 42 |
| 19 | 45 | 8.504057 | 11.495943 | 8.504278 | 11.495722 | 10.000221 | 9.999779 | 15 | 41 |
| 20 | 50 | 8.505045 | 11.494955 | 8.505267 | 11.494733 | 10.000222 | 9.999778 | 10 | 40 |
| 21 | 15 | 8.506030 | 11.493970 | 8.506254 | 11.493746 | 10.000223 | 9.999777 | 45 | 39 |
| 22 | 30 | 8.507014 | 11.492986 | 8.507238 | 11.492762 | 10.000224 | 9.999776 | 30 | 38 |
| 23 | 45 | 8.507995 | 11.492005 | 8.508220 | 11.491780 | 10.000225 | 9.999775 | 15 | 37 |
| 24 | 51 | 8.508974 | 11.491026 | 8.509200 | 11.490800 | 10.000226 | 9.999774 | 9 | 36 |
| 25 | 15 | 8.509950 | 11.490050 | 8.510178 | 11.489822 | 10.000227 | 9.999773 | 45 | 35 |
| 26 | 30 | 8.510925 | 11.489075 | 8.511153 | 11.488847 | 10.000229 | 9.999771 | 30 | 34 |
| 27 | 45 | 8.511897 | 11.488103 | 8.512127 | 11.487873 | 10.000230 | 9.999770 | 15 | 33 |
| 28 | 52 | 8.512867 | 11.487133 | 8.513098 | 11.486902 | 10.000231 | 9.999769 | 8 | 32 |
| 29 | 15 | 8.513835 | 11.486165 | 8.514067 | 11.485933 | 10.000232 | 9.999768 | 45 | 31 |
| 30 | 30 | 8.514801 | 11.485199 | 8.515034 | 11.484966 | 10.000233 | 9.999767 | 30 | 30 |
| 31 | 45 | 8.515765 | 11.484235 | 8.515998 | 11.484002 | 10.000234 | 9.999766 | 15 | 29 |
| 32 | 53 | 8.516726 | 11.483274 | 8.516961 | 11.483039 | 10.000235 | 9.999765 | 7 | 28 |
| 33 | 15 | 8.517686 | 11.482314 | 8.517921 | 11.482079 | 10.000236 | 9.999764 | 45 | 27 |
| 34 | 30 | 8.518643 | 11.481357 | 8.518880 | 11.481120 | 10.000237 | 9.999763 | 30 | 26 |
| 35 | 45 | 8.519598 | 11.480402 | 8.519836 | 11.480164 | 10.000238 | 9.999762 | 15 | 25 |
| 36 | 54 | 8.520551 | 11.479449 | 8.520790 | 11.479210 | 10.000239 | 9.999761 | 6 | 24 |
| 37 | 15 | 8.521502 | 11.478498 | 8.521742 | 11.478258 | 10.000240 | 9.999760 | 45 | 23 |
| 38 | 30 | 8.522451 | 11.477549 | 8.522692 | 11.477308 | 10.000241 | 9.999759 | 30 | 22 |
| 39 | 45 | 8.523398 | 11.476602 | 8.523640 | 11.476360 | 10.000242 | 9.999758 | 15 | 21 |
| 40 | 55 | 8.524343 | 11.475657 | 8.524586 | 11.475414 | 10.000243 | 9.999757 | 5 | 20 |
| 41 | 15 | 8.525286 | 11.474714 | 8.525530 | 11.474470 | 10.000244 | 9.999756 | 45 | 19 |
| 42 | 30 | 8.526226 | 11.473774 | 8.526472 | 11.473528 | 10.000245 | 9.999755 | 30 | 18 |
| 43 | 45 | 8.527165 | 11.472835 | 8.527411 | 11.472589 | 10.000246 | 9.999754 | 15 | 17 |
| 44 | 56 | 8.528102 | 11.471898 | 8.528349 | 11.471651 | 10.000247 | 9.999753 | 4 | 16 |
| 45 | 15 | 8.529036 | 11.470964 | 8.529285 | 11.470715 | 10.000248 | 9.999752 | 45 | 15 |
| 46 | 30 | 8.529969 | 11.470031 | 8.530218 | 11.469782 | 10.000249 | 9.999751 | 30 | 14 |
| 47 | 45 | 8.530899 | 11.469101 | 8.531150 | 11.468850 | 10.000251 | 9.999749 | 15 | 13 |
| 48 | 57 | 8.531828 | 11.468172 | 8.532080 | 11.467920 | 10.000252 | 9.999748 | 3 | 12 |
| 49 | 15 | 8.532755 | 11.467245 | 8.533007 | 11.466993 | 10.000253 | 9.999747 | 45 | 11 |
| 50 | 30 | 8.533679 | 11.466321 | 8.533933 | 11.466067 | 10.000254 | 9.999746 | 30 | 10 |
| 51 | 45 | 8.534602 | 11.465398 | 8.534857 | 11.465143 | 10.000255 | 9.999745 | 15 | 9 |
| 52 | 58 | 8.535523 | 11.464477 | 8.535779 | 11.464221 | 10.000256 | 9.999744 | 2 | 8 |
| 53 | 15 | 8.536442 | 11.463558 | 8.536699 | 11.463301 | 10.000257 | 9.999743 | 45 | 7 |
| 54 | 30 | 8.537358 | 11.462642 | 8.537616 | 11.462384 | 10.000258 | 9.999742 | 30 | 6 |
| 55 | 45 | 8.538273 | 11.461727 | 8.538532 | 11.461468 | 10.000259 | 9.999741 | 15 | 5 |
| 56 | 59 | 8.539186 | 11.460814 | 8.539447 | 11.460553 | 10.000260 | 9.999740 | 1 | 4 |
| 57 | 15 | 8.540097 | 11.459903 | 8.540359 | 11.459641 | 10.000261 | 9.999739 | 45 | 3 |
| 58 | 30 | 8.541007 | 11.458993 | 8.541269 | 11.458731 | 10.000262 | 9.999738 | 30 | 2 |
| 59 | 45 | 8.541914 | 11.458086 | 8.542177 | 11.457823 | 10.000264 | 9.999736 | 15 | 1 |
| 60 | 60 | 8.542819 | 11.457181 | 8.543084 | 11.456916 | 10.000265 | 9.999735 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ | sec. |
| | 5h 52m. | | LOG SINES, &c. | | | | 88 deg. | | |

| 0h 8m. | | | LOG. SINES, &c. (t.) | | | 2 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 8.542819 | 11.457181 | 8.543084 | 11.456916 | 10.000265 | 9.999735 | 60 | 60 |
| 1 | 15 | 8.543723 | 11.456277 | 8.543988 | 11.456012 | 10.000266 | 9.999734 | 45 | 59 |
| 2 | 30 | 8.544624 | 11.455376 | 8.544891 | 11.455109 | 10.000267 | 9.999733 | 30 | 58 |
| 3 | 45 | 8.545524 | 11.454476 | 8.545792 | 11.454208 | 10.000268 | 9.999732 | 15 | 57 |
| 4 | 1 | 8.546422 | 11.453578 | 8.546691 | 11.453309 | 10.000269 | 9.999731 | 59 | 56 |
| 5 | 15 | 8.547318 | 11.452682 | 8.547588 | 11.452412 | 10.000270 | 9.999730 | 45 | 55 |
| 6 | 30 | 8.548212 | 11.451788 | 8.548483 | 11.451517 | 10.000271 | 9.999729 | 30 | 54 |
| 7 | 45 | 8.549104 | 11.450896 | 8.549377 | 11.450623 | 10.000272 | 9.999728 | 15 | 53 |
| 8 | 2 | 8.549995 | 11.450005 | 8.550268 | 11.449732 | 10.000274 | 9.999726 | 58 | 52 |
| 9 | 15 | 8.550883 | 11.449117 | 8.551158 | 11.448842 | 10.000275 | 9.999725 | 45 | 51 |
| 10 | 30 | 8.551770 | 11.448230 | 8.552046 | 11.447954 | 10.000276 | 9.999724 | 30 | 50 |
| 11 | 45 | 8.552655 | 11.447345 | 8.552932 | 11.447068 | 10.000277 | 9.999723 | 15 | 49 |
| 12 | 3 | 8.553539 | 11.446461 | 8.553817 | 11.446183 | 10.000278 | 9.999722 | 57 | 48 |
| 13 | 15 | 8.554420 | 11.445580 | 8.554699 | 11.445301 | 10.000279 | 9.999721 | 45 | 47 |
| 14 | 30 | 8.555300 | 11.444700 | 8.555580 | 11.444420 | 10.000280 | 9.999720 | 30 | 46 |
| 15 | 45 | 8.556177 | 11.443823 | 8.556459 | 11.443541 | 10.000281 | 9.999719 | 15 | 45 |
| 16 | 4 | 8.557054 | 11.442946 | 8.557336 | 11.442664 | 10.000283 | 9.999717 | 56 | 44 |
| 17 | 15 | 8.557928 | 11.442072 | 8.558212 | 11.441788 | 10.000284 | 9.999716 | 45 | 43 |
| 18 | 30 | 8.558800 | 11.441200 | 8.559085 | 11.440915 | 10.000285 | 9.999715 | 30 | 42 |
| 19 | 45 | 8.559671 | 11.440329 | 8.559957 | 11.440043 | 10.000286 | 9.999714 | 15 | 41 |
| 20 | 5 | 8.560540 | 11.439460 | 8.560828 | 11.439172 | 10.000287 | 9.999713 | 55 | 40 |
| 21 | 15 | 8.561408 | 11.438592 | 8.561696 | 11.438304 | 10.000288 | 9.999712 | 45 | 39 |
| 22 | 30 | 8.562273 | 11.437727 | 8.562563 | 11.437437 | 10.000290 | 9.999710 | 30 | 38 |
| 23 | 45 | 8.563137 | 11.436863 | 8.563428 | 11.436572 | 10.000291 | 9.999709 | 15 | 37 |
| 24 | 6 | 8.563999 | 11.436001 | 8.564291 | 11.435709 | 10.000292 | 9.999708 | 54 | 36 |
| 25 | 15 | 8.564860 | 11.435140 | 8.565153 | 11.434847 | 10.000293 | 9.999707 | 45 | 35 |
| 26 | 30 | 8.565719 | 11.434281 | 8.566013 | 11.433987 | 10.000294 | 9.999706 | 30 | 34 |
| 27 | 45 | 8.566576 | 11.433424 | 8.566871 | 11.433129 | 10.000295 | 9.999705 | 15 | 33 |
| 28 | 7 | 8.567431 | 11.432569 | 8.567727 | 11.432273 | 10.000296 | 9.999704 | 53 | 32 |
| 29 | 15 | 8.568285 | 11.431715 | 8.568582 | 11.431418 | 10.000298 | 9.999702 | 45 | 31 |
| 30 | 30 | 8.569137 | 11.430863 | 8.569435 | 11.430565 | 10.000299 | 9.999701 | 30 | 30 |
| 31 | 45 | 8.569987 | 11.430013 | 8.570287 | 11.429713 | 10.000300 | 9.999700 | 15 | 29 |
| 32 | 8 | 8.570836 | 11.429164 | 8.571137 | 11.428863 | 10.000301 | 9.999699 | 52 | 28 |
| 33 | 15 | 8.571683 | 11.428317 | 8.571985 | 11.428015 | 10.000302 | 9.999698 | 45 | 27 |
| 34 | 30 | 8.572528 | 11.427472 | 8.572832 | 11.427168 | 10.000304 | 9.999696 | 30 | 26 |
| 35 | 45 | 8.573372 | 11.426628 | 8.573676 | 11.426324 | 10.000305 | 9.999695 | 15 | 25 |
| 36 | 9 | 8.574214 | 11.425786 | 8.574520 | 11.425480 | 10.000306 | 9.999694 | 51 | 24 |
| 37 | 15 | 8.575054 | 11.424946 | 8.575361 | 11.424639 | 10.000307 | 9.999693 | 45 | 23 |
| 38 | 30 | 8.575893 | 11.424107 | 8.576201 | 11.423799 | 10.000308 | 9.999692 | 30 | 22 |
| 39 | 45 | 8.576730 | 11.423270 | 8.577040 | 11.422960 | 10.000309 | 9.999691 | 15 | 21 |
| 40 | 10 | 8.577566 | 11.422434 | 8.577877 | 11.422123 | 10.000311 | 9.999689 | 50 | 20 |
| 41 | 15 | 8.578400 | 11.421600 | 8.578712 | 11.421288 | 10.000312 | 9.999688 | 45 | 19 |
| 42 | 30 | 8.579232 | 11.420768 | 8.579545 | 11.420455 | 10.000313 | 9.999687 | 30 | 18 |
| 43 | 45 | 8.580063 | 11.419937 | 8.580377 | 11.419623 | 10.000314 | 9.999686 | 15 | 17 |
| 44 | 11 | 8.580892 | 11.419108 | 8.581208 | 11.418792 | 10.000315 | 9.999685 | 49 | 16 |
| 45 | 15 | 8.581720 | 11.418280 | 8.582036 | 11.417964 | 10.000317 | 9.999683 | 45 | 15 |
| 46 | 30 | 8.582546 | 11.417454 | 8.582864 | 11.417136 | 10.000318 | 9.999682 | 30 | 14 |
| 47 | 45 | 8.583370 | 11.416630 | 8.583689 | 11.416311 | 10.000319 | 9.999681 | 15 | 13 |
| 48 | 12 | 8.584193 | 11.415807 | 8.584514 | 11.415486 | 10.000320 | 9.999680 | 48 | 12 |
| 49 | 15 | 8.585015 | 11.414985 | 8.585336 | 11.414664 | 10.000321 | 9.999679 | 45 | 11 |
| 50 | 30 | 8.585834 | 11.414166 | 8.586157 | 11.413843 | 10.000323 | 9.999677 | 30 | 10 |
| 51 | 45 | 8.586653 | 11.413347 | 8.586977 | 11.413023 | 10.000324 | 9.999676 | 15 | 9 |
| 52 | 13 | 8.587469 | 11.412531 | 8.587794 | 11.412206 | 10.000325 | 9.999675 | 47 | 8 |
| 53 | 15 | 8.588285 | 11.411715 | 8.588611 | 11.411389 | 10.000326 | 9.999674 | 45 | 7 |
| 54 | 30 | 8.589098 | 11.410902 | 8.589426 | 11.410574 | 10.000328 | 9.999672 | 30 | 6 |
| 55 | 45 | 8.589910 | 11.410090 | 8.590239 | 11.409761 | 10.000329 | 9.999671 | 15 | 5 |
| 56 | 14 | 8.590721 | 11.409279 | 8.591051 | 11.408949 | 10.000330 | 9.999670 | 46 | 4 |
| 57 | 15 | 8.591530 | 11.408470 | 8.591861 | 11.408139 | 10.000331 | 9.999669 | 45 | 3 |
| 58 | 30 | 8.592338 | 11.407662 | 8.592670 | 11.407330 | 10.000333 | 9.999667 | 30 | 2 |
| 59 | 45 | 8.593144 | 11.406856 | 8.593477 | 11.406523 | 10.000334 | 9.999666 | 15 | 1 |
| 60 | 15 | 8.593948 | 11.406052 | 8.594283 | 11.405717 | 10.000335 | 9.999665 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 51m. | | | LOG. SINES, &c. | | | | | 87 deg. | |

| 0h 9m. | | | LOG. SINES, &c. (t.) | | | 2 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 8.593948 | 11.406052 | 8.594283 | 11.405717 | 10.000335 | 9.999665 | 45 | 60 |
| 1 | 15 | 8.594751 | 11.405219 | 8.595087 | 11.404913 | 10.000336 | 9.999664 | 45 | 59 |
| 2 | 30 | 8.595553 | 11.404447 | 8.595890 | 11.404110 | 10.000337 | 9.999663 | 30 | 58 |
| 3 | 45 | 8.596353 | 11.403647 | 8.596692 | 11.403308 | 10.000339 | 9.999661 | 15 | 57 |
| 4 | 16 | 8.597152 | 11.402848 | 8.597492 | 11.402508 | 10.000340 | 9.999660 | 44 | 56 |
| 5 | 15 | 8.597949 | 11.402051 | 8.598290 | 11.401710 | 10.000341 | 9.999659 | 45 | 55 |
| 6 | 30 | 8.598745 | 11.401255 | 8.599087 | 11.400913 | 10.000342 | 9.999658 | 30 | 54 |
| 7 | 45 | 8.599539 | 11.400461 | 8.599883 | 11.400117 | 10.000344 | 9.999656 | 15 | 53 |
| 8 | 17 | 8.600332 | 11.399668 | 8.600677 | 11.399323 | 10.000345 | 9 999655 | 43 | 52 |
| 9 | 15 | 8.601123 | 11.398877 | 8.601469 | 11.398531 | 10.000346 | 9.999654 | 45 | 51 |
| 10 | 30 | 8.601913 | 11.398087 | 8.602260 | 11.397740 | 10.000348 | 9.999652 | 30 | 50 |
| 11 | 45 | 8.602701 | 11.397299 | 8.603050 | 11.396950 | 10.000349 | 9.999651 | 15 | 49 |
| 12 | 18 | 8.603489 | 11.396511 | 8.603839 | 11.396161 | 10.000350 | 9.999650 | 42 | 48 |
| 13 | 15 | 8.604274 | 11.395726 | 8.604625 | 11.395374 | 10.000351 | 9.999649 | 45 | 47 |
| 14 | 30 | 8.605058 | 11.394942 | 8.605411 | 11.394589 | 10.000353 | 9.999647 | 30 | 46 |
| 15 | 45 | 8.605841 | 11.394159 | 8.606195 | 11.393805 | 10.000354 | 9.999646 | 15 | 45 |
| 16 | 19 | 8.606623 | 11.393377 | 8.606978 | 11.393022 | 10.000355 | 9.999645 | 41 | 44 |
| 17 | 15 | 8.607403 | 11.392597 | 8.607759 | 11.392241 | 10.000356 | 9.999644 | 45 | 43 |
| 18 | 30 | 8.608181 | 11.391819 | 8.608539 | 11.391461 | 10.000358 | 9.999642 | 30 | 42 |
| 19 | 45 | 8.608958 | 11.391042 | 8.609317 | 11.390683 | 10.000359 | 9.999641 | 15 | 41 |
| 20 | 20 | 8.609734 | 11.390266 | 8.610094 | 11.389906 | 10.000360 | 9.999640 | 40 | 40 |
| 21 | 15 | 8.610508 | 11.389492 | 8.610870 | 11.389130 | 10.000362 | 9.999638 | 45 | 39 |
| 22 | 30 | 8.611281 | 11.388719 | 8.611644 | 11.388356 | 10.000363 | 9.999637 | 30 | 38 |
| 23 | 45 | 8.612053 | 11.387947 | 8.612417 | 11.387583 | 10.000364 | 9.999636 | 15 | 37 |
| 24 | 21 | 8.612823 | 11.387177 | 8.613189 | 11.386811 | 10.000365 | 9.999635 | 39 | 36 |
| 25 | 15 | 8.613592 | 11.386408 | 8.613959 | 11.386041 | 10.000367 | 9.999633 | 45 | 35 |
| 26 | 30 | 8.614360 | 11.385640 | 8.614728 | 11.385272 | 10.000368 | 9.999632 | 30 | 34 |
| 27 | 45 | 8.615126 | 11.384874 | 8.615495 | 11.384505 | 10.000369 | 9.999631 | 15 | 33 |
| 28 | 22 | 8.615891 | 11.384109 | 8.616262 | 11.383738 | 10.000371 | 9.999629 | 38 | 32 |
| 29 | 15 | 8.616654 | 11.383346 | 8.617026 | 11.382974 | 10.000372 | 9.999628 | 45 | 31 |
| 30 | 30 | 8.617417 | 11.382583 | 8.617790 | 11.382210 | 10.000373 | 9.999627 | 30 | 30 |
| 31 | 45 | 8.618177 | 11.381823 | 8.618552 | 11.381448 | 10.000375 | 9.999625 | 15 | 29 |
| 32 | 23 | 8.618937 | 11.381063 | 8.619313 | 11.380687 | 10.000376 | 9.999624 | 37 | 28 |
| 33 | 15 | 8.619695 | 11.380305 | 8.620072 | 11.379928 | 10.000377 | 9.999623 | 45 | 27 |
| 34 | 30 | 8.620452 | 11.379548 | 8.620830 | 11.379170 | 10.000379 | 9.999621 | 30 | 26 |
| 35 | 45 | 8.621207 | 11.378793 | 8.621587 | 11.378413 | 10.000380 | 9.999620 | 15 | 25 |
| 36 | 24 | 8.621962 | 11.378038 | 8.622343 | 11.377657 | 10.000381 | 9.999619 | 36 | 24 |
| 37 | 15 | 8.622714 | 11.377285 | 8.623097 | 11.376903 | 10.000382 | 9.999618 | 45 | 23 |
| 38 | 30 | 8.623466 | 11.376534 | 8.623850 | 11.376150 | 10.000384 | 9.999616 | 30 | 22 |
| 39 | 45 | 8.624216 | 11.375784 | 8.624601 | 11.375399 | 10.000385 | 9.999615 | 15 | 21 |
| 40 | 25 | 8.624965 | 11.375035 | 8.625352 | 11.374648 | 10.000386 | 9.999614 | 35 | 20 |
| 41 | 15 | 8.625713 | 11.374287 | 8.626101 | 11.373899 | 10.000388 | 9.999612 | 45 | 19 |
| 42 | 30 | 8.626459 | 11.373541 | 8.626848 | 11.373152 | 10.000389 | 9.999611 | 30 | 18 |
| 43 | 45 | 8.627205 | 11.372795 | 8.627595 | 11.372405 | 10.000390 | 9.999610 | 15 | 17 |
| 44 | 26 | 8.627948 | 11.372052 | 8.628340 | 11.371660 | 10.000392 | 9.999608 | 34 | 16 |
| 45 | 15 | 8.628691 | 11.371309 | 8.629084 | 11.370916 | 10.000393 | 9.999607 | 45 | 15 |
| 46 | 30 | 8.629432 | 11.370568 | 8.629827 | 11.370173 | 10.000395 | 9.999605 | 30 | 14 |
| 47 | 45 | 8.630172 | 11.369828 | 8.630568 | 11.369432 | 10.000396 | 9.999604 | 15 | 13 |
| 48 | 27 | 8.630911 | 11.369089 | 8.631308 | 11.368692 | 10.000397 | 9.999603 | 33 | 12 |
| 49 | 15 | 8.631649 | 11.368351 | 8.632047 | 11.367953 | 10.000399 | 9.999601 | 45 | 11 |
| 50 | 30 | 8.632385 | 11.367615 | 8.632785 | 11.367215 | 10.000400 | 9.999600 | 30 | 10 |
| 51 | 45 | 8.633120 | 11.366880 | 8.633521 | 11.366479 | 10.000401 | 9.999599 | 15 | 9 |
| 52 | 28 | 8.633854 | 11.366146 | 8.634256 | 11.365744 | 10.000403 | 9.999597 | 32 | 8 |
| 53 | 15 | 8.634586 | 11.365414 | 8.634990 | 11.365010 | 10.000404 | 9.999596 | 45 | 7 |
| 54 | 30 | 8.635317 | 11.364683 | 8.635723 | 11.364277 | 10.000405 | 9.999595 | 30 | 6 |
| 55 | 45 | 8.636048 | 11.363952 | 8.636454 | 11.363546 | 10.000407 | 9.999593 | 15 | 5 |
| 56 | 29 | 8.636776 | 11.363224 | 8.637184 | 11.362816 | 10.000408 | 9.999592 | 31 | 4 |
| 57 | 15 | 8.637504 | 11.362496 | 8.637913 | 11.362087 | 10.000409 | 9.999591 | 45 | 3 |
| 58 | 30 | 8.638230 | 11.361770 | 8.638641 | 11.361359 | 10.000411 | 9.999589 | 30 | 2 |
| 59 | 45 | 8.638956 | 11.361044 | 8.639368 | 11.360632 | 10.000412 | 9.999588 | 15 | 1 |
| 60 | 30 | 8.639680 | 11 360320 | 8.640093 | 11.359907 | 10.000414 | 9.999586 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 50m. | | | | LOG. SINES, &c. | | | | 87 deg. | |

| 0h 10m. | | | LOG. SINES, &c. (t.) | | | 2 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 8.639680 | 11.360320 | 8.640093 | 11.359907 | 10.000414 | 9.999586 | 30 | 60 |
| 1 | 15 | 8.640402 | 11.359598 | 8.640817 | 11.359183 | 10.000415 | 9.999585 | 45 | 59 |
| 2 | 30 | 8.641124 | 11.358876 | 8.641540 | 11.358460 | 10.000416 | 9.999584 | 30 | 58 |
| 3 | 45 | 8.641844 | 11.358156 | 8.642262 | 11.357738 | 10.000418 | 9.999582 | 15 | 57 |
| 4 | 31 | 8.642563 | 11.357437 | 8.642982 | 11.357018 | 10.000419 | 9.999581 | 29 | 56 |
| 5 | 15 | 8.643281 | 11.356719 | 8.643702 | 11.356298 | 10.000421 | 9.999579 | 45 | 55 |
| 6 | 30 | 8.643998 | 11.356002 | 8.644420 | 11.355580 | 10.000422 | 9.999578 | 30 | 54 |
| 7 | 45 | 8.644714 | 11.355286 | 8.645137 | 11.354863 | 10.000423 | 9.999577 | 15 | 53 |
| 8 | 32 | 8.645428 | 11.354572 | 8.645853 | 11.354147 | 10.000425 | 9.999575 | 28 | 52 |
| 9 | 15 | 8.646141 | 11.353859 | 8.646567 | 11.353433 | 10.000426 | 9.999574 | 45 | 51 |
| 10 | 30 | 8.646853 | 11.353147 | 8.647281 | 11.352719 | 10.000428 | 9.999572 | 30 | 50 |
| 11 | 45 | 8.647564 | 11.352436 | 8.647993 | 11.352007 | 10.000429 | 9.999571 | 15 | 49 |
| 12 | 33 | 8.648274 | 11.351726 | 8.648704 | 11.351296 | 10.000430 | 9.999570 | 27 | 48 |
| 13 | 15 | 8.648983 | 11.351017 | 8.649414 | 11.350586 | 10.000432 | 9.999568 | 45 | 47 |
| 14 | 30 | 8.649690 | 11.350310 | 8.650123 | 11.349877 | 10.000433 | 9.999567 | 30 | 46 |
| 15 | 45 | 8.650396 | 11.349604 | 8.650831 | 11.349169 | 10.000435 | 9.999565 | 15 | 45 |
| 16 | 34 | 8.651102 | 11.348898 | 8.651537 | 11.348463 | 10.000436 | 9.999564 | 26 | 44 |
| 17 | 15 | 8.651806 | 11.348194 | 8.652243 | 11.347757 | 10.000437 | 9.999563 | 45 | 43 |
| 18 | 30 | 8.652508 | 11.347492 | 8.652947 | 11.347053 | 10.000439 | 9.999561 | 30 | 42 |
| 19 | 45 | 8.653210 | 11.346790 | 8.653650 | 11.346350 | 10.000440 | 9.999560 | 15 | 41 |
| 20 | 35 | 8.653911 | 11.346089 | 8.654352 | 11.345648 | 10.000442 | 9.999558 | 25 | 40 |
| 21 | 15 | 8.654610 | 11.345390 | 8.655053 | 11.344947 | 10.000443 | 9.999557 | 45 | 39 |
| 22 | 30 | 8.655308 | 11.344692 | 8.655753 | 11.344247 | 10.000444 | 9.999556 | 30 | 38 |
| 23 | 45 | 8.656006 | 11.343994 | 8.656451 | 11.343549 | 10.000446 | 9.999554 | 15 | 37 |
| 24 | 36 | 8.656702 | 11.343298 | 8.657149 | 11.342851 | 10.000447 | 9.999553 | 24 | 36 |
| 25 | 15 | 8.657397 | 11.342603 | 8.657845 | 11.342155 | 10.000449 | 9.999551 | 45 | 35 |
| 26 | 30 | 8.658090 | 11.341910 | 8.658541 | 11.341459 | 10.000450 | 9.999550 | 30 | 34 |
| 27 | 45 | 8.658783 | 11.341217 | 8.659235 | 11.340765 | 10.000452 | 9.999548 | 15 | 33 |
| 28 | 37 | 8.659475 | 11.340525 | 8.659928 | 11.340072 | 10.000453 | 9.999547 | 23 | 32 |
| 29 | 15 | 8.660165 | 11.339835 | 8.660620 | 11.339380 | 10.000455 | 9.999545 | 45 | 31 |
| 30 | 30 | 8.660855 | 11.339145 | 8.661311 | 11.338689 | 10.000456 | 9.999544 | 30 | 30 |
| 31 | 45 | 8.661543 | 11.338457 | 8.662000 | 11.338000 | 10.000457 | 9.999543 | 15 | 29 |
| 32 | 38 | 8.662230 | 11.337770 | 8.662689 | 11.337311 | 10.000459 | 9.999541 | 22 | 28 |
| 33 | 15 | 8.662916 | 11.337084 | 8.663377 | 11.336623 | 10.000460 | 9.999540 | 45 | 27 |
| 34 | 30 | 8.663601 | 11.336399 | 8.664063 | 11.335937 | 10.000462 | 9.999538 | 30 | 26 |
| 35 | 45 | 8.664285 | 11.335715 | 8.664749 | 11.335251 | 10.000463 | 9.999537 | 15 | 25 |
| 36 | 39 | 8.664968 | 11.335032 | 8.665433 | 11.334567 | 10.000465 | 9.999535 | 21 | 24 |
| 37 | 15 | 8.665650 | 11.334350 | 8.666116 | 11.333884 | 10.000466 | 9.999534 | 45 | 23 |
| 38 | 30 | 8.666331 | 11.333669 | 8.666799 | 11.333201 | 10.000468 | 9.999532 | 30 | 22 |
| 39 | 45 | 8.667011 | 11.332989 | 8.667480 | 11.332520 | 10.000469 | 9.999531 | 15 | 21 |
| 40 | 40 | 8.667689 | 11.332311 | 8.668160 | 11.331840 | 10.000470 | 9.999530 | 20 | 20 |
| 41 | 15 | 8.668367 | 11.331633 | 8.668839 | 11.331161 | 10.000472 | 9.999528 | 45 | 19 |
| 42 | 30 | 8.669043 | 11.330957 | 8.669517 | 11.330483 | 10.000474 | 9.999526 | 30 | 18 |
| 43 | 45 | 8.669719 | 11.330281 | 8.670194 | 11.329806 | 10.000475 | 9.999525 | 15 | 17 |
| 44 | 41 | 8.670393 | 11.329607 | 8.670870 | 11.329130 | 10.000476 | 9.999524 | 19 | 16 |
| 45 | 15 | 8.671067 | 11.328933 | 8.671544 | 11.328456 | 10.000478 | 9.999522 | 45 | 15 |
| 46 | 30 | 8.671739 | 11.328261 | 8.672218 | 11.327782 | 10.000479 | 9.999521 | 30 | 14 |
| 47 | 45 | 8.672410 | 11.327590 | 8.672891 | 11.327109 | 10.000481 | 9.999519 | 15 | 13 |
| 48 | 42 | 8.673080 | 11.326920 | 8.673563 | 11.326437 | 10.000482 | 9.999518 | 18 | 12 |
| 49 | 15 | 8.673750 | 11.326250 | 8.674233 | 11.325767 | 10.000484 | 9.999516 | 45 | 11 |
| 50 | 30 | 8.674418 | 11.325582 | 8.674903 | 11.325097 | 10.000485 | 9.999515 | 30 | 10 |
| 51 | 45 | 8.675085 | 11.324915 | 8.675572 | 11.324428 | 10.000487 | 9.999513 | 15 | 9 |
| 52 | 43 | 8.675751 | 11.324249 | 8.676239 | 11.323761 | 10.000488 | 9.999512 | 17 | 8 |
| 53 | 15 | 8.676416 | 11.323584 | 8.676906 | 11.323094 | 10.000490 | 9.999510 | 45 | 7 |
| 54 | 30 | 8.677080 | 11.322920 | 8.677571 | 11.322429 | 10.000491 | 9.999509 | 30 | 6 |
| 55 | 45 | 8.677743 | 11.322257 | 8.678236 | 11.321764 | 10.000493 | 9.999507 | 15 | 5 |
| 56 | 44 | 8.678405 | 11.321595 | 8.678900 | 11.321100 | 10.000494 | 9.999506 | 16 | 4 |
| 57 | 15 | 8.679066 | 11.320934 | 8.679562 | 11.320438 | 10.000496 | 9.999504 | 45 | 3 |
| 58 | 30 | 8.679726 | 11.320274 | 8.680224 | 11.319776 | 10.000497 | 9.999503 | 30 | 2 |
| 59 | 45 | 8.680385 | 11.319615 | 8.680884 | 11.319116 | 10.000499 | 9.999501 | 15 | 1 |
| 60 | 45 | 8.681043 | 11.318957 | 8.681544 | 11.318456 | 10.000500 | 9.999500 | 15 | 0 |
| sec | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 49m | | | LOG. SINES, &c. | | | | | 87 deg. | |

| 0h 11m. | | | LOG. SINES, &c. (t.) | | | | 2 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 8.681043 | 11.318957 | 8.681544 | 11.318456 | 10.000500 | 9.999500 | 15 | 60 |
| 1 | 15 | 8.681700 | 11.318300 | 8.682202 | 11.317798 | 10.000502 | 9.999498 | 45 | 59 |
| 2 | 30 | 8.682356 | 11.317644 | 8.682860 | 11.317140 | 10.000504 | 9.999496 | 30 | 58 |
| 3 | 45 | 8.683011 | 11.316989 | 8.683516 | 11.316484 | 10.000505 | 9.999495 | 15 | 57 |
| 4 | 46 | 8.683665 | 11.316335 | 8.684172 | 11.315828 | 10.000507 | 9.999493 | 14 | 56 |
| 5 | 15 | 8.684318 | 11.315682 | 8.684826 | 11.315174 | 10.000508 | 9.999492 | 45 | 55 |
| 6 | 30 | 8.684971 | 11.315029 | 8.685480 | 11.314520 | 10.000510 | 9.999490 | 30 | 54 |
| 7 | 45 | 8.685622 | 11.314378 | 8.686133 | 11.313867 | 10.000511 | 9.999489 | 15 | 53 |
| 8 | 47 | 8.686272 | 11.313728 | 8.686784 | 11.313216 | 10.000513 | 9.999487 | 13 | 52 |
| 9 | 15 | 8.686921 | 11.313079 | 8.687435 | 11.312565 | 10.000514 | 9.999486 | 45 | 51 |
| 10 | 30 | 8.687569 | 11.312431 | 8.688085 | 11.311915 | 10.000516 | 9.999484 | 30 | 50 |
| 11 | 45 | 8.688216 | 11.311784 | 8.688733 | 11.311267 | 10.000517 | 9.999483 | 15 | 49 |
| 12 | 48 | 8.688862 | 11.311138 | 8.689381 | 11.310619 | 10.000519 | 9.999481 | 12 | 48 |
| 13 | 15 | 8.689508 | 11.310492 | 8.690028 | 11.309972 | 10.000520 | 9.999480 | 45 | 47 |
| 14 | 30 | 8.690152 | 11.309848 | 8.690674 | 11.309326 | 10.000522 | 9.999478 | 30 | 46 |
| 15 | 45 | 8.690795 | 11.309205 | 8.691319 | 11.308681 | 10.000523 | 9.999477 | 15 | 45 |
| 16 | 49 | 8.691438 | 11.308562 | 8.691963 | 11.308037 | 10.000525 | 9.999475 | 11 | 44 |
| 17 | 15 | 8.692079 | 11.307921 | 8.692606 | 11.307394 | 10.000527 | 9.999473 | 45 | 43 |
| 18 | 30 | 8.692720 | 11.307280 | 8.693248 | 11.306752 | 10.000528 | 9.999472 | 30 | 42 |
| 19 | 45 | 8.693359 | 11.306641 | 8.693889 | 11.306111 | 10.000530 | 9.999470 | 15 | 41 |
| 20 | 50 | 8.693998 | 11.306002 | 8.694529 | 11.305471 | 10.000531 | 9.999469 | 10 | 40 |
| 21 | 15 | 8.694636 | 11.305364 | 8.695168 | 11.304832 | 10.000533 | 9.999467 | 45 | 39 |
| 22 | 30 | 8.695272 | 11.304728 | 8.695807 | 11.304193 | 10.000534 | 9.999466 | 30 | 38 |
| 23 | 45 | 8.695908 | 11.304092 | 8.696444 | 11.303556 | 10.000536 | 9.999464 | 15 | 37 |
| 24 | 51 | 8.696543 | 11.303457 | 8.697081 | 11.302919 | 10.000538 | 9.999462 | 9 | 36 |
| 25 | 15 | 8.697177 | 11.302823 | 8.697716 | 11.302284 | 10.000539 | 9.999461 | 45 | 35 |
| 26 | 30 | 8.697810 | 11.302190 | 8.698351 | 11.301649 | 10.000541 | 9.999459 | 30 | 34 |
| 27 | 45 | 8.698442 | 11.301558 | 8.698984 | 11.301016 | 10.000542 | 9.999458 | 15 | 33 |
| 28 | 52 | 8.699073 | 11.300927 | 8.699617 | 11.300383 | 10.000544 | 9.999456 | 8 | 32 |
| 29 | 15 | 8.699704 | 11.300296 | 8.700249 | 11.299751 | 10.000545 | 9.999455 | 45 | 31 |
| 30 | 30 | 8.700333 | 11.299667 | 8.700880 | 11.299120 | 10.000547 | 9.999453 | 30 | 30 |
| 31 | 45 | 8.700961 | 11.299039 | 8.701510 | 11.298490 | 10.000549 | 9.999451 | 15 | 29 |
| 32 | 53 | 8.701589 | 11.298411 | 8.702139 | 11.297861 | 10.000550 | 9.999450 | 7 | 28 |
| 33 | 15 | 8.702215 | 11.297785 | 8.702767 | 11.297233 | 10.000552 | 9.999448 | 45 | 27 |
| 34 | 30 | 8.702841 | 11.297159 | 8.703395 | 11.296605 | 10.000553 | 9.999447 | 30 | 26 |
| 35 | 45 | 8.703466 | 11.296534 | 8.704021 | 11.295979 | 10.000555 | 9.999445 | 15 | 25 |
| 36 | 54 | 8.704090 | 11.295910 | 8.704646 | 11.295354 | 10.000557 | 9.999443 | 6 | 24 |
| 37 | 15 | 8.704713 | 11.295287 | 8.705271 | 11.294729 | 10.000558 | 9.999442 | 45 | 23 |
| 38 | 30 | 8.705335 | 11.294665 | 8.705895 | 11.294105 | 10.000560 | 9.999440 | 30 | 22 |
| 39 | 45 | 8.705956 | 11.294044 | 8.706518 | 11.293482 | 10.000561 | 9.999439 | 15 | 21 |
| 40 | 55 | 8.706577 | 11.293423 | 8.707139 | 11.292861 | 10.000563 | 9.999437 | 5 | 20 |
| 41 | 15 | 8.707196 | 11.292804 | 8.707761 | 11.292239 | 10.000565 | 9.999435 | 45 | 19 |
| 42 | 30 | 8.707815 | 11.292185 | 8.708381 | 11.291619 | 10.000566 | 9.999434 | 30 | 18 |
| 43 | 45 | 8.708432 | 11.291568 | 8.709000 | 11.291000 | 10.000568 | 9.999432 | 15 | 17 |
| 44 | 56 | 8.709049 | 11.290951 | 8.709618 | 11.290382 | 10.000569 | 9.999431 | 4 | 16 |
| 45 | 15 | 8.709665 | 11.290335 | 8.710236 | 11.289764 | 10.000571 | 9.999429 | 45 | 15 |
| 46 | 30 | 8.710280 | 11.289720 | 8.710853 | 11.289147 | 10.000573 | 9.999427 | 30 | 14 |
| 47 | 45 | 8.710894 | 11.289106 | 8.711468 | 11.288532 | 10.000574 | 9.999426 | 15 | 13 |
| 48 | 57 | 8.711507 | 11.288493 | 8.712083 | 11.287917 | 10.000576 | 9.999424 | 3 | 12 |
| 49 | 15 | 8.712120 | 11.287880 | 8.712697 | 11.287303 | 10.000578 | 9.999422 | 45 | 11 |
| 50 | 30 | 8.712731 | 11.287269 | 8.713311 | 11.286689 | 10.000579 | 9.999421 | 30 | 10 |
| 51 | 45 | 8.713342 | 11.286658 | 8.713923 | 11.286077 | 10.000581 | 9.999419 | 15 | 9 |
| 52 | 58 | 8.713952 | 11.286048 | 8.714534 | 11.285466 | 10.000582 | 9.999418 | 2 | 8 |
| 53 | 15 | 8.714561 | 11.285439 | 8.715145 | 11.284855 | 10.000584 | 9.999416 | 45 | 7 |
| 54 | 30 | 8.715169 | 11.284831 | 8.715755 | 11.284245 | 10.000586 | 9.999414 | 30 | 6 |
| 55 | 45 | 8.715776 | 11.284224 | 8.716364 | 11.283636 | 10.000587 | 9.999413 | 15 | 5 |
| 56 | 59 | 8.716383 | 11.283617 | 8.716972 | 11.283028 | 10.000589 | 9.999411 | 1 | 4 |
| 57 | 15 | 8.716988 | 11.283012 | 8.717579 | 11.282421 | 10.000591 | 9.999409 | 45 | 3 |
| 58 | 30 | 8.717593 | 11.282407 | 8.718185 | 11.281815 | 10.000592 | 9.999408 | 30 | 2 |
| 59 | 45 | 8.718197 | 11.281803 | 8.718791 | 11.281209 | 10.000594 | 9.999406 | 15 | 1 |
| 60 | 60 | 8.718800 | 11.281200 | 8.719396 | 11.280604 | 10.000596 | 9.999404 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 48m. | | | LOG. SINES, &c. | | | | 87 deg. | | |

| 0h 12m. | | LOG. SINES, &c. (t.) | | | | | 3 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 8.718800 | 11.281200 | 8.719396 | 11.280604 | 10.000596 | 9.999404 | 60 | 60 |
| 1 | 15 | 8.719402 | 11.280598 | 8.720000 | 11.280000 | 10.000597 | 9.999403 | 45 | 59 |
| 2 | 30 | 8.720004 | 11.279996 | 8.720603 | 11.279397 | 10.000599 | 9.999401 | 30 | 58 |
| 3 | 45 | 8.720604 | 11.279396 | 8.721205 | 11.278795 | 10.000601 | 9.999399 | 15 | 57 |
| 4 | 1 | 8.721204 | 11.278796 | 8.721806 | 11.278194 | 10.000602 | 9.999398 | 59 | 56 |
| 5 | 15 | 8.721803 | 11.278197 | 8.722407 | 11.277593 | 10.000604 | 9.999396 | 45 | 55 |
| 6 | 30 | 8.722401 | 11.277599 | 8.723006 | 11.276994 | 10.000606 | 9.999394 | 30 | 54 |
| 7 | 45 | 8.722998 | 11.277002 | 8.723605 | 11.276395 | 10.000607 | 9.999393 | 15 | 53 |
| 8 | 2 | 8.723595 | 11.276405 | 8.724203 | 11.275797 | 10.000609 | 9.999391 | 58 | 52 |
| 9 | 15 | 8.724190 | 11.275810 | 8.724801 | 11.275199 | 10.000611 | 9.999389 | 45 | 51 |
| 10 | 30 | 8.724785 | 11.275215 | 8.725397 | 11.274603 | 10.000612 | 9.999388 | 30 | 50 |
| 11 | 45 | 8.725379 | 11.274621. | 8.725993 | 11.274007 | 10.000614 | 9.999386 | 15 | 49 |
| 12 | 3 | 8.725972 | 11.274028 | 8.726588 | 11.273412 | 10.000616 | 9.999384 | 57 | 48 |
| 13 | 15 | 8.726564 | 11.273436 | 8.727182 | 11.272818 | 10.000617 | 9.999383 | 45 | 47 |
| 14 | 30 | 8.727156 | 11.272844 | 8.727775 | 11.272225 | 10.000619 | 9.999381 | 30 | 46 |
| 15 | 45 | 8.727747 | 11.272253 | 8.728367 | 11.271633 | 10.000621 | 9.999379 | 15 | 45 |
| 16 | 4 | 8.728337 | 11.271663 | 8.728959 | 11.271041 | 10.000622 | 9.999378 | 56 | 44 |
| 17 | 15 | 8.728926 | 11.271074 | 8.729550 | 11.270450 | 10.000624 | 9.999376 | 45 | 43 |
| 18 | 30 | 8.729514 | 11.270486 | 8.730140 | 11.269860 | 10.000626 | 9.999374 | 30 | 42 |
| 19 | 45 | 8.730101 | 11.269899 | 8.730729 | 11.269271 | 10.000628 | 9.999372 | 15 | 41 |
| 20 | 5 | 8.730688 | 11.269312 | 8.731317 | 11.268683 | 10.000629 | 9.999371 | 55 | 40 |
| 21 | 15 | 8.731274 | 11.268726 | 8.731905 | 11.268095 | 10.000631 | 9.999369 | 45 | 39 |
| 22 | 30 | 8.731859 | 11.268141 | 8.732492 | 11.267508 | 10.000633 | 9.999367 | 30 | 38 |
| 23 | 45 | 8.732444 | 11.267556 | 8.733078 | 11.266922 | 10.000634 | 9.999366 | 15 | 37 |
| 24 | 6 | 8.733027 | 11.266973 | 8.733663 | 11.266337 | 10.000636 | 9.999364 | 54 | 36 |
| 25 | 15 | 8.733610 | 11.266390 | 8.734248 | 11.265752 | 10.000638 | 9.999362 | 45 | 35 |
| 26 | 30 | 8.734192 | 11.265808 | 8.734831 | 11.265169 | 10.000639 | 9.999361 | 30 | 34 |
| 27 | 45 | 8.734773 | 11.265227 | 8.735414 | 11.264586 | 10.000641 | 9.999359 | 15 | 33 |
| 28 | 7 | 8.735353 | 11.264647 | 8.735996 | 11.264004 | 10.000643 | 9.999357 | 53 | 32 |
| 29 | 15 | 8.735933 | 11.264067 | 8.736578 | 11.263422 | 10.000645 | 9.999355 | 45 | 31 |
| 30 | 30 | 8.736512 | 11.263488 | 8.737158 | 11.262842 | 10.000646 | 9.999354 | 30 | 30 |
| 31 | 45 | 8.737090 | 11.262910 | 8.737738 | 11.262262 | 10.000648 | 9.999352 | 15 | 29 |
| 32 | 8 | 8.737667 | 11.262333 | 8.738317 | 11.261683 | 10.000650 | 9.999350 | 52 | 28 |
| 33 | 15 | 8.738244 | 11.261756 | 8.738895 | 11.261105 | 10.000652 | 9.999348 | 45 | 27 |
| 34 | 30 | 8.738820 | 11.261180 | 8.739473 | 11.260527 | 10.000653 | 9.999347 | 30 | 26 |
| 35 | 45 | 8.739395 | 11.260605 | 8.740050 | 11.259950 | 10.000655 | 9.999345 | 15 | 25 |
| 36 | 9 | 8.739969 | 11.260031 | 8.740626 | 11.259374 | 10.000657 | 9.999343 | 51 | 24 |
| 37 | 15 | 8.740543 | 11.259457 | 8.741201 | 11.258799 | 10.000658 | 9.999342 | 45 | 23 |
| 38 | 30 | 8.741115 | 11.258885 | 8.741775 | 11.258225 | 10.000660 | 9.999340 | 30 | 22 |
| 39 | 45 | 8.741687 | 11.258313 | 8.742349 | 11.257651 | 10.000662 | 9.999338 | 15 | 21 |
| 40 | 10 | 8.742259 | 11.257741 | 8.742922 | 11.257078 | 10.000664 | 9.999336 | 50 | 20 |
| 41 | 15 | 8.742829 | 11.257171 | 8.743494 | 11.256506 | 10.000665 | 9.999335 | 45 | 19 |
| 42 | 30 | 8.743399 | 11.256601 | 8.744066 | 11.255934 | 10.000667 | 9.999333 | 30 | 18 |
| 43 | 45 | 8.743968 | 11.256032 | 8.744637 | 11.255363 | 10.000669 | 9.999331 | 15 | 17 |
| 44 | 11 | 8.744536 | 11.255464 | 8.745207 | 11.254793 | 10.000671 | 9.999329 | 49 | 16 |
| 45 | 15 | 8.745103 | 11.254897 | 8.745776 | 11.254224 | 10.000672 | 9.999328 | 45 | 15 |
| 46 | 30 | 8.745670 | 11.254330 | 8.746344 | 11.253656 | 10.000674 | 9.999326 | 30 | 14 |
| 47 | 45 | 8.746236 | 11.253764 | 8.746912 | 11.253088 | 10.000676 | 9.999324 | 15 | 13 |
| 48 | 12 | 8.746801 | 11.253199 | 8.747479 | 11.252521 | 10.000678 | 9.999322 | 48 | 12 |
| 49 | 15 | 8.747366 | 11.252634 | 8.748045 | 11.251955 | 10.000680 | 9.999320 | 45 | 11 |
| 50 | 30 | 8.747930 | 11.252070 | 8.748611 | 11.251389 | 10.000681 | 9.999319 | 30 | 10 |
| 51 | 45 | 8.748493 | 11.251507 | 8.749176 | 11.250824 | 10.000683 | 9.999317 | 15 | 9 |
| 52 | 13 | 8.749055 | 11.250945 | 8.749740 | 11.250260 | 10.000685 | 9.999315 | 47 | 8 |
| 53 | 15 | 8.749617 | 11.250383 | 8.750303 | 11.249697 | 10.000687 | 9.999313 | 45 | 7 |
| 54 | 30 | 8.750178 | 11.249822 | 8.750866 | 11.249134 | 10.000688 | 9.999312 | 30 | 6 |
| 55 | 45 | 8.750738 | 11.249262 | 8.751428 | 11.248572 | 10.000690 | 9.999310 | 15 | 5 |
| 56 | 14 | 8.751297 | 11.248703 | 8.751989 | 11.248011 | 10.000692 | 9.999308 | 46 | 4 |
| 57 | 15 | 8.751856 | 11.248144 | 8.752550 | 11.247450 | 10.000694 | 9.999306 | 45 | 3 |
| 58 | 30 | 8.752414 | 11.247586 | 8.753109 | 11.246891 | 10.000696 | 9.999304 | 30 | 2 |
| 59 | 45 | 8.752971 | 11.247029 | 8.753668 | 11.246332 | 10.000697 | 9.999303 | 15 | 1 |
| 60 | 15 | 8.753528 | 11.246472 | 8.754227 | 11.245773 | 10.000699 | 9.999301 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 47m | | | | LOG. SINES, &c. | | | | 86 deg. | |

| 0h 13m. | | LOG. SINES, &c. (t) | | | | | 3 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ | sec. |
| 0 | 15 | 8 753528 | 11.246472 | 8.754227 | 11.245773 | 10.000699 | 9.999301 | 45 | 60 |
| 1 | 15 | 8.754084 | 11.245916 | 8.754784 | 11.245216 | 10.000701 | 9.999299 | 45 | 59 |
| 2 | 30 | 8.754639 | 11.245361 | 8.755341 | 11.244659 | 10.000703 | 9.999297 | 30 | 58 |
| 3 | 45 | 8.755193 | 11.244807 | 8.755898 | 11.244102 | 10.000704 | 9.999296 | 15 | 57 |
| 4 | 16 | 8.755747 | 11.244253 | 8.756453 | 11.243547 | 10.000706 | 9.999294 | 44 | 56 |
| 5 | 15 | 8.756300 | 11.243700 | 8.757008 | 11.242992 | 10.000708 | 9.999292 | 45 | 55 |
| 6 | 30 | 8.756852 | 11.243148 | 8.757562 | 11.242438 | 10.000710 | 9.999290 | 30 | 54 |
| 7 | 45 | 8.757404 | 11.242596 | 8.758115 | 11.241885 | 10.000712 | 9.999288 | 15 | 53 |
| 8 | 17 | 8.757955 | 11.242045 | 8.758668 | 11.241332 | 10.000714 | 9.999286 | 43 | 52 |
| 9 | 15 | 8.758505 | 11.241495 | 8.759220 | 11.240780 | 10.000715 | 9.999285 | 45 | 51 |
| 10 | 30 | 8.759054 | 11.240946 | 8.759771 | 11.240229 | 10.000717 | 9.999283 | 30 | 50 |
| 11 | 45 | 8.759603 | 11.240397 | 8.760322 | 11.239678 | 10.000719 | 9.999281 | 15 | 49 |
| 12 | 18 | 8.760151 | 11.239849 | 8.760872 | 11.239128 | 10.000721 | 9.999279 | 42 | 48 |
| 13 | 15 | 8.760699 | 11.239301 | 8.761421 | 11.238579 | 10.000723 | 9.999277 | 45 | 47 |
| 14 | 30 | 8.761245 | 11.238755 | 8.761970 | 11.238030 | 10.000724 | 9.999276 | 30 | 46 |
| 15 | 45 | 8.761791 | 11.238209 | 8.762517 | 11.237483 | 10.000726 | 9.999274 | 15 | 45 |
| 16 | 19 | 8.762337 | 11.237663 | 8.763065 | 11.236935 | 10.000728 | 9.999272 | 41 | 44 |
| 17 | 15 | 8.762881 | 11.237119 | 8.763611 | 11.236389 | 10.000730 | 9.999270 | 45 | 43 |
| 18 | 30 | 8.763425 | 11.236575 | 8.764157 | 11.235843 | 10.000732 | 9.999268 | 30 | 42 |
| 19 | 45 | 8.763968 | 11.236032 | 8.764702 | 11.235298 | 10.000734 | 9.999266 | 15 | 41 |
| 20 | 20 | 8.764511 | 11.235489 | 8.765246 | 11.234754 | 10.000735 | 9.999265 | 40 | 40 |
| 21 | 15 | 8.765053 | 11.234947 | 8.765790 | 11.234210 | 10.000737 | 9.999263 | 45 | 39 |
| 22 | 30 | 8.765594 | 11.234406 | 8.766333 | 11.233667 | 10.000739 | 9.999261 | 30 | 38 |
| 23 | 45 | 8.766135 | 11.233865 | 8.766876 | 11.233124 | 10.000741 | 9.999259 | 15 | 37 |
| 24 | 21 | 8.766675 | 11.233325 | 8.767417 | 11.232583 | 10.000743 | 9.999257 | 39 | 36 |
| 25 | 15 | 8.767214 | 11.232786 | 8.767958 | 11.232042 | 10.000745 | 9.999255 | 45 | 35 |
| 26 | 30 | 8.767752 | 11.232248 | 8.768499 | 11.231501 | 10.000747 | 9.999253 | 30 | 34 |
| 27 | 45 | 8.768290 | 11.231710 | 8.769039 | 11.230961 | 10.000748 | 9.999252 | 15 | 33 |
| 28 | 22 | 8.768827 | 11.231173 | 8.769578 | 11.230422 | 10.000750 | 9.999250 | 38 | 32 |
| 29 | 15 | 8.769364 | 11.230636 | 8.770116 | 11.229884 | 10.000752 | 9.999248 | 45 | 31 |
| 30 | 30 | 8.769900 | 11.230100 | 8.770654 | 11.229346 | 10.000754 | 9.999246 | 30 | 30 |
| 31 | 45 | 8.770435 | 11.229565 | 8.771191 | 11.228809 | 10.000756 | 9.999244 | 15 | 29 |
| 32 | 23 | 8.770970 | 11.229030 | 8.771727 | 11.228273 | 10.000758 | 9.999242 | 37 | 28 |
| 33 | 15 | 8.771504 | 11.228496 | 8.772263 | 11.227737 | 10.000760 | 9.999240 | 45 | 27 |
| 34 | 30 | 8.772037 | 11.227963 | 8.772798 | 11.227202 | 10.000761 | 9.999239 | 30 | 26 |
| 35 | 45 | 8.772569 | 11.227431 | 8.773333 | 11.226667 | 10.000763 | 9.999237 | 15 | 25 |
| 36 | 24 | 8.773101 | 11.226899 | 8.773866 | 11.226134 | 10.000765 | 9.999235 | 36 | 24 |
| 37 | 15 | 8.773633 | 11.226367 | 8.774400 | 11.225600 | 10.000767 | 9.999233 | 45 | 23 |
| 38 | 30 | 8.774163 | 11.225837 | 8.774932 | 11.225068 | 10.000769 | 9.999231 | 30 | 22 |
| 39 | 45 | 8.774693 | 11.225307 | 8.775464 | 11.224536 | 10.000771 | 9.999229 | 15 | 21 |
| 40 | 25 | 8.775223 | 11.224777 | 8.775995 | 11.224005 | 10.000773 | 9.999227 | 35 | 20 |
| 41 | 15 | 8.775751 | 11.224249 | 8.776526 | 11.223474 | 10.000775 | 9.999225 | 45 | 19 |
| 42 | 30 | 8.776279 | 11.223721 | 8.777056 | 11.222944 | 10.000776 | 9.999224 | 30 | 18 |
| 43 | 45 | 8.776807 | 11.223193 | 8.777585 | 11.222415 | 10.000778 | 9.999222 | 15 | 17 |
| 44 | 26 | 8.777333 | 11.222667 | 8.778114 | 11.221886 | 10.000780 | 9.999220 | 34 | 16 |
| 45 | 15 | 8.777859 | 11.222141 | 8.778642 | 11.221358 | 10.000782 | 9.999218 | 45 | 15 |
| 46 | 30 | 8.778385 | 11.221615 | 8.779169 | 11.220831 | 10.000784 | 9.999216 | 30 | 14 |
| 47 | 45 | 8.778910 | 11.221090 | 8.779696 | 11.220304 | 10.000786 | 9.999214 | 15 | 13 |
| 48 | 27 | 8.779434 | 11.220566 | 8.780222 | 11.219778 | 10.000788 | 9.999212 | 33 | 12 |
| 49 | 15 | 8.779958 | 11.220042 | 8.780747 | 11.219253 | 10.000790 | 9.999210 | 45 | 11 |
| 50 | 30 | 8.780480 | 11.219520 | 8.781272 | 11.218728 | 10.000792 | 9.999208 | 30 | 10 |
| 51 | 45 | 8.781003 | 11.218997 | 8.781796 | 11.218204 | 10.000794 | 9.999206 | 15 | 9 |
| 52 | 28 | 8.781524 | 11.218476 | 8.782320 | 11.217680 | 10.000795 | 9.999205 | 32 | 8 |
| 53 | 15 | 8.782045 | 11.217955 | 8.782843 | 11.217157 | 10.000797 | 9.999203 | 45 | 7 |
| 54 | 30 | 8.782566 | 11.217434 | 8.783365 | 11.216635 | 10.000799 | 9.999201 | 30 | 6 |
| 55 | 45 | 8.783086 | 11.216914 | 8.783887 | 11.216113 | 10.000801 | 9.999199 | 15 | 5 |
| 56 | 29 | 9.783605 | 11.216395 | 8.784408 | 11.215592 | 10.000803 | 9.999197 | 31 | 4 |
| 57 | 15 | 8.784123 | 11.215877 | 8.784928 | 11.215072 | 10.000805 | 9.999195 | 45 | 3 |
| 58 | 30 | 8.784641 | 11.215359 | 8.785448 | 11.214552 | 10.000807 | 9.999193 | 30 | 2 |
| 59 | 45 | 8.785159 | 11.214841 | 8.785967 | 11.214033 | 10.000809 | 9.999191 | 15 | 1 |
| 60 | 30 | 8.785675 | 11.214325 | 8.786486 | 11.213514 | 10.000811 | 9.999189 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 46m. | | | | LOG. SINES, &c. | | | | 86 deg. | |

| 0h 14m. | | LOG. SINES, &c. (t.) | | | | | 3 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 8.785675 | 11.214325 | 8.786486 | 11.213514 | 10.000811 | 9.999189 | 30 | 60 |
| 1 | 15 | 8.786191 | 11.213809 | 8.787004 | 11.212996 | 10.000813 | 9.999187 | 45 | 59 |
| 2 | 30 | 8.786707 | 11.213293 | 8.787521 | 11.212479 | 10.000815 | 9.999185 | 30 | 58 |
| 3 | 45 | 8.787222 | 11.212778 | 8.788038 | 11.211962 | 10.000817 | 9.999183 | 15 | 57 |
| 4 | 31 | 8.787736 | 11.212264 | 8.788554 | 11.211446 | 10.000819 | 9.999181 | 29 | 56 |
| 5 | 15 | 8.788249 | 11.211751 | 8.789070 | 11.210930 | 10.000821 | 9.999179 | 45 | 55 |
| 6 | 30 | 8.788762 | 11.211238 | 8.789585 | 11.210415 | 10 000822 | 9.999178 | 30 | 54 |
| 7 | 45 | 8.789275 | 11.210725 | 8.790099 | 11.209901 | 10.000824 | 9.999176 | 15 | 53 |
| 8 | 32 | 8.789787 | 11.210213 | 8.790613 | 11.209387 | 10.000826 | 9.999174 | 28 | 52 |
| 9 | 15 | 8.790298 | 11.209702 | 8.791126 | 11.208874 | 10.000828 | 9 999172 | 45 | 51 |
| 10 | 30 | 8.790808 | 11.209192 | 8.791639 | 11.208361 | 10.000830 | 9.999170 | 30 | 50 |
| 11 | 45 | 8.791318 | 11.208682 | 8.792151 | 11.207849 | 10.000832 | 9.999168 | 15 | 49 |
| 12 | 33 | 8.791828 | 11.208172 | 8.792562 | 11.207338 | 10.000834 | 9.999166 | 27 | 48 |
| 13 | 15 | 8.792337 | 11.207663 | 8.793173 | 11.206827 | 10.000836 | 9.999164 | 45 | 47 |
| 14 | 30 | 8.792845 | 11.207155 | 8.793683 | 11.206317 | 10.000838 | 9.999162 | 30 | 46 |
| 15 | 45 | 8.793352 | 11.206648 | 8.794192 | 11.205808 | 10.000840 | 9.999160 | 15 | 45 |
| 16 | 34 | 8.793859 | 11.206141 | 8.794701 | 11.205299 | 10.000842 | 9.999158 | 26 | 44 |
| 17 | 15 | 8.794366 | 11.205634 | 8.795210 | 11.204790 | 10.000844 | 9.999156 | 45 | 43 |
| 18 | 30 | 8.794872 | 11.205128 | 8.795717 | 11.204283 | 10.000846 | 9.999154 | 30 | 42 |
| 19 | 45 | 8.795377 | 11.204623 | 8.796225 | 11.203775 | 10.000848 | 9.999152 | 15 | 41 |
| 20 | 35 | 8.795881 | 11.204119 | 8.796731 | 11.203269 | 10.000850 | 9.999150 | 25 | 40 |
| 21 | 15 | 8.796385 | 11.203615 | 8.797237 | 11.202763 | 10.000852 | 9.999148 | 45 | 39 |
| 22 | 30 | 8.796889 | 11.203111 | 8.797743 | 11.202257 | 10.000854 | 9.999146 | 30 | 38 |
| 23 | 45 | 8.797392 | 11.202608 | 8.798248 | 11.201752 | 10.000856 | 9.999144 | 15 | 37 |
| 24 | 36 | 8.797894 | 11.202106 | 8.798752 | 11.201248 | 10.000858 | 9.999142 | 24 | 36 |
| 25 | 15 | 8.798396 | 11.201604 | 8.799256 | 11.200744 | 10.000860 | 9.999140 | 45 | 35 |
| 26 | 30 | 8.798897 | 11.201103 | 8.799759 | 11.200241 | 10.000862 | 9.999138 | 30 | 34 |
| 27 | 45 | 8.799397 | 11.200603 | 8.800261 | 11.199739 | 10.000864 | 9.999136 | 15 | 33 |
| 28 | 37 | 8.799897 | 11.200103 | 8.800763 | 11.199237 | 10.000866 | 9.999134 | 23 | 32 |
| 29 | 15 | 8.800397 | 11.199603 | 8.801265 | 11.198735 | 10.000868 | 9.999132 | 45 | 31 |
| 30 | 30 | 8.800896 | 11.199104 | 8.801765 | 11.198235 | 10.000870 | 9.999130 | 30 | 30 |
| 31 | 45 | 8.801394 | 11.198606 | 8.802266 | 11.197734 | 10.000872 | 9.999128 | 15 | 29 |
| 32 | 38 | 8.801891 | 11.198109 | 8.802765 | 11.197235 | 10.000874 | 9.999126 | 22 | 28 |
| 33 | 15 | 8.802389 | 11.197611 | 8.803264 | 11.196736 | 10.000876 | 9.999124 | 45 | 27 |
| 34 | 30 | 8.802885 | 11.197115 | 8.803763 | 11.196237 | 10.000878 | 9.999122 | 30 | 26 |
| 35 | 45 | 8.803381 | 11.196619 | 8.804261 | 11.195739 | 10.000880 | 9.999120 | 15 | 25 |
| 36 | 39 | 8.803876 | 11.196124 | 8.804758 | 11.195242 | 10.000882 | 9.999118 | 21 | 24 |
| 37 | 15 | 8.804371 | 11.195629 | 8.805255 | 11.194745 | 10.000884 | 9.999116 | 45 | 23 |
| 38 | 30 | 8.804865 | 11.195135 | 8.805751 | 11.194249 | 10.000886 | 9.999114 | 30 | 22 |
| 39 | 45 | 8.805359 | 11.194641 | 8.806247 | 11.193753 | 10.000888 | 9.999112 | 15 | 21 |
| 40 | 40 | 8.805852 | 11.194148 | 8.806742 | 11.193258 | 10.000890 | 9.999110 | 20 | 20 |
| 41 | 15 | 8.806345 | 11.193655 | 8.807237 | 11.192763 | 10.000892 | 9.999108 | 45 | 19 |
| 42 | 30 | 8.806837 | 11.193163 | 8.807731 | 11.192269 | 10.000894 | 9.999106 | 30 | 18 |
| 43 | 45 | 8.807328 | 11.192672 | 8.808224 | 11.191776 | 10.000896 | 9.999104 | 15 | 17 |
| 44 | 41 | 8.807819 | 11.192181 | 8.808717 | 11.191283 | 10.000898 | 9.999102 | 19 | 16 |
| 45 | 15 | 8.808309 | 11.191691 | 8.809210 | 11.190790 | 10.000900 | 9.999100 | 45 | 15 |
| 46 | 30 | 8.808799 | 11.191201 | 8.809701 | 11.190299 | 10.000902 | 9.999098 | 30 | 14 |
| 47 | 45 | 8.809288 | 11.190712 | 8.810193 | 11.189807 | 10.000904 | 9.999096 | 15 | 13 |
| 48 | 42 | 8.809777 | 11.190223 | 8.810683 | 11.189317 | 10.000906 | 9.999094 | 18 | 12 |
| 49 | 15 | 8.810265 | 11.189735 | 8.811173 | 11.188827 | 10.000908 | 9.999092 | 45 | 11 |
| 50 | 30 | 8.810753 | 11.189247 | 8.811663 | 11.188337 | 10.000910 | 9.999090 | 30 | 10 |
| 51 | 45 | 8.811240 | 11.188760 | 8.812152 | 11.187848 | 10.000912 | 9.999088 | 15 | 9 |
| 52 | 43 | 8.811726 | 11.188274 | 8.812641 | 11.187359 | 10.000914 | 9.999086 | 17 | 8 |
| 53 | 15 | 8.812212 | 11.187788 | 8.813129 | 11.186871 | 10.000916 | 9.999084 | 45 | 7 |
| 54 | 30 | 8.812698 | 11.187302 | 8.813616 | 11.186384 | 10.000919 | 9.999081 | 30 | 6 |
| 55 | 45 | 8.813182 | 11.186818 | 8.814103 | 11.185897 | 10.000921 | 9.999079 | 15 | 5 |
| 56 | 44 | 8.813667 | 11.186333 | 8.814589 | 11.185411 | 10.000923 | 9.999077 | 16 | 4 |
| 57 | 15 | 8.814150 | 11.185850 | 8.815075 | 11.184925 | 10.000925 | 9.999075 | 45 | 3 |
| 58 | 30 | 8.814634 | 11.185366 | 8.815560 | 11.184440 | 10.000927 | 9.999073 | 30 | 2 |
| 59 | 45 | 8.815116 | 11.184884 | 8.816045 | 11.183955 | 10.000929 | 9.999071 | 15 | 1 |
| 60 | 45 | 8.815598 | 11.184402 | 8.816529 | 11.183471 | 10.000931 | 9.999069 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 45m. | | | | LOG. SINES, &c. | | | | 86 deg. | |

| 0h 15m. | | | LOG. SINES, &c. (t) | | | | 3 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ | sec. |
| 0 | 45 | 8.815598 | 11.184402 | 8.816529 | 11.183471 | 10.000931 | 9.999069 | 15 | 60 |
| 1 | 15 | 8.816080 | 11.183920 | 8.817013 | 11.182987 | 10.000933 | 9.999067 | 45 | 59 |
| 2 | 30 | 8.816561 | 11.183439 | 8.817496 | 11.182504 | 10.000935 | 9.999065 | 30 | 58 |
| 3 | 45 | 8.817042 | 11.182958 | 8.817979 | 11.182021 | 10.000937 | 9.999063 | 15 | 57 |
| 4 | 46 | 8.817522 | 11.182478 | 8.818461 | 11.181539 | 10.000939 | 9.999061 | 14 | 56 |
| 5 | 15 | 8.818001 | 11.181999 | 8.818942 | 11.181058 | 10.000941 | 9.999059 | 45 | 55 |
| 6 | 30 | 8.818480 | 11.181520 | 8.819423 | 11.180577 | 10.000943 | 9.999057 | 30 | 54 |
| 7 | 45 | 8.818958 | 11.181042 | 8.819904 | 11.180096 | 10.000945 | 9.999055 | 15 | 53 |
| 8 | 47 | 8.819436 | 11.180564 | 8.820384 | 11.179616 | 10.000948 | 9.999052 | 13 | 52 |
| 9 | 15 | 8.819914 | 11.180086 | 8.820863 | 11.179137 | 10.000950 | 9.999050 | 45 | 51 |
| 10 | 30 | 8.820390 | 11.179610 | 8.821342 | 11.178658 | 10.000952 | 9.999048 | 30 | 50 |
| 11 | 45 | 8.820867 | 11.179133 | 8.821820 | 11.178180 | 10.000954 | 9.999046 | 15 | 49 |
| 12 | 48 | 8.821342 | 11.178658 | 8.822298 | 11.177702 | 10.000956 | 9.999044 | 12 | 48 |
| 13 | 15 | 8.821818 | 11.178182 | 8.822776 | 11.177224 | 10.000958 | 9.999042 | 45 | 47 |
| 14 | 30 | 8.822292 | 11.177708 | 8.823253 | 11.176747 | 10.000960 | 9.999040 | 30 | 46 |
| 15 | 45 | 8.822767 | 11.177233 | 8.823729 | 11.176271 | 10.000962 | 9.999038 | 15 | 45 |
| 16 | 49 | 8.823240 | 11.176760 | 8.824205 | 11.175795 | 10.000964 | 9.999036 | 11 | 44 |
| 17 | 15 | 8.823713 | 11.176287 | 8.824680 | 11.175320 | 10.000966 | 9.999034 | 45 | 43 |
| 18 | 30 | 8.824186 | 11.175814 | 8.825155 | 11.174845 | 10.000969 | 9.999031 | 30 | 42 |
| 19 | 45 | 8.824658 | 11.175342 | 8.825629 | 11.174371 | 10.000971 | 9.999029 | 15 | 41 |
| 20 | 50 | 8.825130 | 11.174870 | 8.826103 | 11.173897 | 10.000973 | 9.999027 | 10 | 40 |
| 21 | 15 | 8.825601 | 11.174399 | 8.826576 | 11.173424 | 10.000975 | 9.999025 | 45 | 39 |
| 22 | 30 | 8.826072 | 11.173928 | 8.827048 | 11.172952 | 10.000977 | 9.999023 | 30 | 38 |
| 23 | 45 | 8.826542 | 11.173458 | 8.827521 | 11.172479 | 10.000979 | 9.999021 | 15 | 37 |
| 24 | 51 | 8.827011 | 11.172989 | 8.827992 | 11.172008 | 10.000981 | 9.999019 | 9 | 36 |
| 25 | 15 | 8.827480 | 11.172520 | 8.828464 | 11.171536 | 10.000983 | 9.999017 | 45 | 35 |
| 26 | 30 | 8.827949 | 11.172051 | 8.828934 | 11.171066 | 10.000986 | 9.999014 | 30 | 34 |
| 27 | 45 | 8.828417 | 11.171583 | 8.829404 | 11.170596 | 10.000988 | 9.999012 | 15 | 33 |
| 28 | 52 | 8.828884 | 11.171116 | 8.829874 | 11.170126 | 10.000990 | 9.999010 | 8 | 32 |
| 29 | 15 | 8.829351 | 11.170649 | 8.830343 | 11.169657 | 10.000992 | 9.999008 | 45 | 31 |
| 30 | 30 | 8.829818 | 11.170182 | 8.830812 | 11.169188 | 10.000994 | 9.999006 | 30 | 30 |
| 31 | 45 | 8.830284 | 11.169716 | 8.831280 | 11.168720 | 10.000996 | 9.999004 | 15 | 29 |
| 32 | 53 | 8.830749 | 11.169251 | 8.831748 | 11.168252 | 10.000998 | 9.999002 | 7 | 28 |
| 33 | 15 | 8.831214 | 11.168786 | 8.832215 | 11.167785 | 10.001000 | 9.999000 | 45 | 27 |
| 34 | 30 | 8.831679 | 11.168321 | 8.832682 | 11.167318 | 10.001003 | 9.998997 | 30 | 26 |
| 35 | 45 | 8.832143 | 11.167857 | 8.833148 | 11.166852 | 10.001005 | 9.998995 | 15 | 25 |
| 36 | 54 | 8.832607 | 11.167393 | 8.833613 | 11.166387 | 10.001007 | 9.998993 | 6 | 24 |
| 37 | 15 | 8.833070 | 11.166930 | 8.834079 | 11.165921 | 10.001009 | 9.998991 | 45 | 23 |
| 38 | 30 | 8.833532 | 11.166468 | 8.834543 | 11.165457 | 10.001011 | 9.998989 | 30 | 22 |
| 39 | 45 | 8.833994 | 11.166006 | 8.835007 | 11.164993 | 10.001013 | 9.998987 | 15 | 21 |
| 40 | 55 | 8.834456 | 11.165544 | 8.835471 | 11.164529 | 10.001016 | 9.998984 | 5 | 20 |
| 41 | 15 | 8.834917 | 11.165083 | 8.835934 | 11.164066 | 10.001018 | 9.998982 | 45 | 19 |
| 42 | 30 | 8.835377 | 11.164623 | 8.836397 | 11.163603 | 10.001020 | 9.998980 | 30 | 18 |
| 43 | 45 | 8.835837 | 11.164163 | 8.836859 | 11.163141 | 10.001022 | 9.998978 | 15 | 17 |
| 44 | 56 | 8.836297 | 11.163703 | 8.837321 | 11.162679 | 10.001024 | 9.998976 | 4 | 16 |
| 45 | 15 | 8.836756 | 11.163244 | 8.837782 | 11.162218 | 10.001026 | 9.998974 | 45 | 15 |
| 46 | 30 | 8.837215 | 11.162785 | 8.838243 | 11.161757 | 10.001029 | 9.998971 | 30 | 14 |
| 47 | 45 | 8.837673 | 11.162327 | 8.838703 | 11.161297 | 10.001031 | 9.998969 | 15 | 13 |
| 48 | 57 | 8.838130 | 11.161870 | 8.839163 | 11.160837 | 10.001033 | 9.998967 | 3 | 12 |
| 49 | 15 | 8.838587 | 11.161413 | 8.839623 | 11.160377 | 10.001035 | 9.998965 | 45 | 11 |
| 50 | 30 | 8.839044 | 11.160956 | 8.840081 | 11.159919 | 10.001037 | 9.998963 | 30 | 10 |
| 51 | 45 | 8.839500 | 11.160500 | 8.840540 | 11.159460 | 10.001039 | 9.998961 | 15 | 9 |
| 52 | 58 | 8.839956 | 11.160044 | 8.840998 | 11.159002 | 10.001042 | 9.998958 | 2 | 8 |
| 53 | 15 | 8.840411 | 11.159589 | 8.841455 | 11.158545 | 10.001044 | 9.998956 | 45 | 7 |
| 54 | 30 | 8.840866 | 11.159134 | 8.841912 | 11.158088 | 10.001046 | 9.998954 | 30 | 6 |
| 55 | 45 | 8.841320 | 11.158680 | 8.842368 | 11.157632 | 10.001048 | 9.998952 | 15 | 5 |
| 56 | 59 | 8.841774 | 11.158226 | 8.842824 | 11.157176 | 10.001050 | 9.998950 | 1 | 4 |
| 57 | 15 | 8.842227 | 11.157773 | 8.843280 | 11.156720 | 10.001053 | 9.998947 | 45 | 3 |
| 58 | 30 | 8.842680 | 11.157320 | 8.843735 | 11.156265 | 10.001055 | 9.998945 | 30 | 2 |
| 59 | 45 | 8.843133 | 11.156867 | 8.844190 | 11.155810 | 10.001057 | 9.998943 | 15 | 1 |
| 60 | 60 | 8.843584 | 11.156416 | 8.844644 | 11.155356 | 10.001059 | 9.998941 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 44m. | | | LOG SINES, &c. | | | | 86 deg. | | |

| 0h 16m. | | | LOG. SINES, &c. (t.) | | | | 4 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 8.843584 | 11.156416 | 8.844644 | 11.155356 | 10.001059 | 9.998941 | 60 | 60 |
| 1 | 15 | 8.844036 | 11.155964 | 8.845097 | 11.154903 | 10.001061 | 9.998939 | 45 | 59 |
| 2 | 30 | 8.844487 | 11.155513 | 8.845550 | 11.154450 | 10.001064 | 9.998936 | 30 | 58 |
| 3 | 45 | 8.844937 | 11. 55063 | 8.846003 | 11.153997 | 10.001066 | 9.998934 | 15 | 57 |
| 4 | 1 | 8.845387 | 11. .54613 | 8.846455 | 11.153545 | 10.001068 | 9.998932 | 59 | 56 |
| 5 | 15 | 8.845837 | 11.154163 | 8.846907 | 11.153093 | 10.001070 | 9.998930 | 45 | 55 |
| 6 | 30 | 8.846286 | 11.153714 | 8.847358 | 11.152642 | 10.001073 | 9.998927 | 30 | 54 |
| 7 | 45 | 8.846735 | 11.153265 | 8.847809 | 11.152191 | 10.001075 | 9.998925 | 15 | 53 |
| 8 | 2 | 8.847183 | 11.152817 | 8.848260 | 11.151740 | 10.001077 | 9.998923 | 58 | 52 |
| 9 | 15 | 8.847630 | 11.152370 | 8.848710 | 11.151290 | 10.001079 | 9.998921 | 45 | 51 |
| 10 | 30 | 8.848078 | 11.151922 | 8.849159 | 11.150841 | 10.001081 | 9.998919 | 30 | 50 |
| 11 | 45 | 8.848524 | 11.151476 | 8.849608 | 11.150392 | 10.001084 | 9.998916 | 15 | 49 |
| 12 | 3 | 8.848971 | 11.151029 | 8.850057 | 11.149943 | 10.001086 | 9.998914 | 57 | 48 |
| 13 | 15 | 8.849416 | 11.150584 | 8.850505 | 11.149495 | 10.001088 | 9.998912 | 45 | 47 |
| 14 | 30 | 8.849862 | 11.150138 | 8.850952 | 11.149048 | 10.001090 | 9.998910 | 30 | 46 |
| 15 | 45 | 8.850307 | 11.149693 | 8.851399 | 11.148601 | 10.001093 | 9.998907 | 15 | 45 |
| 16 | 4 | 8.850751 | 11.149249 | 8.851846 | 11.148154 | 10.001095 | 9.998905 | 56 | 44 |
| 17 | 15 | 8.851195 | 11.148805 | 8.852292 | 11.147708 | 10.001097 | 9.998903 | 45 | 43 |
| 18 | 30 | 8.851639 | 11.148361 | 8.852738 | 11.147262 | 10.001099 | 9.998901 | 30 | 42 |
| 19 | 45 | 8.852082 | 11.147918 | 8.853183 | 11.146817 | 10.001102 | 9.998898 | 15 | 41 |
| 20 | 5 | 8.852524 | 11.147476 | 8.853628 | 11.146372 | 10.001104 | 9.998896 | 55 | 40 |
| 21 | 15 | 8.852967 | 11.147033 | 8.854073 | 11.145927 | 10.001106 | 9.998894 | 45 | 39 |
| 22 | 30 | 8.853408 | 11.146592 | 8.854517 | 11.145483 | 10.001108 | 9.998892 | 30 | 38 |
| 23 | 45 | 8.853850 | 11.146150 | 8.854960 | 11.145040 | 10.001111 | 9.998889 | 15 | 37 |
| 24 | 6 | 8.854290 | 11.145710 | 8.855403 | 11.144597 | 10.001113 | 9.998887 | 54 | 36 |
| 25 | 15 | 8.854731 | 11.145269 | 8.855846 | 11.144154 | 10.001115 | 9.998885 | 45 | 35 |
| 26 | 30 | 8.855171 | 11.144829 | 8.856288 | 11.143712 | 10.001117 | 9.998883 | 30 | 34 |
| 27 | 45 | 8.855610 | 11.144390 | 8.856730 | 11.143270 | 10.001120 | 9.998880 | 15 | 33 |
| 28 | 7 | 8.856049 | 11.143951 | 8.857171 | 11.142829 | 10.001122 | 9.998878 | 53 | 32 |
| 29 | 15 | 8.856488 | 11.143512 | 8.857612 | 11.142388 | 10.001124 | 9.998876 | 45 | 31 |
| 30 | 30 | 8.856926 | 11.143074 | 8.858053 | 11.141947 | 10.001127 | 9.998873 | 30 | 30 |
| 31 | 45 | 8.857364 | 11.142636 | 8.858493 | 11.141507 | 10.001129 | 9.998871 | 15 | 29 |
| 32 | 8 | 8.857801 | 11.142199 | 8.858932 | 11.141068 | 10.001131 | 9.998869 | 52 | 28 |
| 33 | 15 | 8.858238 | 11.141762 | 8.859371 | 11.140629 | 10.001133 | 9.998867 | 45 | 27 |
| 34 | 30 | 8.858674 | 11.141326 | 8.859810 | 11.140190 | 10.001136 | 9.998864 | 30 | 26 |
| 35 | 45 | 8.859110 | 11.140890 | 8.860248 | 11.139752 | 10.001138 | 9.998862 | 15 | 25 |
| 36 | 9 | 8.859546 | 11.140454 | 8.860686 | 11.139314 | 10.001140 | 9.998860 | 51 | 24 |
| 37 | 15 | 8.859981 | 11.140019 | 8.861123 | 11.138877 | 10.001143 | 9.998857 | 45 | 23 |
| 38 | 30 | 8.860415 | 11.139585 | 8.861560 | 11.138440 | 10.001145 | 9.998855 | 30 | 22 |
| 39 | 45 | 8.860849 | 11.139151 | 8.861997 | 11.138003 | 10.001147 | 9.998853 | 15 | 21 |
| 40 | 10 | 8.861283 | 11.138717 | 8.862433 | 11.137567 | 10.001149 | 9.998851 | 50 | 20 |
| 41 | 15 | 8.861717 | 11.138283 | 8.862868 | 11.137132 | 10.001152 | 9.998848 | 45 | 19 |
| 42 | 30 | 8.862149 | 11.137851 | 8.863303 | 11.136697 | 10.001154 | 9.998846 | 30 | 18 |
| 43 | 45 | 8.862582 | 11.137418 | 8.863738 | 11.136262 | 10.001156 | 9.998844 | 15 | 17 |
| 44 | 11 | 8.863014 | 11.136986 | 8.864172 | 11.135828 | 10.001159 | 9.998841 | 49 | 16 |
| 45 | 15 | 8.863445 | 11.136555 | 8.864606 | 11.135394 | 10.001161 | 9.998839 | 45 | 15 |
| 46 | 30 | 8.863877 | 11.136123 | 8.865040 | 11.134960 | 10.001163 | 9.998837 | 30 | 14 |
| 47 | 45 | 8.864307 | 11.135693 | 8.865473 | 11.134527 | 10.001166 | 9.998834 | 15 | 13 |
| 48 | 12 | 8.864738 | 11.135262 | 8.865905 | 11.134095 | 10.001168 | 9.998832 | 48 | 12 |
| 49 | 15 | 8.865167 | 11.134833 | 8.866338 | 11.133662 | 10.001170 | 9.998830 | 45 | 11 |
| 50 | 30 | 8.865597 | 11.134403 | 8.866769 | 11.133231 | 10.001173 | 9.998827 | 30 | 10 |
| 51 | 45 | 8.866026 | 11.133974 | 8.867201 | 11.132799 | 10.001175 | 9.998825 | 15 | 9 |
| 52 | 13 | 8.866454 | 11.133546 | 8.867632 | 11.132368 | 10.001177 | 9.998823 | 47 | 8 |
| 53 | 15 | 8.866883 | 11.133117 | 8.868062 | 11.131938 | 10.001180 | 9.998820 | 45 | 7 |
| 54 | 30 | 8.867310 | 11.132690 | 8.868492 | 11.131508 | 10.001182 | 9.998818 | 30 | 6 |
| 55 | 45 | 8.867738 | 11.132262 | 8.868922 | 11.131078 | 10.001184 | 9.998816 | 15 | 5 |
| 56 | 14 | 8.868165 | 11.131835 | 8.869351 | 11.130649 | 10.001187 | 9.998813 | 46 | 4 |
| 57 | 15 | 8.868591 | 11.131409 | 8.869780 | 11.130220 | 10.001189 | 9.998811 | 45 | 3 |
| 58 | 30 | 8.869017 | 11.130983 | 8.870208 | 11.129792 | 10.001191 | 9.998809 | 30 | 2 |
| 59 | 45 | 8.869443 | 11.130557 | 8.870636 | 11.129364 | 10.001194 | 9.998806 | 15 | 1 |
| 60 | 15 | 8.869868 | 11.130132 | 8.871064 | 11.128936 | 10.001196 | 9.998804 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 43m. | | | LOG. SINES, &c. | | | | 85 deg. | | |

| 0h 17m. | | | LOG. SINES, &c. (t.) | | | | 4 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 8.869868 | 11.130132 | 8.871064 | 11.128936 | 10.001196 | 9.998804 | 45 | 60 |
| 1 | 15 | 8.870293 | 11.129707 | 8.871491 | 11.128509 | 10.001198 | 9.998802 | 45 | 59 |
| 2 | 30 | 8.870717 | 11.129283 | 8.871918 | 11.128082 | 10.001201 | 9.998799 | 30 | 58 |
| 3 | 45 | 8.871141 | 11.128859 | 8.872344 | 11.127656 | 10.001203 | 9.998797 | 15 | 57 |
| 4 | 16 | 8.871565 | 11.128435 | 8.872770 | 11.127230 | 10.001205 | 9.998795 | 44 | 56 |
| 5 | 15 | 8.871988 | 11.128012 | 8.873195 | 11.126805 | 10.001208 | 9.998792 | 45 | 55 |
| 6 | 30 | 8.872410 | 11.127590 | 8.873620 | 11.126380 | 10.001210 | 9.998790 | 30 | 54 |
| 7 | 45 | 8.872833 | 11.127167 | 8.874045 | 11.125955 | 10.001212 | 9.998788 | 15 | 53 |
| 8 | 17 | 8.873255 | 11.126745 | 8.874469 | 11.125531 | 10.001215 | 9.998785 | 43 | 52 |
| 9 | 15 | 8.873676 | 11.126324 | 8.874893 | 11.125107 | 10.001217 | 9.998783 | 45 | 51 |
| 10 | 30 | 8.874097 | 11.125903 | 8.875317 | 11.124683 | 10.001220 | 9.998780 | 30 | 50 |
| 11 | 45 | 8.874518 | 11.125482 | 8.875740 | 11.124260 | 10.001222 | 9.998778 | 15 | 49 |
| 12 | 18 | 8.874938 | 11.125062 | 8.876162 | 11.123838 | 10.001224 | 9.998776 | 42 | 48 |
| 13 | 15 | 8.875358 | 11.124642 | 8.876584 | 11.123416 | 10.001227 | 9.998773 | 45 | 47 |
| 14 | 30 | 8.875777 | 11.124223 | 8.877006 | 11.122994 | 10.001229 | 9.998771 | 30 | 46 |
| 15 | 45 | 8.876196 | 11.123804 | 8.877428 | 11.122572 | 10.001231 | 9.998769 | 15 | 45 |
| 16 | 19 | 8.876615 | 11 123385 | 8.877849 | 11.122151 | 10.001234 | 9.998766 | 41 | 44 |
| 17 | 15 | 8.877033 | 11.122967 | 8.878269 | 11.121731 | 10.001236 | 9.998764 | 45 | 43 |
| 18 | 30 | 8.877451 | 11.122549 | 8.878689 | 11.121311 | 10.001239 | 9.998761 | 30 | 42 |
| 19 | 45 | 8.877868 | 11.122132 | 8.879109 | 11.120891 | 10.001241 | 9.998759 | 15 | 41 |
| 20 | 20 | 8.878285 | 11.121715 | 8.879529 | 11.120471 | 10.001243 | 9.998757 | 40 | 40 |
| 21 | 15 | 8.878702 | 11.121298 | 8.879948 | 11.120052 | 10.001246 | 9.998754 | 45 | 39 |
| 22 | 30 | 8.879118 | 11.120882 | 8.880366 | 11.119634 | 10.001248 | 9.998752 | 30 | 38 |
| 23 | 45 | 8.879534 | 11.120466 | 8.880784 | 11.119216 | 10.001251 | 9.998749 | 15 | 37 |
| 24 | 21 | 8.879949 | 11.120051 | 8.881202 | 11.118798 | 10.001253 | 9.998747 | 39 | 36 |
| 25 | 15 | 8.880364 | 11.119636 | 8.881620 | 11.118380 | 10.001255 | 9.998745 | 45 | 35 |
| 26 | 30 | 8.880779 | 11.119221 | 8.882037 | 11.117963 | 10.001258 | 9.998742 | 30 | 34 |
| 27 | 45 | 8.881193 | 11.118807 | 8.882453 | 11.117547 | 10.001260 | 9.998740 | 15 | 33 |
| 28 | 22 | 8.881607 | 11.118393 | 8.882869 | 11.117131 | 10.001263 | 9.998737 | 38 | 32 |
| 29 | 15 | 8.882020 | 11.117980 | 8.883285 | 11.116715 | 10.001265 | 9.998735 | 45 | 31 |
| 30 | 30 | 8.882433 | 11.117567 | 8.883701 | 11.116299 | 10.001267 | 9.998733 | 30 | 30 |
| 31 | 45 | 8.882846 | 11.117154 | 8.884116 | 11.115884 | 10.001270 | 9.998730 | 15 | 29 |
| 32 | 23 | 8.883258 | 11.116742 | 8.884530 | 11.115470 | 10.001272 | 9.998728 | 37 | 28 |
| 33 | 15 | 8.883670 | 11.116330 | 8.884945 | 11.115055 | 10.001275 | 9.998725 | 45 | 27 |
| 34 | 30 | 8.884081 | 11.115919 | 8.885358 | 11.114642 | 10.001277 | 9.998723 | 30 | 26 |
| 35 | 45 | 8.884492 | 11.115508 | 8.885772 | 11.114228 | 10.001279 | 9.998721 | 15 | 25 |
| 36 | 24 | 8.884903 | 11.115097 | 8.886185 | 11.113815 | 10.001282 | 9.998718 | 36 | 24 |
| 37 | 15 | 8.885313 | 11.114687 | 8.886598 | 11.113402 | 10.001284 | 9.998716 | 45 | 23 |
| 38 | 30 | 8.885723 | 11.114277 | 8.887010 | 11.112990 | 10.001287 | 9.998713 | 30 | 22 |
| 39 | 45 | 8.886133 | 11.113867 | 8.887422 | 11.112578 | 10.001289 | 9.998711 | 15 | 21 |
| 40 | 25 | 8.886542 | 11.113458 | 8.887833 | 11.112167 | 10.001292 | 9.998708 | 35 | 20 |
| 41 | 15 | 8.886950 | 11.113050 | 8.888244 | 11.111756 | 10.001294 | 9.998706 | 45 | 19 |
| 42 | 30 | 8.887359 | 11.112641 | 8.888655 | 11.111345 | 10.001297 | 9.998703 | 30 | 18 |
| 43 | 45 | 8.887767 | 11.112233 | 8.889066 | 11.110934 | 10.001299 | 9.998701 | 15 | 17 |
| 44 | 26 | 8.888174 | 11.111826 | 8.889476 | 11.110524 | 10.001301 | 9.998699 | 34 | 16 |
| 45 | 15 | 8.888581 | 11.111419 | 8.889885 | 11.110115 | 10.001304 | 9.998696 | 45 | 15 |
| 46 | 30 | 8.888988 | 11.111012 | 8.890294 | 11.109706 | 10.001306 | 9.998694 | 30 | 14 |
| 47 | 45 | 8.889395 | 11.110605 | 8.890703 | 11.109297 | 10.001309 | 9.998691 | 15 | 13 |
| 48 | 27 | 8.889801 | 11.110199 | 8.891112 | 11.108888 | 10.001311 | 9.998689 | 33 | 12 |
| 49 | 15 | 8.890206 | 11.109794 | 8.891520 | 11.108480 | 10.001314 | 9.998686 | 45 | 11 |
| 50 | 30 | 8.890612 | 11.109388 | 8.891928 | 11.108072 | 10.001316 | 9.998684 | 30 | 10 |
| 51 | 45 | 8.891016 | 11.108984 | 8.892335 | 11.107665 | 10.001319 | 9.998681 | 15 | 9 |
| 52 | 28 | 8.891421 | 11.108579 | 8.892742 | 11.107258 | 10.001321 | 9.998679 | 32 | 8 |
| 53 | 15 | 8.891825 | 11.108175 | 8.893148 | 11.106852 | 10.001324 | 9.998676 | 45 | 7 |
| 54 | 30 | 8.892229 | 11.107771 | 8.893555 | 11.106445 | 10.001326 | 9.998674 | 30 | 6 |
| 55 | 45 | 8.892632 | 11.107368 | 8.893961 | 11.106039 | 10.001329 | 9.998671 | 15 | 5 |
| 56 | 29 | 8.893035 | 11.106965 | 8.894366 | 11.105634 | 10.001331 | 9.998669 | 31 | 4 |
| 57 | 15 | 8.893438 | 11.106562 | 8.894771 | 11.105229 | 10.001333 | 9.998667 | 45 | 3 |
| 58 | 30 | 8.893840 | 11.106160 | 8.895176 | 11.104824 | 10.001336 | 9.998664 | 30 | 2 |
| 59 | 45 | 8.894242 | 11.105758 | 8.895580 | 11.104420 | 10.001338 | 9.998662 | 15 | 1 |
| 60 | 30 | 8.894643 | 11.105357 | 8.895984 | 11.104016 | 10.001341 | 9.998659 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 42m. | | | LOG. SINES, &c. | | | | 85 deg. | | |

| 0h 18m. | | LOG. SINES, &c. (t.) | | | | | 4 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| ″. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 8.894643 | 11.105357 | 8.895984 | 11.104016 | 10.001341 | 9.998659 | 30 | 60 |
| 1 | 15 | 8.895044 | 11.104956 | 8.896388 | 11.103612 | 10.001343 | 9.998657 | 45 | 59 |
| 2 | 30 | 8.895445 | 11.104555 | 8.896791 | 11.103209 | 10.001346 | 9.998654 | 30 | 58 |
| 3 | 45 | 8.895845 | 11.104155 | 8.897194 | 11.102806 | 10.001348 | 9.998652 | 15 | 57 |
| 4 | 31 | 8.896245 | 11.103755 | 8.897596 | 11.102404 | 10.001351 | 9.998649 | 29 | 56 |
| 5 | 15 | 8.896645 | 11.103355 | 8.897998 | 11.102002 | 10.001353 | 9.998647 | 45 | 55 |
| 6 | 30 | 8.897044 | 11.102956 | 8.898400 | 11.101600 | 10.001356 | 9.998644 | 30 | 54 |
| 7 | 45 | 8.897443 | 11.102557 | 8.898802 | 11.101198 | 10.001358 | 9.998642 | 15 | 53 |
| 8 | 32 | 8.897842 | 11.102158 | 8.899203 | 11.100797 | 10.001361 | 9.998639 | 28 | 52 |
| 9 | 15 | 8.898240 | 11.101760 | 8.899603 | 11.100397 | 10.001363 | 9.998637 | 45 | 51 |
| 10 | 30 | 8.898638 | 11.101362 | 8.900004 | 11.099996 | 10.001366 | 9.998634 | 30 | 50 |
| 11 | 45 | 8.899035 | 11.100965 | 8.900403 | 11.099597 | 10.001368 | 9.998632 | 15 | 49 |
| 12 | 33 | 8.899432 | 11.100568 | 8.900803 | 11.099197 | 10.001371 | 9.998629 | 27 | 48 |
| 13 | 15 | 8.899829 | 11.100171 | 8.901202 | 11.098798 | 10.001373 | 9.998627 | 45 | 47 |
| 14 | 30 | 8.900225 | 11.099775 | 8.901601 | 11.098399 | 10.001376 | 9.998624 | 30 | 46 |
| 15 | 45 | 8.900621 | 11.099379 | 8.902000 | 11.098000 | 10.001378 | 9.998622 | 15 | 45 |
| 16 | 34 | 8.901017 | 11.098983 | 8.902398 | 11.097602 | 10.001381 | 9.998619 | 26 | 44 |
| 17 | 15 | 8.901412 | 11.098588 | 8.902795 | 11.097205 | 10.001383 | 9.998617 | 45 | 43 |
| 18 | 30 | 8.901807 | 11.098193 | 8.903193 | 11.096807 | 10.001386 | 9.998614 | 30 | 42 |
| 19 | 45 | 8.902201 | 11.097799 | 8.903590 | 11.096410 | 10.001389 | 9.998611 | 15 | 41 |
| 20 | 35 | 8.902595 | 11.097405 | 8.903987 | 11.096013 | 10.001391 | 9.998609 | 25 | 40 |
| 21 | 15 | 8.902989 | 11.097011 | 8.904383 | 11.095617 | 10.001394 | 9.998606 | 45 | 39 |
| 22 | 30 | 8.903383 | 11.096617 | 8.904779 | 11.095221 | 10.001396 | 9.998604 | 30 | 38 |
| 23 | 45 | 8.903776 | 11.096224 | 8.905174 | 11.094826 | 10.001399 | 9.998601 | 15 | 37 |
| 24 | 36 | 8.904168 | 11.095832 | 8.905570 | 11.094430 | 10.001401 | 9.998599 | 24 | 36 |
| 25 | 15 | 8.904561 | 11.095439 | 8.905965 | 11.094035 | 10.001404 | 9.998596 | 45 | 35 |
| 26 | 30 | 8.904953 | 11.095047 | 8.906359 | 11.093641 | 10.001406 | 9.998594 | 30 | 34 |
| 27 | 45 | 8.905345 | 11.094655 | 8.906753 | 11.093247 | 10.001409 | 9.998591 | 15 | 33 |
| 28 | 37 | 8.905736 | 11.094264 | 8.907147 | 11.092853 | 10.001411 | 9.998589 | 23 | 32 |
| 29 | 15 | 8.906127 | 11.093873 | 8.907541 | 11.092459 | 10.001414 | 9.998586 | 45 | 31 |
| 30 | 30 | 8.906517 | 11.093483 | 8.907934 | 11.092066 | 10.001417 | 9.998583 | 30 | 30 |
| 31 | 45 | 8.906908 | 11.093092 | 8.908327 | 11.091673 | 10.001419 | 9.998581 | 15 | 29 |
| 32 | 38 | 8.907297 | 11.092703 | 8.908719 | 11.091281 | 10.001422 | 9.998578 | 22 | 28 |
| 33 | 15 | 8.907687 | 11.092313 | 8.909111 | 11.090889 | 10.001424 | 9.998576 | 45 | 27 |
| 34 | 30 | 8.908076 | 11.091924 | 8.909503 | 11.090497 | 10.001427 | 9.998573 | 30 | 26 |
| 35 | 45 | 8.908465 | 11.091535 | 8.909894 | 11.090106 | 10.001429 | 9.998571 | 15 | 25 |
| 36 | 39 | 8.908853 | 11.091147 | 8.910285 | 11.089715 | 10.001432 | 9.998568 | 21 | 24 |
| 37 | 15 | 8.909242 | 11.090758 | 8.910676 | 11.089324 | 10.001434 | 9.998566 | 45 | 23 |
| 38 | 30 | 8.909629 | 11.090371 | 8.911066 | 11.088934 | 10.001437 | 9.998563 | 30 | 22 |
| 39 | 45 | 8.910017 | 11.089983 | 8.911456 | 11.088544 | 10.001440 | 9.998560 | 15 | 21 |
| 40 | 40 | 8.910404 | 11.089596 | 8.911846 | 11.088154 | 10.001442 | 9.998558 | 20 | 20 |
| 41 | 15 | 8.910791 | 11.089209 | 8.912235 | 11.087765 | 10.001445 | 9.998555 | 45 | 19 |
| 42 | 30 | 8.911177 | 11.088823 | 8.912624 | 11.087376 | 10.001447 | 9.998553 | 30 | 18 |
| 43 | 45 | 8.911563 | 11.088437 | 8.913013 | 11.086987 | 10.001450 | 9.998550 | 15 | 17 |
| 44 | 41 | 8.911949 | 11.088051 | 8.913401 | 11.086599 | 10.001453 | 9.998547 | 19 | 16 |
| 45 | 15 | 8.912334 | 11.087666 | 8.913789 | 11.086211 | 10.001455 | 9.998545 | 45 | 15 |
| 46 | 30 | 8.912719 | 11.087281 | 8.914177 | 11.085823 | 10.001458 | 9.998542 | 30 | 14 |
| 47 | 45 | 8.913104 | 11.086896 | 8.914564 | 11.085436 | 10.001460 | 9.998540 | 15 | 13 |
| 48 | 42 | 8.913488 | 11.086512 | 8.914951 | 11.085049 | 10.001463 | 9.998537 | 18 | 12 |
| 49 | 15 | 8.913872 | 11.086128 | 8.915337 | 11.084663 | 10.001465 | 9.998535 | 45 | 11 |
| 50 | 30 | 8.914256 | 11.085744 | 8.915724 | 11.084276 | 10.001468 | 9.998532 | 30 | 10 |
| 51 | 45 | 8.914639 | 11.085361 | 8.916110 | 11.083890 | 10.001471 | 9.998529 | 15 | 9 |
| 52 | 43 | 8.915022 | 11.084978 | 8.916495 | 11.083505 | 10.001473 | 9.998527 | 17 | 8 |
| 53 | 15 | 8.915404 | 11.084596 | 8.916880 | 11.083120 | 10.001476 | 9.998524 | 45 | 7 |
| 54 | 30 | 8.915787 | 11.084213 | 8.917265 | 11.082735 | 10.001478 | 9.998522 | 30 | 6 |
| 55 | 45 | 8.916169 | 11.083831 | 8.917650 | 11.082350 | 10.001481 | 9.998519 | 15 | 5 |
| 56 | 44 | 8.916550 | 11.083450 | 8.918034 | 11.081966 | 10.001484 | 9.998516 | 16 | 4 |
| 57 | 15 | 8.916932 | 11.083068 | 8.918418 | 11.081582 | 10.001486 | 9.998514 | 45 | 3 |
| 58 | 30 | 8.917312 | 11.0826 8 | 8.918801 | 11.081199 | 10.001489 | 9.998511 | 30 | 2 |
| 59 | 45 | 8.917693 | 11.082307 | 8.919185 | 11.080815 | 10.001492 | 9.998508 | 15 | 1 |
| 60 | 45 | 8.918073 | 11.081927 | 8.919567 | 11.080433 | 10.001494 | 9.998506 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | co-secant. | sine. | ″ ′ | sec. |
| 5h 41m. | | | LOG. SINES, &c. | | | | | 85 deg. | |

| 0h 19m. | | LOG. SINES, &c. (t.) | | | | | 4 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 8.918073 | 11.081927 | 8.919567 | 11.080433 | 10.001494 | 9.998506 | 15 | 60 |
| 1 | 15 | 8.918453 | 11.081547 | 8.919950 | 11.080050 | 10.001497 | 9.998503 | 45 | 59 |
| 2 | 30 | 8.918833 | 11.081167 | 8.920332 | 11.079668 | 10.001499 | 9.998501 | 30 | 58 |
| 3 | 45 | 8.919212 | 11.080788 | 8.920714 | 11.079286 | 10.001502 | 9.998498 | 15 | 57 |
| 4 | 46 | 8.919591 | 11.080409 | 8.921096 | 11.078904 | 10.001505 | 9.998495 | 14 | 56 |
| 5 | 15 | 8.919970 | 11.080030 | 8.921477 | 11.078523 | 10.001507 | 9.998493 | 45 | 55 |
| 6 | 30 | 8.920348 | 11.079652 | 8.921858 | 11.078142 | 10.001510 | 9.998490 | 30 | 54 |
| 7 | 45 | 8.920726 | 11.079274 | 8.922238 | 11.077762 | 10.001513 | 9.998487 | 15 | 53 |
| 8 | 47 | 8.921103 | 11.078897 | 8.922619 | 11.077381 | 10.001515 | 9.998485 | 13 | 52 |
| 9 | 15 | 8.921481 | 11.078519 | 8.922998 | 11.077002 | 10.001518 | 9.998482 | 45 | 51 |
| 10 | 30 | 8.921858 | 11.078142 | 8.923378 | 11.076622 | 10.001521 | 9.998479 | 30 | 50 |
| 11 | 45 | 8.922234 | 11.077766 | 8.923757 | 11.076243 | 10.001523 | 9.998477 | 15 | 49 |
| 12 | 48 | 8.922610 | 11.077390 | 8.924136 | 11.075864 | 10.001526 | 9.998474 | 12 | 48 |
| 13 | 15 | 8.922986 | 11.077014 | 8.924515 | 11.075485 | 10.001529 | 9.998471 | 45 | 47 |
| 14 | 30 | 8.923362 | 11.076638 | 8.924893 | 11.075107 | 10.001531 | 9.998469 | 30 | 46 |
| 15 | 45 | 8.923737 | 11.076263 | 8.925271 | 11.074729 | 10.001534 | 9.998466 | 15 | 45 |
| 16 | 49 | 8.924112 | 11.075888 | 8.925649 | 11.074351 | 10.001536 | 9.998464 | 11 | 44 |
| 17 | 15 | 8.924487 | 11.075513 | 8.926026 | 11.073974 | 10.001539 | 9.998461 | 45 | 43 |
| 18 | 30 | 8.924861 | 11.075139 | 8.926403 | 11.073597 | 10.001542 | 9.998458 | 30 | 42 |
| 19 | 45 | 8.925235 | 11.074765 | 8.926780 | 11.073220 | 10.001544 | 9.998456 | 15 | 41 |
| 20 | 50 | 8.925609 | 11.074391 | 8.927156 | 11.072844 | 10.001547 | 9.998453 | 10 | 40 |
| 21 | 15 | 8.925982 | 11.074018 | 8.927532 | 11.072468 | 10.001550 | 9.998450 | 45 | 39 |
| 22 | 30 | 8.926355 | 11.073645 | 8.927908 | 11.072092 | 10.001552 | 9.998448 | 30 | 38 |
| 23 | 45 | 8.926728 | 11.073272 | 8.928283 | 11.071717 | 10.001555 | 9.998445 | 15 | 37 |
| 24 | 51 | 8.927100 | 11.072900 | 8.928658 | 11.071342 | 10.001558 | 9.998442 | 9 | 36 |
| 25 | 15 | 8.927472 | 11.072528 | 8.929033 | 11.070967 | 10.001561 | 9.998439 | 45 | 35 |
| 26 | 30 | 8.927844 | 11.072156 | 8.929407 | 11.070593 | 10.001563 | 9.998437 | 30 | 34 |
| 27 | 45 | 8.928215 | 11.071785 | 8.929781 | 11.070219 | 10.001566 | 9.998434 | 15 | 33 |
| 28 | 52 | 8.928587 | 11.071413 | 8.930155 | 11.069845 | 10.001569 | 9.998431 | 8 | 32 |
| 29 | 15 | 8.928957 | 11.071043 | 8.930529 | 11.069471 | 10.001571 | 9.998429 | 45 | 31 |
| 30 | 30 | 8.929328 | 11.070672 | 8.930902 | 11.069098 | 10.001574 | 9.998426 | 30 | 30 |
| 31 | 45 | 8.929698 | 11.070302 | 8.931275 | 11.068725 | 10.001577 | 9.998423 | 15 | 29 |
| 32 | 53 | 8.930068 | 11.069932 | 8.931647 | 11.068353 | 10.001579 | 9.998421 | 7 | 28 |
| 33 | 15 | 8.930437 | 11.069563 | 8.932019 | 11.067981 | 10.001582 | 9.998418 | 45 | 27 |
| 34 | 30 | 8.930806 | 11.069194 | 8.932391 | 11.067609 | 10.001585 | 9.998415 | 30 | 26 |
| 35 | 45 | 8.931175 | 11.068825 | 8.932763 | 11.067237 | 10.001587 | 9.998413 | 15 | 25 |
| 36 | 54 | 8.931544 | 11.068456 | 8.933134 | 11.066866 | 10.001590 | 9.998410 | 6 | 24 |
| 37 | 15 | 8.931912 | 11.068088 | 8.933505 | 11.066495 | 10.001593 | 9.998407 | 45 | 23 |
| 38 | 30 | 8.932280 | 11.067720 | 8.933876 | 11.066124 | 10.001596 | 9.998404 | 30 | 22 |
| 39 | 45 | 8.932648 | 11.067352 | 8.934246 | 11.065754 | 10.001598 | 9.998402 | 15 | 21 |
| 40 | 55 | 8.933015 | 11.066985 | 8.934616 | 11.065384 | 10.001601 | 9.998399 | 5 | 20 |
| 41 | 15 | 8.933382 | 11.066618 | 8.934986 | 11.065014 | 10.001604 | 9.998396 | 45 | 19 |
| 42 | 30 | 8.933749 | 11.066251 | 8.935355 | 11.064645 | 10.001606 | 9.998394 | 30 | 18 |
| 43 | 45 | 8.934115 | 11.065885 | 8.935724 | 11.064276 | 10.001609 | 9.998391 | 15 | 17 |
| 44 | 56 | 8.934481 | 11.065519 | 8.936093 | 11.063907 | 10.001612 | 9.998388 | 4 | 16 |
| 45 | 15 | 8.934847 | 11.065153 | 8.936461 | 11.063539 | 10.001615 | 9.998385 | 45 | 15 |
| 46 | 30 | 8.935212 | 11.064788 | 8.936830 | 11.063170 | 10.001617 | 9.998383 | 30 | 14 |
| 47 | 45 | 8.935577 | 11.064423 | 8.937197 | 11.062803 | 10.001620 | 9.998380 | 15 | 13 |
| 48 | 57 | 8.935942 | 11.064058 | 8.937565 | 11.062435 | 10.001623 | 9.998377 | 3 | 12 |
| 49 | 15 | 8.936307 | 11.063693 | 8.937932 | 11.062068 | 10.001626 | 9.998374 | 45 | 11 |
| 50 | 30 | 8.936671 | 11.063329 | 8.938299 | 11.061701 | 10.001628 | 9.998372 | 30 | 10 |
| 51 | 45 | 8.937035 | 11.062965 | 8.938666 | 11.061334 | 10.001631 | 9.998369 | 15 | 9 |
| 52 | 58 | 8.937398 | 11.062602 | 8.939032 | 11.060968 | 10.001634 | 9.998366 | 2 | 8 |
| 53 | 15 | 8.937762 | 11.062238 | 8.939398 | 11.060602 | 10.001637 | 9.998363 | 45 | 7 |
| 54 | 30 | 8.938125 | 11.061875 | 8.939764 | 11.060236 | 10.001639 | 9.998361 | 30 | 6 |
| 55 | 45 | 8.938487 | 11.061513 | 8.940129 | 11.059871 | 10.001642 | 9.998358 | 15 | 5 |
| 56 | 59 | 8.938850 | 11.061150 | 8.940494 | 11.059506 | 10.001645 | 9.998355 | 1 | 4 |
| 57 | 15 | 8.939212 | 11.060788 | 8.940859 | 11.059141 | 10.001648 | 9.998352 | 45 | 3 |
| 58 | 30 | 8.939573 | 11.060427 | 8.941224 | 11.058776 | 10.001650 | 9.998350 | 30 | 2 |
| 59 | 45 | 8.939935 | 11.060065 | 8.941588 | 11.058412 | 10.001653 | 9.998347 | 15 | 1 |
| 60 | 60 | 8.940296 | 11.059704 | 8.941952 | 11.058048 | 10.001656 | 9.998344 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 40m. | | | LOG. SINES, &c. | | | | 85 deg. | | |

| 0h 20m. | | LOG. SINES, &c. (t.) | | | | | | 5 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 8.940296 | 11.059704 | 8.941952 | 11.058048 | 10.001656 | 9.998344 | 60 | 60 |
| 1 | 15 | 8.940657 | 11.059343 | 8.942315 | 11.057685 | 10.001659 | 9.998341 | 45 | 59 |
| 2 | 30 | 8.941017 | 11.058983 | 8.942679 | 11.057321 | 10.001661 | 9.998339 | 30 | 58 |
| 3 | 45 | 8.941378 | 11.058622 | 8.943042 | 11.056958 | 10.001664 | 9.998336 | 15 | 57 |
| 4 | 1 | 8.941738 | 11.058262 | 8.943404 | 11.056596 | 10.001667 | 9.998333 | 59 | 56 |
| 5 | 15 | 8.942097 | 11.057903 | 8.943767 | 11.056233 | 10.001670 | 9.998330 | 45 | 55 |
| 6 | 30 | 8.942456 | 11.057544 | 8.944129 | 11.055871 | 10.001672 | 9.998328 | 30 | 54 |
| 7 | 45 | 8.942816 | 11.057184 | 8.944491 | 11.055509 | 10.001675 | 9.998325 | 15 | 53 |
| 8 | 2 | 8.943174 | 11.056826 | 8.944852 | 11.055148 | 10.001678 | 9.998322 | 58 | 52 |
| 9 | 15 | 8.943533 | 11.056467 | 8.945213 | 11.054787 | 10.001681 | 9.998319 | 45 | 51 |
| 10 | 30 | 8.943891 | 11 056109 | 8.945574 | 11.054426 | 10.001684 | 9.998316 | 30 | 50 |
| 11 | 45 | 8.944249 | 11.055751 | 8.945935 | 11.054065 | 10.001686 | 9.998314 | 15 | 49 |
| 12 | 3 | 8.944606 | 11.055394 | 8.946295 | 11.053705 | 10.001689 | 9.998311 | 57 | 48 |
| 13 | 15 | 8.944963 | 11.055037 | 8.946655 | 11.053345 | 10.001692 | 9.998308 | 45 | 47 |
| 14 | 30 | 8.945320 | 11.054680 | 8.947015 | 11.052985 | 10.001695 | 9.998305 | 30 | 46 |
| 15 | 45 | 8.945677 | 11.054323 | 8.947375 | 11.052625 | 10.001698 | 9.998302 | 15 | 45 |
| 16 | 4 | 8.946033 | 11.053967 | 8.947734 | 11.052266 | 10.001700 | 9.998300 | 56 | 44 |
| 17 | 15 | 8.946390 | 11.053610 | 8.948093 | 11.051907 | 10.001703 | 9.998297 | 45 | 43 |
| 18 | 30 | 8.946745 | 11.053255 | 8.948451 | 11.051549 | 10.001706 | 9.998294 | 30 | 42 |
| 19 | 45 | 8.947101 | 11.052899 | 8.948810 | 11.051190 | 10.001709 | 9.998291 | 15 | 41 |
| 20 | 5 | 8.947456 | 11.052544 | 8.949168 | 11.050832 | 10.001712 | 9.998288 | 55 | 40 |
| 21 | 15 | 8.947811 | 11.052189 | 8.949525 | 11.050475 | 10.001714 | 9.998286 | 45 | 39 |
| 22 | 30 | 8.948166 | 11.051834 | 8.949883 | 11.050117 | 10.001717 | 9.998283 | 30 | 38 |
| 23 | 45 | 8.948520 | 11.051480 | 8.950240 | 11.049760 | 10.001720 | 9.998280 | 15 | 37 |
| 24 | 6 | 8.948874 | 11.051126 | 8.950597 | 11.049403 | 10.001723 | 9.998277 | 54 | 36 |
| 25 | 15 | 8.949228 | 11.050772 | 8.950953 | 11.049047 | 10.001726 | 9.998274 | 45 | 35 |
| 26 | 30 | 8.949581 | 11.050419 | 8.951309 | 11.048691 | 10.001728 | 9.998272 | 30 | 34 |
| 27 | 45 | 8.949934 | 11.050066 | 8.951665 | 11.048335 | 10.001731 | 9.998269 | 15 | 33 |
| 28 | 7 | 8.950287 | 11.049713 | 8.952021 | 11.047979 | 10.001734 | 9.998266 | 53 | 32 |
| 29 | 15 | 8.950640 | 11.049360 | 8.952376 | 11.047624 | 10.001737 | 9.998263 | 45 | 31 |
| 30 | 30 | 8.950992 | 11.049008 | 8.952732 | 11.047268 | 10.001740 | 9.998260 | 30 | 30 |
| 31 | 45 | 8.951344 | 11.048656 | 8.953086 | 11.046914 | 10.001743 | 9.998257 | 15 | 29 |
| 32 | 8 | 8.951696 | 11.048304 | 8.953441 | 11.046559 | 10.001745 | 9.998255 | 52 | 28 |
| 33 | 15 | 8.952047 | 11.047953 | 8.953795 | 11.046205 | 10.001748 | 9.998252 | 45 | 27 |
| 34 | 30 | 8.952398 | 11.047602 | 8.954149 | 11.045851 | 10.001751 | 9.998249 | 30 | 26 |
| 35 | 45 | 8.952749 | 11.047251 | 8.954503 | 11.045497 | 10.001754 | 9.998246 | 15 | 25 |
| 36 | 9 | 8.953100 | 11.046900 | 8.954856 | 11.045144 | 10.001757 | 9.998243 | 51 | 24 |
| 37 | 15 | 8.953450 | 11.046550 | 8.955209 | 11.044791 | 10.001760 | 9.998240 | 45 | 23 |
| 38 | 30 | 8.953800 | 11.046200 | 8.955562 | 11.044438 | 10.001762 | 9.998238 | 30 | 22 |
| 39 | 45 | 8.954150 | 11.045850 | 8.955915 | 11.044085 | 10.001765 | 9.998235 | 15 | 21 |
| 40 | 10 | 8.954499 | 11.045501 | 8.956267 | 11.043733 | 10.001768 | 9.998232 | 50 | 20 |
| 41 | 15 | 8.954848 | 11.045152 | 8.956619 | 11.043381 | 10.001771 | 9.998229 | 45 | 19 |
| 42 | 30 | 8.955197 | 11.044803 | 8.956971 | 11.043029 | 10.001774 | 9.998226 | 30 | 18 |
| 43 | 45 | 8.955546 | 11.044454 | 8.957322 | 11.042678 | 10.001777 | 9.998223 | 15 | 17 |
| 44 | 11 | 8.955894 | 11.044106 | 8.957673 | 11.042327 | 10.001780 | 9.998220 | 49 | 16 |
| 45 | 15 | 8.956242 | 11.043758 | 8.958024 | 11.041976 | 10.001783 | 9.998217 | 45 | 15 |
| 46 | 30 | 8.956590 | 11.043410 | 8.958375 | 11.041625 | 10.001785 | 9.998215 | 30 | 14 |
| 47 | 45 | 8.956937 | 11.043063 | 8.958725 | 11.041275 | 10.001788 | 9.998212 | 15 | 13 |
| 48 | 12 | 8.957284 | 11.042716 | 8.959075 | 11.040925 | 10.001791 | 9.998209 | 48 | 12 |
| 49 | 15 | 8.957631 | 11.042369 | 8.959425 | 11.040575 | 10.001794 | 9.998206 | 45 | 11 |
| 50 | 30 | 8.957978 | 11.042022 | 8.959775 | 11.040225 | 10.001797 | 9.998203 | 30 | 10 |
| 51 | 45 | 8.958324 | 11.041676 | 8.960124 | 11.039876 | 10.001800 | 9.998200 | 15 | 9 |
| 52 | 13 | 8.958670 | 11.041330 | 8.960473 | 11.039527 | 10.001803 | 9.998197 | 47 | 8 |
| 53 | 15 | 8.959016 | 11.040984 | 8.960821 | 11.039179 | 10.001806 | 9.998194 | 45 | 7 |
| 54 | 30 | 8.959361 | 11.040639 | 8.961170 | 11.038830 | 10.001808 | 9.998192 | 30 | 6 |
| 55 | 45 | 8.959707 | 11.040293 | 8.961518 | 11.038482 | 10.001811 | 9.998189 | 15 | 5 |
| 56 | 14 | 8.960052 | 11.039948 | 8.961866 | 11.038134 | 10.001814 | 9.998186 | 46 | 4 |
| 57 | 15 | 8.960396 | 11.039604 | 8.962213 | 11.037787 | 10.001817 | 9.998183 | 45 | 3 |
| 58 | 30 | 8.960741 | 11.039259 | 8.962561 | 11.037439 | 10.001820 | 9.998180 | 30 | 2 |
| 59 | 45 | 8.961085 | 11.038915 | 8.962908 | 11.037092 | 10.001823 | 9.998177 | 15 | 1 |
| 60 | 15 | 8.961429 | 11.038571 | 8.963254 | 11.036746 | 10.001826 | 9.998174 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 39m. | | | | LOG. SINES, &c. | | | | 84 deg. | |

| 0h 21m. | | LOG. SINES, &c. (t) | | | | | 5 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 8.961429 | 11.038571 | 8.963254 | 11.036746 | 10.001826 | 9.998174 | 45 | 60 |
| 1 | 15 | 8.961772 | 11.038228 | 8.963601 | 11.036399 | 10.001829 | 9.998171 | 45 | 59 |
| 2 | 30 | 8.962116 | 11.037884 | 8.963947 | 11.036053 | 10.001832 | 9.998168 | 30 | 58 |
| 3 | 45 | 8.962459 | 11.037541 | 8.964293 | 11.035707 | 10.001834 | 9.998166 | 15 | 57 |
| 4 | 16 | 8.962801 | 11.037199 | 8.964639 | 11.035361 | 10.001837 | 9.998163 | 44 | 56 |
| 5 | 15 | 8.963144 | 11.036856 | 8.964984 | 11.035016 | 10.001840 | 9.998160 | 45 | 55 |
| 6 | 30 | 8.963486 | 11.036514 | 8.965329 | 11.034671 | 10.001843 | 9.998157 | 30 | 54 |
| 7 | 45 | 8.963828 | 11.036172 | 8.965674 | 11.034326 | 10.001846 | 9.998154 | 15 | 53 |
| 8 | 17 | 8.964170 | 11.035830 | 8.966019 | 11.033981 | 10.001849 | 9.998151 | 43 | 52 |
| 9 | 15 | 8.964511 | 11.035489 | 8.966363 | 11.033637 | 10.001852 | 9.998148 | 45 | 51 |
| 10 | 30 | 8.964852 | 11.035148 | 8.966707 | 11.033293 | 10.001855 | 9.998145 | 30 | 50 |
| 11 | 45 | 8.965193 | 11.034807 | 8.967051 | 11.032949 | 10.001858 | 9.998142 | 15 | 49 |
| 12 | 18 | 8.965534 | 11.034466 | 8.967394 | 11.032606 | 10.001861 | 9.998139 | 42 | 48 |
| 13 | 15 | 8.965874 | 11.034126 | 8.967738 | 11.032262 | 10.001864 | 9.998136 | 45 | 47 |
| 14 | 30 | 8.966214 | 11.033786 | 8.968081 | 11.031919 | 10.001867 | 9.998133 | 30 | 46 |
| 15 | 45 | 8.966554 | 11.033446 | 8.968423 | 11.031577 | 10.001870 | 9.998130 | 15 | 45 |
| 16 | 19 | 8.966893 | 11.033107 | 8.968766 | 11.031234 | 10.001873 | 9.998127 | 41 | 44 |
| 17 | 15 | 8.967233 | 11.032767 | 8.969108 | 11.030892 | 10.001875 | 9.998125 | 45 | 43 |
| 18 | 30 | 8.967572 | 11.032428 | 8.969450 | 11.030550 | 10.001878 | 9.998122 | 30 | 42 |
| 19 | 45 | 8.967910 | 11.032090 | 8.969792 | 11.030208 | 10.001881 | 9.998119 | 15 | 41 |
| 20 | 20 | 8.968249 | 11.031751 | 8.970133 | 11.029867 | 10.001884 | 9.998116 | 40 | 40 |
| 21 | 15 | 8.968587 | 11.031413 | 8.970474 | 11.029526 | 10.001887 | 9.998113 | 45 | 39 |
| 22 | 30 | 8.968925 | 11.031075 | 8.970815 | 11.029185 | 10.001890 | 9.998110 | 30 | 38 |
| 23 | 45 | 8.969262 | 11.030738 | 8.971156 | 11.028844 | 10.001893 | 9.998107 | 15 | 37 |
| 24 | 21 | 8.969600 | 11.030400 | 8.971496 | 11.028504 | 10.001896 | 9.998104 | 39 | 36 |
| 25 | 15 | 8.969937 | 11.030063 | 8.971836 | 11.028164 | 10.001899 | 9.998101 | 45 | 35 |
| 26 | 30 | 8.970274 | 11.029726 | 8.972176 | 11.027824 | 10.001902 | 9.998098 | 30 | 34 |
| 27 | 45 | 8.970610 | 11.029390 | 8.972515 | 11.027485 | 10.001905 | 9.998095 | 15 | 33 |
| 28 | 22 | 8.970947 | 11.029053 | 8.972855 | 11.027145 | 10.001908 | 9.998092 | 38 | 32 |
| 29 | 15 | 8.971283 | 11.028717 | 8.973194 | 11.026806 | 10.001911 | 9.998089 | 45 | 31 |
| 30 | 30 | 8.971619 | 11.028381 | 8.973532 | 11.026468 | 10.001914 | 9.998086 | 30 | 30 |
| 31 | 45 | 8.971954 | 11.028046 | 8.973871 | 11.026129 | 10.001917 | 9.998083 | 15 | 29 |
| 32 | 23 | 8.972289 | 11.027711 | 8.974209 | 11.025791 | 10.001920 | 9.998080 | 37 | 28 |
| 33 | 15 | 8.972624 | 11.027376 | 8.974547 | 11.025453 | 10.001923 | 9.998077 | 45 | 27 |
| 34 | 30 | 8.972959 | 11.027041 | 8.974885 | 11.025115 | 10.001926 | 9.998074 | 30 | 26 |
| 35 | 45 | 8.973294 | 11.026706 | 8.975222 | 11.024778 | 10.001929 | 9.998071 | 15 | 25 |
| 36 | 24 | 8.973628 | 11.026372 | 8.975560 | 11.024440 | 10.001932 | 9.998068 | 36 | 24 |
| 37 | 15 | 8.973962 | 11.026038 | 8.975897 | 11.024103 | 10.001935 | 9.998065 | 45 | 23 |
| 38 | 30 | 8.974296 | 11.025704 | 8.976233 | 11.023767 | 10.001938 | 9.998062 | 30 | 22 |
| 39 | 45 | 8.974629 | 11.025371 | 8.976570 | 11.023430 | 10.001941 | 9.998059 | 15 | 21 |
| 40 | 25 | 8.974962 | 11.025038 | 8.976906 | 11.023094 | 10.001944 | 9.998056 | 35 | 20 |
| 41 | 15 | 8.975295 | 11.024705 | 8.977242 | 11.022758 | 10.001947 | 9.998053 | 45 | 19 |
| 42 | 30 | 8.975628 | 11.024372 | 8.977578 | 11.022422 | 10.001950 | 9.998050 | 30 | 18 |
| 43 | 45 | 8.975960 | 11.024040 | 8.977913 | 11.022087 | 10.001953 | 9.998047 | 15 | 17 |
| 44 | 26 | 8.976293 | 11.023707 | 8.978248 | 11.021752 | 10.001956 | 9.998044 | 34 | 16 |
| 45 | 15 | 8.976624 | 11.023376 | 8.978583 | 11.021417 | 10.001959 | 9.998041 | 45 | 15 |
| 46 | 30 | 8.976956 | 11.023044 | 8.978918 | 11.021082 | 10.001962 | 9.998038 | 30 | 14 |
| 47 | 45 | 8.977288 | 11.022712 | 8.979252 | 11.020748 | 10.001965 | 9.998035 | 15 | 13 |
| 48 | 27 | 8.977619 | 11.022381 | 8.979586 | 11.020414 | 10.001968 | 9.998032 | 33 | 12 |
| 49 | 15 | 8.977950 | 11.022050 | 8.979920 | 11.020080 | 10.001971 | 9.998029 | 45 | 11 |
| 50 | 30 | 8.978280 | 11.021720 | 8.980254 | 11.019746 | 10.001974 | 9.998026 | 30 | 10 |
| 51 | 45 | 8.978611 | 11.021389 | 8.980587 | 11.019413 | 10.001977 | 9.998023 | 15 | 9 |
| 52 | 28 | 8.978941 | 11.021059 | 8.980921 | 11.019079 | 10.001980 | 9.998020 | 32 | 8 |
| 53 | 15 | 8.979271 | 11.020729 | 8.981253 | 11.018747 | 10.001983 | 9.998017 | 45 | 7 |
| 54 | 30 | 8.979600 | 11.020400 | 8.981586 | 11.018414 | 10.001986 | 9.998014 | 30 | 6 |
| 55 | 45 | 8.979930 | 11.020070 | 8.981919 | 11.018081 | 10.001989 | 9.998011 | 15 | 5 |
| 56 | 29 | 8.980259 | 11.019741 | 8.982251 | 11.017749 | 10.001992 | 9.998008 | 31 | 4 |
| 57 | 15 | 8.980588 | 11.019412 | 8.982583 | 11.017417 | 10.001995 | 9.998005 | 45 | 3 |
| 58 | 30 | 8.980916 | 11.019084 | 8.982914 | 11.017086 | 10.001998 | 9.998002 | 30 | 2 |
| 59 | 45 | 8.981245 | 11.018755 | 8.983246 | 11.016754 | 10.002001 | 9.997999 | 15 | 1 |
| 60 | 30 | 8.981573 | 11.018427 | 8.983577 | 11.016423 | 10.002004 | 9.997996 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 38m. | | | | LOG. SINES, &c. | | | | 84 deg. | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $0^h\ 22^m$. | | LOG. SINES, &c. (t.) | | | | | 5 deg. | |
| 0 | 30 | 8.981573 | 11.018427 | 8.983577 | 11.016423 | 10.002004 | 9.997996 | 30 | 60 |
| 1 | 15 | 8.981901 | 11.018099 | 8.983908 | 11.016092 | 10.002007 | 9.997993 | 45 | 59 |
| 2 | 30 | 8.982228 | 11.017772 | 8.984238 | 11.015762 | 10.002010 | 9.997990 | 30 | 58 |
| 3 | 45 | 8.982556 | 11.017444 | 8.984569 | 11.015431 | 10.002013 | 9.997987 | 15 | 57 |
| 4 | 31 | 8.982883 | 11.017117 | 8.984899 | 11.015101 | 10.002016 | 9.997984 | 29 | 56 |
| 5 | 15 | 8.983210 | 11.016790 | 8.985229 | 11.014771 | 10.002019 | 9.997981 | 45 | 55 |
| 6 | 30 | 8.983536 | 11.016464 | 8.985559 | 11.014441 | 10.002022 | 9.997978 | 30 | 54 |
| 7 | 45 | 8.983863 | 11.016137 | 8.985888 | 11.014112 | 10.002025 | 9.997975 | 15 | 53 |
| 8 | 32 | 8.984189 | 11.015811 | 8.986217 | 11.013783 | 10.002028 | 9.997972 | 28 | 52 |
| 9 | 15 | 8.984515 | 11.015485 | 8.986546 | 11.013454 | 10.002032 | 9.997968 | 45 | 51 |
| 10 | 30 | 8.984840 | 11.015160 | 8.986875 | 11.013125 | 10.002035 | 9.997965 | 30 | 50 |
| 11 | 45 | 8.985166 | 11.014834 | 8.987203 | 11.012797 | 10.002038 | 9.997962 | 15 | 49 |
| 12 | 33 | 8.985491 | 11.014509 | 8.987532 | 11.012468 | 10.002041 | 9.997959 | 27 | 48 |
| 13 | 15 | 8.985816 | 11.014184 | 8.987860 | 11.012140 | 10.002044 | 9.997956 | 45 | 47 |
| 14 | 30 | 8.986140 | 11.013860 | 8.988187 | 11.011813 | 10.002047 | 9.997953 | 30 | 46 |
| 15 | 45 | 8.986465 | 11.013535 | 8.988515 | 11.011485 | 10.002050 | 9.997950 | 15 | 45 |
| 16 | 34 | 8.986789 | 11.013211 | 8.988842 | 11.011158 | 10.002053 | 9.997947 | 26 | 44 |
| 17 | 15 | 8.987113 | 11.012887 | 8.989169 | 11.010831 | 10.002056 | 9.997944 | 45 | 43 |
| 18 | 30 | 8.987437 | 11.012563 | 8.989496 | 11.010504 | 10.002059 | 9.997941 | 30 | 42 |
| 19 | 45 | 8.987760 | 11.012240 | 8.989822 | 11.010178 | 10.002062 | 9.997938 | 15 | 41 |
| 20 | 35 | 8.988083 | 11.011917 | 8.990149 | 11.009851 | 10.002065 | 9.997935 | 25 | 40 |
| 21 | 15 | 8.988406 | 11.011594 | 8.990475 | 11.009525 | 10.002068 | 9.997932 | 45 | 39 |
| 22 | 30 | 8.988729 | 11.011271 | 8.990800 | 11.009200 | 10.002072 | 9.997928 | 30 | 38 |
| 23 | 45 | 8.989051 | 11.010949 | 8.991126 | 11.008874 | 10.002075 | 9.997925 | 15 | 37 |
| 24 | 36 | 8.989374 | 11.010626 | 8.991451 | 11.008549 | 10.002078 | 9.997922 | 24 | 36 |
| 25 | 15 | 8.989696 | 11.010304 | 8.991776 | 11.008224 | 10.002081 | 9.997919 | 45 | 35 |
| 26 | 30 | 8.990017 | 11.009983 | 8.992101 | 11.007899 | 10.002084 | 9.997916 | 30 | 34 |
| 27 | 45 | 8.990339 | 11.009661 | 8.992426 | 11.007574 | 10.002087 | 9.997913 | 15 | 33 |
| 28 | 37 | 8.990660 | 11.009340 | 8.992750 | 11.007250 | 10.002090 | 9.997910 | 23 | 32 |
| 29 | 15 | 8.990981 | 11.009019 | 8.993074 | 11.006926 | 10.002093 | 9.997907 | 45 | 31 |
| 30 | 30 | 8.991302 | 11.008698 | 8.993398 | 11.006602 | 10.002096 | 9.997904 | 30 | 30 |
| 31 | 45 | 8.991623 | 11.008377 | 8.993722 | 11.006278 | 10.002099 | 9.997901 | 15 | 29 |
| 32 | 38 | 8.991943 | 11.008057 | 8.994045 | 11.005965 | 10.002103 | 9.997897 | 22 | 28 |
| 33 | 15 | 8.992263 | 11.007737 | 8.994369 | 11.005631 | 10.002106 | 9.997894 | 45 | 27 |
| 34 | 30 | 8.992583 | 11.007417 | 8.994691 | 11.005309 | 10.002109 | 9.997891 | 30 | 26 |
| 35 | 45 | 8.992902 | 11.007098 | 8.995014 | 11.004986 | 10.002112 | 9.997888 | 15 | 25 |
| 36 | 39 | 8.993222 | 11.006778 | 8.995337 | 11.004663 | 10.002115 | 9.997885 | 21 | 24 |
| 37 | 15 | 8.993541 | 11.006459 | 8.995659 | 11.004341 | 10.002118 | 9.997882 | 45 | 23 |
| 38 | 30 | 8.993860 | 11.006140 | 8.995981 | 11.004019 | 10.002121 | 9.997879 | 30 | 22 |
| 39 | 45 | 8.994178 | 11.005822 | 8.996303 | 11.003697 | 10.002124 | 9.997876 | 15 | 21 |
| 40 | 40 | 8.994497 | 11.005503 | 8.996624 | 11.003376 | 10.002128 | 9.997872 | 20 | 20 |
| 41 | 15 | 8.994815 | 11.005185 | 8.996946 | 11.003054 | 10.002131 | 9.997869 | 45 | 19 |
| 42 | 30 | 8.995133 | 11.004867 | 8.997267 | 11.002733 | 10.002134 | 9.997866 | 30 | 18 |
| 43 | 45 | 8.995451 | 11.004549 | 8.997587 | 11.002413 | 10.002137 | 9.997863 | 15 | 17 |
| 44 | 41 | 8.995768 | 11.004232 | 8.997908 | 11.002092 | 10.002140 | 9.997860 | 19 | 16 |
| 45 | 15 | 8.996085 | 11.003915 | 8.998228 | 11.001772 | 10.002143 | 9.997857 | 45 | 15 |
| 46 | 30 | 8.996402 | 11.003598 | 8.998549 | 11.001451 | 10.002146 | 9.997854 | 30 | 14 |
| 47 | 45 | 8.996719 | 11.003281 | 8.998869 | 11.001131 | 10.002150 | 9.997850 | 15 | 13 |
| 48 | 42 | 8.997036 | 11.002964 | 8.999188 | 11.000812 | 10.002153 | 9.997847 | 18 | 12 |
| 49 | 15 | 8.997352 | 11.002648 | 8.999508 | 11.000492 | 10.002156 | 9.997844 | 45 | 11 |
| 50 | 30 | 8.997668 | 11.002332 | 8.999827 | 11.000173 | 10.002159 | 9.997841 | 30 | 10 |
| 51 | 45 | 8.997984 | 11.002016 | 9.000146 | 10.999854 | 10.002162 | 9.997838 | 15 | 9 |
| 52 | 43 | 8.998299 | 11.001701 | 9.000465 | 10.999535 | 10.002165 | 9.997835 | 17 | 8 |
| 53 | 15 | 8.998615 | 11.001385 | 9.000783 | 10.999217 | 10.002169 | 9.997831 | 45 | 7 |
| 54 | 30 | 8.998930 | 11.001070 | 9.001102 | 10.998898 | 10.002172 | 9.997828 | 30 | 6 |
| 55 | 45 | 8.999245 | 11.000756 | 9.001420 | 10.998580 | 10.002175 | 9.997825 | 15 | 5 |
| 56 | 44 | 8.999559 | 11.000441 | 9.001737 | 10.998263 | 10.002178 | 9.997822 | 16 | 4 |
| 57 | 15 | 8.999874 | 11.000126 | 9.002055 | 10.997945 | 10.002181 | 9.997819 | 45 | 3 |
| 58 | 30 | 9.000188 | 10.999812 | 9.002372 | 10.997628 | 10.002184 | 9.997816 | 30 | 2 |
| 59 | 45 | 9.000502 | 10.999498 | 9.002690 | 10.997310 | 10.002188 | 9.997812 | 15 | 1 |
| 60 | 45 | 9.000816 | 10.999184 | 9.003007 | 10.996993 | 10.002191 | 9.997809 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | $5^h\ 37^m$. | | LOG. SINES, &c. | | | | | 84 deg. | |

| 0h 23m. | | LOG. SINES, &c. (t) | | | | | 5 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.000816 | 10.999184 | 9.003007 | 10.996993 | 10.002191 | 9.997809 | 15 | 60 |
| 1 | 15 | 9.001129 | 10.998871 | 9.003323 | 10.996677 | 10.002194 | 9.997806 | 45 | 59 |
| 2 | 30 | 9.001443 | 10.998557 | 9.003640 | 10.996360 | 10.002197 | 9.997803 | 30 | 58 |
| 3 | 45 | 9.001756 | 10.998244 | 9.003956 | 10.996044 | 10.002200 | 9.997800 | 15 | 57 |
| 4 | 46 | 9.002069 | 10.997931 | 9.004272 | 10.995728 | 10.002203 | 9.997797 | 14 | 56 |
| 5 | 15 | 9.002381 | 10.997619 | 9.004588 | 10.995412 | 10.002207 | 9.997793 | 45 | 55 |
| 6 | 30 | 9.002694 | 10.997306 | 9.004903 | 10.995097 | 10.002210 | 9.997790 | 30 | 54 |
| 7 | 45 | 9.003006 | 10.996994 | 9.005219 | 10.994781 | 10.002213 | 9.997787 | 15 | 53 |
| 8 | 47 | 9.003318 | 10.996682 | 9.005534 | 10.994466 | 10.002216 | 9.997784 | 13 | 52 |
| 9 | 15 | 9.003630 | 10.996370 | 9.005849 | 10.994151 | 10.002219 | 9.997781 | 45 | 51 |
| 10 | 30 | 9.003941 | 10.996059 | 9.006164 | 10.993836 | 10.002223 | 9.997777 | 30 | 50 |
| 11 | 45 | 9.004252 | 10.995748 | 9.006478 | 10.993522 | 10.002226 | 9.997774 | 15 | 49 |
| 12 | 48 | 9.004563 | 10.995437 | 9.006792 | 10.993208 | 10.002229 | 9.997771 | 12 | 48 |
| 13 | 15 | 9.004874 | 10.995126 | 9.007106 | 10.992894 | 10.002232 | 9.997768 | 45 | 47 |
| 14 | 30 | 9.005185 | 10.994815 | 9.007420 | 10.992580 | 10.002235 | 9.997765 | 30 | 46 |
| 15 | 45 | 9.005495 | 10.994505 | 9.007734 | 10.992266 | 10.002239 | 9.997761 | 15 | 45 |
| 16 | 49 | 9.005805 | 10.994195 | 9.008047 | 10.991953 | 10.002242 | 9.997758 | 11 | 44 |
| 17 | 15 | 9.006115 | 10.993885 | 9.008360 | 10.991640 | 10.002245 | 9.997755 | 45 | 43 |
| 18 | 30 | 9.006425 | 10.993575 | 9.008673 | 10.991327 | 10.002248 | 9.997752 | 30 | 42 |
| 19 | 45 | 9.006734 | 10.993266 | 9.008986 | 10.991014 | 10.002252 | 9.997748 | 15 | 41 |
| 20 | 50 | 9.007044 | 10.992956 | 9.009298 | 10.990702 | 10.002255 | 9.997745 | 10 | 40 |
| 21 | 15 | 9.007353 | 10.992647 | 9.009611 | 10.990389 | 10.002258 | 9.997742 | 45 | 39 |
| 22 | 30 | 9.007661 | 10.992339 | 9.009923 | 10.990077 | 10.002261 | 9.997739 | 30 | 38 |
| 23 | 45 | 9.007970 | 10.992030 | 9.010234 | 10.989766 | 10.002264 | 9.997736 | 15 | 37 |
| 24 | 51 | 9.008278 | 10.991722 | 9.010546 | 10.989454 | 10.002268 | 9.997732 | 9 | 36 |
| 25 | 15 | 9.008586 | 10.991414 | 9.010857 | 10.989143 | 10.002271 | 9.997729 | 45 | 35 |
| 26 | 30 | 9.008894 | 10.991106 | 9.011169 | 10.988831 | 10.002274 | 9.997726 | 30 | 34 |
| 27 | 45 | 9.009202 | 10.990798 | 9.011479 | 10.988521 | 10.002277 | 9.997723 | 15 | 33 |
| 28 | 52 | 9.009510 | 10.990490 | 9.011790 | 10.988210 | 10.002281 | 9.997719 | 8 | 32 |
| 29 | 15 | 9.009817 | 10.990183 | 9.012101 | 10.987899 | 10.002284 | 9.997716 | 45 | 31 |
| 30 | 30 | 9.010124 | 10.989876 | 9.012411 | 10.987589 | 10.002287 | 9.997713 | 30 | 30 |
| 31 | 45 | 9.010431 | 10.989569 | 9.012721 | 10.987279 | 10.002290 | 9.997710 | 15 | 29 |
| 32 | 53 | 9.010737 | 10.989263 | 9.013031 | 10.986969 | 10.002294 | 9.997706 | 7 | 28 |
| 33 | 15 | 9.011044 | 10.988956 | 9.013341 | 10.986659 | 10.002297 | 9.997703 | 45 | 27 |
| 34 | 30 | 9.011350 | 10.988650 | 9.013650 | 10.986350 | 10.002300 | 9.997700 | 30 | 26 |
| 35 | 45 | 9.011656 | 10.988344 | 9.013959 | 10.986041 | 10.002303 | 9.997697 | 15 | 25 |
| 36 | 54 | 9.011962 | 10.988038 | 9.014268 | 10.985732 | 10.002307 | 9.997693 | 6 | 24 |
| 37 | 15 | 9.012267 | 10.987733 | 9.014577 | 10.985423 | 10.002310 | 9.997690 | 45 | 23 |
| 38 | 30 | 9.012572 | 10.987428 | 9.014886 | 10.985114 | 10.002313 | 9.997687 | 30 | 22 |
| 39 | 45 | 9.012877 | 10.987123 | 9.015194 | 10.984806 | 10.002317 | 9.997683 | 15 | 21 |
| 40 | 55 | 9.013182 | 10.986818 | 9.015502 | 10.984498 | 10.002320 | 9.997680 | 5 | 20 |
| 41 | 15 | 9.013487 | 10.986513 | 9.015810 | 10.984190 | 10.002323 | 9.997677 | 45 | 19 |
| 42 | 30 | 9.013791 | 10.986209 | 9.016118 | 10.983882 | 10.002326 | 9.997674 | 30 | 18 |
| 43 | 45 | 9.014096 | 10.985904 | 9.016425 | 10.983575 | 10.002330 | 9.997670 | 15 | 17 |
| 44 | 56 | 9.014400 | 10.985600 | 9.016732 | 10.983268 | 10.002333 | 9.997667 | 4 | 16 |
| 45 | 15 | 9.014703 | 10.985297 | 9.017039 | 10.982961 | 10.002336 | 9.997664 | 45 | 15 |
| 46 | 30 | 9.015007 | 10.984993 | 9.017346 | 10.982654 | 10.002339 | 9.997661 | 30 | 14 |
| 47 | 45 | 9.015310 | 10.984690 | 9.017653 | 10.982347 | 10.002343 | 9.997657 | 15 | 13 |
| 48 | 57 | 9.015613 | 10.984387 | 9.017959 | 10.982041 | 10.002346 | 9.997654 | 3 | 12 |
| 49 | 15 | 9.015916 | 10.984084 | 9.018266 | 10.981734 | 10.002349 | 9.997651 | 45 | 11 |
| 50 | 30 | 9.016219 | 10.983781 | 9.018572 | 10.981428 | 10.002353 | 9.997647 | 30 | 10 |
| 51 | 45 | 9.016522 | 10.983478 | 9.018877 | 10.981123 | 10.002356 | 9.997644 | 15 | 9 |
| 52 | 58 | 9.016824 | 10.983176 | 9.019183 | 10.980817 | 10.002359 | 9.997641 | 2 | 8 |
| 53 | 15 | 9.017126 | 10.982874 | 9.019488 | 10.980512 | 10.002363 | 9.997637 | 45 | 7 |
| 54 | 30 | 9.017428 | 10.982572 | 9.019794 | 10.980206 | 10.002366 | 9.997634 | 30 | 6 |
| 55 | 45 | 9.017729 | 10.982271 | 9.020099 | 10.979901 | 10.002369 | 9.997631 | 15 | 5 |
| 56 | 59 | 9.018031 | 10.981969 | 9.020403 | 10.979597 | 10.002372 | 9.997628 | 1 | 4 |
| 57 | 15 | 9.018332 | 10.981668 | 9.020708 | 10.979292 | 10.002376 | 9.997624 | 45 | 3 |
| 58 | 30 | 9.018633 | 10.981367 | 9.021012 | 10.978988 | 10.002379 | 9.997621 | 30 | 2 |
| 59 | 45 | 9.018934 | 10.981066 | 9.021316 | 10.978684 | 10.002382 | 9.997618 | 15 | 1 |
| 60 | 60 | 9.019235 | 10.980765 | 9.021620 | 10.978380 | 10.002386 | 9.997614 | 0 | 0 |
| sec. | ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 36m. | | | | LOG SINES, &c. | | | | 84 deg. | |

| 0h 24m. | | LOG. SINES, &c. (t.) | | | | | 6 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.019235 | 10.980765 | 9.021620 | 10.978380 | 10.002386 | 9.997614 | 60 | 60 |
| 1 | 15 | 9.019535 | 10.980465 | 9.021924 | 10.978076 | 10.002389 | 9.997611 | 45 | 59 |
| 2 | 30 | 9.019835 | 10.980165 | 9.022227 | 10.977773 | 10.002392 | 9.997608 | 30 | 58 |
| 3 | 45 | 9.020135 | 10.979865 | 9.022531 | 10.977469 | 10.002396 | 9.997604 | 15 | 57 |
| 4 | 1 | 9.020435 | 10.979565 | 9.022834 | 10.977166 | 10.002399 | 9.997601 | 59 | 56 |
| 5 | 15 | 9.020734 | 10.979266 | 9.023137 | 10.976863 | 10.002402 | 9.997598 | 45 | 55 |
| 6 | 30 | 9.021034 | 10.978966 | 9.023439 | 10.976561 | 10.002406 | 9.997594 | 30 | 54 |
| 7 | 45 | 9.021333 | 10.978667 | 9.023742 | 10.976258 | 10.002409 | 9.997591 | 15 | 53 |
| 8 | 2 | 9.021632 | 10.978368 | 9.024044 | 10.975956 | 10.002412 | 9.997588 | 58 | 52 |
| 9 | 15 | 9.021930 | 10.978070 | 9.024346 | 10.975654 | 10.002416 | 9.997584 | 45 | 51 |
| 10 | 30 | 9.022229 | 10.977771 | 9.024648 | 10.975352 | 10.002419 | 9.997581 | 30 | 50 |
| 11 | 45 | 9.022527 | 10.977473 | 9.024950 | 10.975050 | 10.002422 | 9.997578 | 15 | 49 |
| 12 | 3 | 9.022825 | 10.977175 | 9.025251 | 10.974749 | 10.002426 | 9.997574 | 57 | 48 |
| 13 | 15 | 9.023123 | 10.976877 | 9.025552 | 10.974448 | 10.002429 | 9.997571 | 45 | 47 |
| 14 | 30 | 9.023421 | 10.976579 | 9.025853 | 10.974147 | 10.002432 | 9.997568 | 30 | 46 |
| 15 | 45 | 9.023718 | 10.976282 | 9.026154 | 10.973846 | 10.002436 | 9.997564 | 15 | 45 |
| 16 | 4 | 9.024016 | 10.975984 | 9.026455 | 10.973545 | 10.002439 | 9.997561 | 56 | 44 |
| 17 | 15 | 9.024313 | 10.975687 | 9.026755 | 10.973245 | 10.002442 | 9.997558 | 45 | 43 |
| 18 | 30 | 9.024610 | 10.975390 | 9.027055 | 10.972945 | 10.002446 | 9.997554 | 30 | 42 |
| 19 | 45 | 9.024906 | 10.975094 | 9.027355 | 10.972645 | 10.002449 | 9.997551 | 15 | 41 |
| 20 | 5 | 9.025203 | 10.974797 | 9.027655 | 10.972345 | 10.002453 | 9.997547 | 55 | 40 |
| 21 | 15 | 9.025499 | 10.974501 | 9.027955 | 10.972045 | 10.002456 | 9.997544 | 45 | 39 |
| 22 | 30 | 9.025795 | 10.974205 | 9.028254 | 10.971746 | 10.002459 | 9.997541 | 30 | 38 |
| 23 | 45 | 9.026091 | 10.973909 | 9.028553 | 10.971447 | 10.002463 | 9.997537 | 15 | 37 |
| 24 | 6 | 9.026386 | 10.973614 | 9.028852 | 10.971148 | 10.002466 | 9.997534 | 54 | 36 |
| 25 | 15 | 9.026682 | 10.973318 | 9.029151 | 10.970849 | 10.002469 | 9.997531 | 45 | 35 |
| 26 | 30 | 9.026977 | 10.973023 | 9.029450 | 10.970550 | 10.002473 | 9.997527 | 30 | 34 |
| 27 | 45 | 9.027272 | 10.972728 | 9.029748 | 10.970252 | 10.002476 | 9.997524 | 15 | 33 |
| 28 | 7 | 9.027567 | 10.972433 | 9.030046 | 10.969954 | 10.002480 | 9.997520 | 53 | 32 |
| 29 | 15 | 9.027862 | 10.972138 | 9.030344 | 10.969656 | 10.002483 | 9.997517 | 45 | 31 |
| 30 | 30 | 9.028156 | 10.971844 | 9.030642 | 10.969358 | 10.002486 | 9.997514 | 30 | 30 |
| 31 | 45 | 9.028450 | 10.971550 | 9.030940 | 10.969060 | 10.002490 | 9.997510 | 15 | 29 |
| 32 | 8 | 9.028744 | 10.971256 | 9.031237 | 10.968763 | 10.002493 | 9.997507 | 52 | 28 |
| 33 | 15 | 9.029038 | 10.970962 | 9.031534 | 10.968466 | 10.002497 | 9.997503 | 45 | 27 |
| 34 | 30 | 9.029332 | 10.970668 | 9.031831 | 10.968169 | 10.002500 | 9.997500 | 30 | 26 |
| 35 | 45 | 9.029625 | 10.970375 | 9.032128 | 10.967872 | 10.002503 | 9.997497 | 15 | 25 |
| 36 | 9 | 9.029918 | 10.970082 | 9.032425 | 10.967575 | 10.002507 | 9.997493 | 51 | 24 |
| 37 | 15 | 9.030211 | 10.969789 | 9.032721 | 10.967279 | 10.002510 | 9.997490 | 45 | 23 |
| 38 | 30 | 9.030504 | 10.969496 | 9.033017 | 10.966983 | 10.002514 | 9.997486 | 30 | 22 |
| 39 | 45 | 9.030797 | 10.969203 | 9.033313 | 10.966687 | 10.002517 | 9.997483 | 15 | 21 |
| 40 | 10 | 9.031089 | 10.968911 | 9.033609 | 10.966391 | 10.002520 | 9.997480 | 50 | 20 |
| 41 | 15 | 9.031381 | 10.968619 | 9.033905 | 10.966095 | 10.002524 | 9.997476 | 45 | 19 |
| 42 | 30 | 9.031673 | 10.968327 | 9.034200 | 10.965800 | 10.002527 | 9.997473 | 30 | 18 |
| 43 | 45 | 9.031965 | 10.968035 | 9.034496 | 10.965504 | 10.002531 | 9.997469 | 15 | 17 |
| 44 | 11 | 9.032257 | 10.967743 | 9.034791 | 10.965209 | 10.002534 | 9.997466 | 49 | 16 |
| 45 | 15 | 9.032548 | 10.967452 | 9.035085 | 10.964915 | 10.002537 | 9.997463 | 45 | 15 |
| 46 | 30 | 9.032839 | 10.967161 | 9.035380 | 10.964620 | 10.002541 | 9.997459 | 30 | 14 |
| 47 | 45 | 9.033130 | 10.966870 | 9.035675 | 10.964325 | 10.002544 | 9.997456 | 15 | 13 |
| 48 | 12 | 9.033421 | 10.966579 | 9.035969 | 10.964031 | 10.002548 | 9.997452 | 48 | 12 |
| 49 | 15 | 9.033712 | 10.966288 | 9.036263 | 10.963737 | 10.002551 | 9.997449 | 45 | 11 |
| 50 | 30 | 9.034002 | 10.965998 | 9.036557 | 10.963443 | 10.002555 | 9.997445 | 30 | 10 |
| 51 | 45 | 9.034292 | 10.965708 | 9.036850 | 10.963150 | 10.002558 | 9.997442 | 15 | 9 |
| 52 | 13 | 9.034582 | 10.965418 | 9.037144 | 10.962856 | 10.002561 | 9.997439 | 47 | 8 |
| 53 | 15 | 9.034872 | 10.965128 | 9.037437 | 10.962563 | 10.002565 | 9.997435 | 45 | 7 |
| 54 | 30 | 9.035162 | 10.964838 | 9.037730 | 10.962270 | 10.002568 | 9.997432 | 30 | 6 |
| 55 | 45 | 9.035451 | 10.964549 | 9.038023 | 10.961977 | 10.002572 | 9.997428 | 15 | 5 |
| 56 | 14 | 9.035741 | 10.964259 | 9.038316 | 10.961684 | 10.002575 | 9.997425 | 46 | 4 |
| 57 | 15 | 9.036030 | 10.963970 | 9.038608 | 10.961392 | 10.002579 | 9.997421 | 45 | 3 |
| 58 | 30 | 9.036319 | 10.963681 | 9.038901 | 10.961099 | 10.002582 | 9.997418 | 30 | 2 |
| 59 | 45 | 9.036607 | 10.963393 | 9.039193 | 10.960807 | 10.002586 | 9.997414 | 15 | 1 |
| 60 | 15 | 9.036896 | 10.963104 | 9.039485 | 10.960515 | 10.002589 | 9.997411 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ | sec. |
| 5h 35m. | | LOG. SINES, &c. | | | | | 83 deg. | | |

| 0h 25m. | | LOG. SINES, &c. (t.) | | | | | 6 deg. | |
|---|---|---|---|---|---|---|---|---|
| sec. | ° ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.036896 | 10.963104 | 9.039485 | 10.960515 | 10.002589 | 9.997411 | 45 | 60 |
| 1 | 15 | 9.037184 | 10.962816 | 9.039776 | 10.960224 | 10.002593 | 9.997407 | 45 | 59 |
| 2 | 30 | 9.037472 | 10.962528 | 9.040068 | 10.959932 | 10.002596 | 9.997404 | 30 | 58 |
| 3 | 45 | 9.037760 | 10 962240 | 9.040359 | 10.959641 | 10.002599 | 9.997401 | 15 | 57 |
| 4 | 16 | 9.038048 | 10.961952 | 9.040651 | 10.959349 | 10.002603 | 9.997397 | 44 | 56 |
| 5 | 15 | 9.038335 | 10.961665 | 9.040942 | 10.959058 | 10.002606 | 9.997394 | 45 | 55 |
| 6 | 30 | 9.038623 | 10.961377 | 9.041232 | 10.958768 | 10.002610 | 9.997390 | 30 | 54 |
| 7 | 45 | 9.038910 | 10.961090 | 9.041523 | 10.958477 | 10.002613 | 9.997387 | 15 | 53 |
| 8 | 17 | 9.039197 | 10.960803 | 9.041813 | 10.958187 | 10.002617 | 9.997383 | 43 | 52 |
| 9 | 15 | 9.039483 | 10.960517 | 9.042104 | 10.957896 | 10.002620 | 9.997380 | 45 | 51 |
| 10 | 30 | 9.039770 | 10.960230 | 9.042394 | 10.957606 | 10.002624 | 9.997376 | 30 | 50 |
| 11 | 45 | 9.040056 | 10.959944 | 9.042683 | 10.957317 | 10.002627 | 9.997373 | 15 | 49 |
| 12 | 18 | 9.040342 | 10.959658 | 9.042973 | 10.957027 | 10.002631 | 9.997369 | 42 | 48 |
| 13 | 15 | 9.040628 | 10.959372 | 9.043263 | 10.956737 | 10.002634 | 9.997366 | 45 | 47 |
| 14 | 30 | 9.040914 | 10.959086 | 9.043552 | 10.956448 | 10.002638 | 9.997362 | 30 | 46 |
| 15 | 45 | 9.041200 | 10.958800 | 9.043841 | 10.956159 | 10.002641 | 9.997359 | 15 | 45 |
| 16 | 19 | 9.041485 | 10.958515 | 9.044130 | 10.955870 | 10.002645 | 9.997355 | 41 | 44 |
| 17 | 15 | 9.041770 | 10.958230 | 9.044419 | 10.955581 | 10.002648 | 9.997352 | 45 | 43 |
| 18 | 30 | 9.042055 | 10.957945 | 9.044707 | 10.955293 | 10.002652 | 9.997348 | 30 | 42 |
| 19 | 45 | 9.042340 | 10.957660 | 9.044995 | 10.955005 | 10.002655 | 9.997345 | 15 | 41 |
| 20 | 20 | 9.042625 | 10.957375 | 9.045284 | 10.954716 | 10.002659 | 9.997341 | 40 | 40 |
| 21 | 15 | 9.042909 | 10.957091 | 9.045572 | 10.954428 | 10.002662 | 9.997338 | 45 | 39 |
| 22 | 30 | 9.043194 | 10.956806 | 9.045859 | 10.954141 | 10.002666 | 9.997334 | 30 | 38 |
| 23 | 45 | 9.043478 | 10.956522 | 9.046147 | 10.953853 | 10.002669 | 9.997331 | 15 | 37 |
| 24 | 21 | 9.043762 | 10.956238 | 9.046434 | 10.953566 | 10.002673 | 9.997327 | 39 | 36 |
| 25 | 15 | 9.044045 | 10.955955 | 9.046722 | 10.953278 | 10.002676 | 9.997324 | 45 | 35 |
| 26 | 30 | 9.044329 | 10.955671 | 9.047009 | 10.952991 | 10.002680 | 9.997320 | 30 | 34 |
| 27 | 45 | 9.044612 | 10.955388 | 9.047295 | 10.952705 | 10.002683 | 9.997317 | 15 | 33 |
| 28 | 22 | 9.044895 | 10.955105 | 9.047582 | 10.952418 | 10.002687 | 9.997313 | 38 | 32 |
| 29 | 15 | 9.045178 | 10.954822 | 9.047869 | 10.952131 | 10.002690 | 9.997310 | 45 | 31 |
| 30 | 30 | 9.045461 | 10.954539 | 9.048155 | 10.951845 | 10.002694 | 9.997306 | 30 | 30 |
| 31 | 45 | 9.045744 | 10.954256 | 9.048441 | 10.951559 | 10.002697 | 9.997303 | 15 | 29 |
| 32 | 23 | 9.046026 | 10.953974 | 9.048727 | 10.951273 | 10.002701 | 9.997299 | 37 | 28 |
| 33 | 15 | 9.046308 | 10.953692 | 9.049013 | 10.950987 | 10.002704 | 9.997296 | 45 | 27 |
| 34 | 30 | 9.046590 | 10.953410 | 9.049298 | 10.950702 | 10.002708 | 9.997292 | 30 | 26 |
| 35 | 45 | 9.046872 | 10.953128 | 9.049584 | 10.950416 | 10.002712 | 9.997288 | 15 | 25 |
| 36 | 24 | 9.047154 | 10.952846 | 9.049869 | 10.950131 | 10.002715 | 9.997285 | 36 | 24 |
| 37 | 15 | 9.047435 | 10.952565 | 9.050154 | 10.949846 | 10.002719 | 9.997281 | 45 | 23 |
| 38 | 30 | 9.047717 | 10.952283 | 9.050439 | 10.949561 | 10.002722 | 9.997278 | 30 | 22 |
| 39 | 45 | 9.047998 | 10.952002 | 9.050723 | 10.949277 | 10.002726 | 9.997274 | 15 | 21 |
| 40 | 25 | 9.048279 | 10.951721 | 9.051008 | 10.948992 | 10.002729 | 9.997271 | 35 | 20 |
| 41 | 15 | 9.048559 | 10.951441 | 9.051292 | 10.948708 | 10.002733 | 9.997267 | 45 | 19 |
| 42 | 30 | 9.048840 | 10.951160 | 9.051576 | 10.948424 | 10.002736 | 9.997264 | 30 | 18 |
| 43 | 45 | 9.049120 | 10.950880 | 9.051860 | 10.948140 | 10.002740 | 9.997260 | 15 | 17 |
| 44 | 26 | 9.049400 | 10.950600 | 9.052144 | 10.947856 | 10.002743 | 9.997257 | 34 | 16 |
| 45 | 15 | 9.049680 | 10.950320 | 9.052427 | 10.947573 | 10.002747 | 9.997253 | 45 | 15 |
| 46 | 30 | 9.049960 | 10.950040 | 9.052711 | 10.947289 | 10.002751 | 9.997249 | 30 | 14 |
| 47 | 45 | 9.050240 | 10.949760 | 9.052994 | 10.947006 | 10.002754 | 9.997246 | 15 | 13 |
| 48 | 27 | 9.050519 | 10.949481 | 9.053277 | 10.946723 | 10.002758 | 9.997242 | 33 | 12 |
| 49 | 15 | 9.050799 | 10.949201 | 9.053560 | 10.946440 | 10.002761 | 9.997239 | 45 | 11 |
| 50 | 30 | 9.051078 | 10.948922 | 9.053843 | 10.946157 | 10.002765 | 9.997235 | 30 | 10 |
| 51 | 45 | 9.051357 | 10.948643 | 9.054125 | 10.945875 | 10.002768 | 9.997232 | 15 | 9 |
| 52 | 28 | 9.051635 | 10.948365 | 9.054407 | 10.945593 | 10.002772 | 9.997228 | 32 | 8 |
| 53 | 15 | 9.051914 | 10.948086 | 9.054689 | 10.945311 | 10.002776 | 9.997224 | 45 | 7 |
| 54 | 30 | 9.052192 | 10.947808 | 9.054971 | 10.945029 | 10.002779 | 9.997221 | 30 | 6 |
| 55 | 45 | 9.052470 | 10.947530 | 9.055253 | 10.944747 | 10.002783 | 9.997217 | 15 | 5 |
| 56 | 29 | 9.052748 | 10.947252 | 9.055535 | 10.944465 | 10.002786 | 9.997214 | 31 | 4 |
| 57 | 15 | 9.053026 | 10.946974 | 9.055816 | 10.944184 | 10.002790 | 9.997210 | 45 | 3 |
| 58 | 30 | 9.053304 | 10.946696 | 9.056097 | 10.943903 | 10.002794 | 9.997206 | 30 | 2 |
| 59 | 45 | 9.053581 | 10.946419 | 9.056379 | 10.943621 | 10.002797 | 9.997203 | 15 | 1 |
| 60 | 30 | 9.053859 | 10.946141 | 9.056659 | 10.943341 | 10.002801 | 9.997199 | 30 | 0 |
| sec. | ° ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 34m. | | | | LOG. SINES, &c. | | | | 83 deg. | |

| 0h 26m. | | | LOG. SINES, &c. (t.) | | | | 6 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.053859 | 10.946141 | 9.056659 | 10.943341 | 10.002801 | 9.997199 | 30 | 60 |
| 1 | 15 | 9.054136 | 10.945864 | 9.056940 | 10.943060 | 10.002804 | 9.997196 | 45 | 59 |
| 2 | 30 | 9.054413 | 10.945587 | 9.057221 | 10.942779 | 10.002808 | 9.997192 | 30 | 58 |
| 3 | 45 | 9.054689 | 10.945311 | 9.057501 | 10.942499 | 10.002812 | 9.997188 | 15 | 57 |
| 4 | 31 | 9.054966 | 10.945034 | 9.057781 | 10.942219 | 10.002815 | 9.997185 | 29 | 56 |
| 5 | 15 | 9.055242 | 10.944758 | 9.058061 | 10.941939 | 10.002819 | 9.997181 | 45 | 55 |
| 6 | 30 | 9.055519 | 10.944481 | 9.058341 | 10.941659 | 10.002822 | 9.997178 | 30 | 54 |
| 7 | 45 | 9.055795 | 10.944205 | 9.058621 | 10.941379 | 10.002826 | 9.997174 | 15 | 53 |
| 8 | 32 | 9.056071 | 10.943929 | 9.058900 | 10.941100 | 10.002830 | 9.997170 | 28 | 52 |
| 9 | 15 | 9.056346 | 10.943654 | 9.059179 | 10.940821 | 10.002833 | 9.997167 | 45 | 51 |
| 10 | 30 | 9.056622 | 10.943378 | 9.059459 | 10.940541 | 10.002837 | 9.997163 | 30 | 50 |
| 11 | 45 | 9.056897 | 10.943103 | 9.059738 | 10.940262 | 10.002840 | 9.997160 | 15 | 49 |
| 12 | 33 | 9.057172 | 10.942828 | 9.060016 | 10.939984 | 10.002844 | 9.997156 | 27 | 48 |
| 13 | 15 | 9.057447 | 10.942553 | 9.060295 | 10.939705 | 10.002848 | 9.997152 | 45 | 47 |
| 14 | 30 | 9.057722 | 10.942278 | 9.060573 | 10.939427 | 10.002851 | 9.997149 | 30 | 46 |
| 15 | 45 | 9.057997 | 10.942003 | 9.060852 | 10.939148 | 10.002855 | 9.997145 | 15 | 45 |
| 16 | 34 | 9.058271 | 10.941729 | 9.061130 | 10.938870 | 10.002859 | 9.997141 | 26 | 44 |
| 17 | 15 | 9.058545 | 10.941455 | 9.061408 | 10.938592 | 10.002862 | 9.997138 | 45 | 43 |
| 18 | 30 | 9.058819 | 10.941181 | 9.061685 | 10.938315 | 10.002866 | 9.997134 | 30 | 42 |
| 19 | 45 | 9.059093 | 10.940907 | 9.061963 | 10.938037 | 10.002870 | 9.997130 | 15 | 41 |
| 20 | 35 | 9.059367 | 10.940633 | 9.062240 | 10.937760 | 10.002873 | 9.997127 | 25 | 40 |
| 21 | 15 | 9.059641 | 10.940359 | 9.062518 | 10.937482 | 10.002877 | 9.997123 | 45 | 39 |
| 22 | 30 | 9.059914 | 10.940086 | 9.062795 | 10.937205 | 10.002880 | 9.997120 | 30 | 38 |
| 23 | 45 | 9.060187 | 10.939813 | 9.063071 | 10.936929 | 10.002884 | 9.997116 | 15 | 37 |
| 24 | 36 | 9.060460 | 10.939540 | 9.063348 | 10.936652 | 10.002888 | 9.997112 | 24 | 36 |
| 25 | 15 | 9.060733 | 10.939267 | 9.063625 | 10.936375 | 10.002891 | 9.997109 | 45 | 35 |
| 26 | 30 | 9.061006 | 10.938994 | 9.063901 | 10.936099 | 10.002895 | 9.997105 | 30 | 34 |
| 27 | 45 | 9.061278 | 10.938722 | 9.064177 | 10.935823 | 10.002899 | 9.997101 | 15 | 33 |
| 28 | 37 | 9.061551 | 10.938449 | 9.064453 | 10.935547 | 10.002902 | 9.997098 | 23 | 32 |
| 29 | 15 | 9.061823 | 10.938177 | 9.064729 | 10.935271 | 10.002906 | 9.997094 | 45 | 31 |
| 30 | 30 | 9.062095 | 10.937905 | 9.065005 | 10.934995 | 10.002910 | 9.997090 | 30 | 30 |
| 31 | 45 | 9.062367 | 10.937633 | 9.065280 | 10.934720 | 10.002913 | 9.997087 | 15 | 29 |
| 32 | 38 | 9.062639 | 10.937361 | 9.065556 | 10.934444 | 10.002917 | 9.997083 | 22 | 28 |
| 33 | 15 | 9.062910 | 10.937090 | 9.065831 | 10.934169 | 10.002921 | 9.997079 | 45 | 27 |
| 34 | 30 | 9.063181 | 10.936819 | 9.066106 | 10.933894 | 10.002924 | 9.997076 | 30 | 26 |
| 35 | 45 | 9.063452 | 10.936548 | 9.066381 | 10.933619 | 10.002928 | 9.997072 | 15 | 25 |
| 36 | 39 | 9.063723 | 10.936277 | 9.066655 | 10.933345 | 10.002932 | 9.997068 | 21 | 24 |
| 37 | 15 | 9.063994 | 10.936006 | 9.066930 | 10.933070 | 10.002936 | 9.997064 | 45 | 23 |
| 38 | 30 | 9.064265 | 10.935735 | 9.067204 | 10.932796 | 10.002939 | 9.997061 | 30 | 22 |
| 39 | 45 | 9.064535 | 10.935465 | 9.067478 | 10.932522 | 10.002943 | 9.997057 | 15 | 21 |
| 40 | 40 | 9.064806 | 10.935194 | 9.067752 | 10.932248 | 10.002947 | 9.997053 | 20 | 20 |
| 41 | 15 | 9.065076 | 10.934924 | 9.068026 | 10.931974 | 10.002950 | 9.997050 | 45 | 19 |
| 42 | 30 | 9.065346 | 10.934654 | 9.068300 | 10.931700 | 10.002954 | 9.997046 | 30 | 18 |
| 43 | 45 | 9.065616 | 10.934384 | 9.068573 | 10.931427 | 10.002958 | 9.997042 | 15 | 17 |
| 44 | 41 | 9.065885 | 10.934115 | 9.068846 | 10.931154 | 10.002961 | 9.997039 | 19 | 16 |
| 45 | 15 | 9.066155 | 10.933845 | 9.069120 | 10.930880 | 10.002965 | 9.997035 | 45 | 15 |
| 46 | 30 | 9.066424 | 10.933576 | 9.069393 | 10.930607 | 10.002969 | 9.997031 | 30 | 14 |
| 47 | 45 | 9.066693 | 10.933307 | 9.069665 | 10.930335 | 10.002972 | 9.997028 | 15 | 13 |
| 48 | 42 | 9.066962 | 10.933038 | 9.069938 | 10.930062 | 10.002976 | 9.997024 | 18 | 12 |
| 49 | 15 | 9.067231 | 10.932769 | 9.070210 | 10.929790 | 10.002980 | 9.997020 | 45 | 11 |
| 50 | 30 | 9.067499 | 10.932501 | 9.070483 | 10.929517 | 10.002984 | 9.997016 | 30 | 10 |
| 51 | 45 | 9.067768 | 10.932232 | 9.070755 | 10.929245 | 10.002987 | 9.997013 | 15 | 9 |
| 52 | 43 | 9.068036 | 10.931964 | 9.071027 | 10.928973 | 10.002991 | 9.997009 | 17 | 8 |
| 53 | 15 | 9.068304 | 10.931696 | 9.071299 | 10.928701 | 10.002995 | 9.997005 | 45 | 7 |
| 54 | 30 | 9.068572 | 10.931428 | 9.071570 | 10.928430 | 10.002998 | 9.997002 | 30 | 6 |
| 55 | 45 | 9.068840 | 10.931160 | 9.071842 | 10.928158 | 10.003002 | 9.996998 | 15 | 5 |
| 56 | 44 | 9.069107 | 10.930893 | 9.072113 | 10.927887 | 10.003006 | 9.996994 | 16 | 4 |
| 57 | 15 | 9.069375 | 10.930625 | 9.072384 | 10.927616 | 10.003010 | 9.996990 | 45 | 3 |
| 58 | 30 | 9.069642 | 10.930358 | 9.072655 | 10.927345 | 10.003013 | 9.996987 | 30 | 2 |
| 59 | 45 | 9.069909 | 10.930091 | 9.072926 | 10.927074 | 10.003017 | 9.996983 | 15 | 1 |
| 60 | 45 | 9.070176 | 10.929824 | 9.073197 | 10.926803 | 10.003021 | 9.996979 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 33m. | | | LOG. SINES, &c. | | | | 83 deg. | | |

| sec. | 0h 27m. | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 45 | 9.070176 | 10.929824 | 9.073197 | 10.926803 | 10.003021 | 9.996979 | 15 | 60 |
| 1 | 15 | 9.070443 | 10.929557 | 9.073467 | 10.926533 | 10.003025 | 9.996975 | 45 | 59 |
| 2 | 30 | 9.070709 | 10.929291 | 9.073738 | 10.926262 | 10.003028 | 9.996972 | 30 | 58 |
| 3 | 45 | 9.070976 | 10.929024 | 9.074008 | 10.925992 | 10.003032 | 9.996968 | 15 | 57 |
| 4 | 46 | 9.071242 | 10.928758 | 9.074278 | 10.925722 | 10.003036 | 9.996964 | 14 | 56 |
| 5 | 15 | 9.071508 | 10.928492 | 9.074548 | 10.925452 | 10.003040 | 9.996960 | 45 | 55 |
| 6 | 30 | 9.071774 | 10.928226 | 9.074817 | 10.925183 | 10.003043 | 9.996957 | 30 | 54 |
| 7 | 45 | 9.072040 | 10.927960 | 9.075087 | 10.924913 | 10.003047 | 9.996953 | 15 | 53 |
| 8 | 47 | 9.072305 | 10.927695 | 9.075356 | 10.924644 | 10.003051 | 9.996949 | 13 | 52 |
| 9 | 15 | 9.072571 | 10.927429 | 9.075625 | 10.924375 | 10.003055 | 9.996945 | 45 | 51 |
| 10 | 30 | 9.072836 | 10.927164 | 9.075894 | 10.924106 | 10.003058 | 9.996942 | 30 | 50 |
| 11 | 45 | 9.073101 | 10.926899 | 9.076163 | 10.923837 | 10.003062 | 9.996938 | 15 | 49 |
| 12 | 48 | 9.073366 | 10.926634 | 9.076432 | 10.923568 | 10.003066 | 9.996934 | 12 | 48 |
| 13 | 15 | 9.073631 | 10.926369 | 9.076701 | 10.923299 | 10.003070 | 9.996930 | 45 | 47 |
| 14 | 30 | 9.073896 | 10.926104 | 9.076969 | 10.923031 | 10.003073 | 9.996927 | 30 | 46 |
| 15 | 45 | 9.074160 | 10.925840 | 9.077237 | 10.922763 | 10.003077 | 9.996923 | 15 | 45 |
| 16 | 49 | 9.074424 | 10.925576 | 9.077505 | 10.922495 | 10.003081 | 9.996919 | 11 | 44 |
| 17 | 15 | 9.074688 | 10.925312 | 9.077773 | 10.922227 | 10.003085 | 9.996915 | 45 | 43 |
| 18 | 30 | 9.074952 | 10.925048 | 9.078041 | 10.921959 | 10.003089 | 9.996911 | 30 | 42 |
| 19 | 45 | 9.075216 | 10.924784 | 9.078308 | 10.921692 | 10.003092 | 9.996908 | 15 | 41 |
| 20 | 50 | 9.075480 | 10.924520 | 9.078576 | 10.921424 | 10.003096 | 9.996904 | 10 | 40 |
| 21 | 15 | 9.075743 | 10.924257 | 9.078843 | 10.921157 | 10.003100 | 9.996900 | 45 | 39 |
| 22 | 30 | 9.076007 | 10.923993 | 9.079110 | 10.920890 | 10.003104 | 9.996896 | 30 | 38 |
| 23 | 45 | 9.076270 | 10.923730 | 9.079377 | 10.920623 | 10.003107 | 9.996893 | 15 | 37 |
| 24 | 51 | 9.076533 | 10.923467 | 9.079644 | 10.920356 | 10.003111 | 9.996889 | 9 | 36 |
| 25 | 15 | 9.076796 | 10.923204 | 9.079911 | 10.920089 | 10.003115 | 9.996885 | 45 | 35 |
| 26 | 30 | 9.077058 | 10.922942 | 9.080177 | 10.919823 | 10.003119 | 9.996881 | 30 | 34 |
| 27 | 45 | 9.077321 | 10.922679 | 9.080443 | 10.919557 | 10.003123 | 9.996877 | 15 | 33 |
| 28 | 52 | 9.077583 | 10.922417 | 9.080710 | 10.919290 | 10.003126 | 9.996874 | 8 | 32 |
| 29 | 15 | 9.077845 | 10.922155 | 9.080976 | 10.919024 | 10.003130 | 9.996870 | 45 | 31 |
| 30 | 30 | 9.078107 | 10.921893 | 9.081241 | 10.918759 | 10.003134 | 9.996866 | 30 | 30 |
| 31 | 45 | 9.078369 | 10.921631 | 9.081507 | 10.918493 | 10.003138 | 9.996862 | 15 | 29 |
| 32 | 53 | 9.078631 | 10.921369 | 9.081773 | 10.918227 | 10.003142 | 9.996858 | 7 | 28 |
| 33 | 15 | 9.078892 | 10.921108 | 9.082038 | 10.917962 | 10.003145 | 9.996855 | 45 | 27 |
| 34 | 30 | 9.079154 | 10.920846 | 9.082303 | 10.917697 | 10.003149 | 9.996851 | 30 | 26 |
| 35 | 45 | 9.079415 | 10.920585 | 9.082568 | 10.917432 | 10.003153 | 9.996847 | 15 | 25 |
| 36 | 54 | 9.079676 | 10.920324 | 9.082833 | 10.917167 | 10.003157 | 9.996843 | 6 | 24 |
| 37 | 15 | 9.079937 | 10.920063 | 9.083098 | 10.916902 | 10.003161 | 9.996839 | 45 | 23 |
| 38 | 30 | 9.080198 | 10.919802 | 9.083362 | 10.916638 | 10.003165 | 9.996835 | 30 | 22 |
| 39 | 45 | 9.080458 | 10.919542 | 9.083627 | 10.916373 | 10.003168 | 9.996832 | 15 | 21 |
| 40 | 55 | 9.080719 | 10.919281 | 9.083891 | 10.916109 | 10.003172 | 9.996828 | 5 | 20 |
| 41 | 15 | 9.080979 | 10.919021 | 9.084155 | 10.915845 | 10.003176 | 9.996824 | 45 | 19 |
| 42 | 30 | 9.081239 | 10.918761 | 9.084419 | 10.915581 | 10.003180 | 9.996820 | 30 | 18 |
| 43 | 45 | 9.081499 | 10.918501 | 9.084683 | 10.915317 | 10.003184 | 9.996816 | 15 | 17 |
| 44 | 56 | 9.081759 | 10.918241 | 9.084947 | 10.915053 | 10.003188 | 9.996812 | 4 | 16 |
| 45 | 15 | 9.082019 | 10.917981 | 9.085210 | 10.914790 | 10.003191 | 9.996809 | 45 | 15 |
| 46 | 30 | 9.082278 | 10.917722 | 9.085473 | 10.914527 | 10.003195 | 9.996805 | 30 | 14 |
| 47 | 45 | 9.082537 | 10.917463 | 9.085736 | 10.914264 | 10.003199 | 9.996801 | 15 | 13 |
| 48 | 57 | 9.082797 | 10.917203 | 9.086000 | 10.914000 | 10.003203 | 9.996797 | 3 | 12 |
| 49 | 15 | 9.083056 | 10.916944 | 9.086262 | 10.913738 | 10.003207 | 9.996793 | 45 | 11 |
| 50 | 30 | 9.083314 | 10.916686 | 9.086525 | 10.913475 | 10.003211 | 9.996789 | 30 | 10 |
| 51 | 45 | 9.083573 | 10.916427 | 9.086788 | 10.913212 | 10.003215 | 9.996785 | 15 | 9 |
| 52 | 58 | 9.083832 | 10.916168 | 9.087050 | 10.912950 | 10.003218 | 9.996782 | 2 | 8 |
| 53 | 15 | 9.084090 | 10.915910 | 9.087312 | 10.912688 | 10.003222 | 9.996778 | 45 | 7 |
| 54 | 30 | 9.084348 | 10.915652 | 9.087574 | 10.912426 | 10.003226 | 9.996774 | 30 | 6 |
| 55 | 45 | 9.084606 | 10.915394 | 9.087836 | 10.912164 | 10.003230 | 9.996770 | 15 | 5 |
| 56 | 59 | 9.084864 | 10.915136 | 9.088098 | 10.911902 | 10.003234 | 9.996766 | 1 | 4 |
| 57 | 15 | 9.085122 | 10.914878 | 9.088360 | 10.911640 | 10.003238 | 9.996762 | 45 | 3 |
| 58 | 30 | 9.085380 | 10.914620 | 9.088621 | 10.911379 | 10.003242 | 9.996758 | 30 | 2 |
| 59 | 45 | 9.085637 | 10.914363 | 9.088883 | 10.911117 | 10.003245 | 9.996755 | 15 | 1 |
| 60 | 60 | 9.085894 | 10.914106 | 9.089144 | 10.910856 | 10.003249 | 9.996751 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ | sec. |

| sec. | ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | | 0h 28m. | LOG. SINES, &c. (t.) | | | | | 7 deg. | |
| 0 | 0 | 9.085894 | 10.914106 | 9.089144 | 10.910856 | 10.003249 | 9.996751 | 60 | 60 |
| 1 | 15 | 9.086152 | 10.913848 | 9.089405 | 10.910595 | 10.003253 | 9.996747 | 45 | 59 |
| 2 | 30 | 9.086409 | 10.913591 | 9.089666 | 10.910334 | 10.003257 | 9.996743 | 30 | 58 |
| 3 | 45 | 9.086665 | 10.913335 | 9.089926 | 10.910074 | 10.003261 | 9.996739 | 15 | 57 |
| 4 | 1 | 9.086922 | 10.913078 | 9.090187 | 10.909813 | 10.003265 | 9.996735 | 59 | 56 |
| 5 | 15 | 9.087179 | 10.912821 | 9.090447 | 10.909553 | 10.003269 | 9.996731 | 45 | 55 |
| 6 | 30 | 9.087435 | 10.912565 | 9.090708 | 10.909292 | 10.003273 | 9.996727 | 30 | 54 |
| 7 | 45 | 9.087691 | 10.912309 | 9.090968 | 10.909032 | 10.003277 | 9.996723 | 15 | 53 |
| 8 | 2 | 9.087947 | 10.912053 | 9.091228 | 10.908772 | 10.003280 | 9.996720 | 58 | 52 |
| 9 | 15 | 9.088203 | 10.911797 | 9.091487 | 10.908513 | 10.003284 | 9.996716 | 45 | 51 |
| 10 | 30 | 9.088459 | 10.911541 | 9.091747 | 10.908253 | 10.003288 | 9.996712 | 30 | 50 |
| 11 | 45 | 9.088715 | 10.911285 | 9.092007 | 10.907993 | 10.003292 | 9.996708 | 15 | 49 |
| 12 | 3 | 9.088970 | 10.911030 | 9.092266 | 10.907734 | 10.003296 | 9.996704 | 57 | 48 |
| 13 | 15 | 9.089225 | 10.910775 | 9.092525 | 10.907475 | 10.003300 | 9.996700 | 45 | 47 |
| 14 | 30 | 9.089480 | 10.910520 | 9.092784 | 10.907216 | 10.003304 | 9.996696 | 30 | 46 |
| 15 | 45 | 9.089735 | 10.910265 | 9.093043 | 10.906957 | 10.003308 | 9.996692 | 15 | 45 |
| 16 | 4 | 9.089990 | 10.910010 | 9.093302 | 10.906698 | 10.003312 | 9.996688 | 56 | 44 |
| 17 | 15 | 9.090245 | 10.909755 | 9.093561 | 10.906439 | 10.003316 | 9.996684 | 45 | 43 |
| 18 | 30 | 9.090500 | 10.909500 | 9.093819 | 10.906181 | 10.003320 | 9.996680 | 30 | 42 |
| 19 | 45 | 9.090754 | 10.909246 | 9.094077 | 10.905923 | 10.003323 | 9.996677 | 15 | 41 |
| 20 | 5 | 9.091008 | 10.908992 | 9.094335 | 10.905665 | 10.003327 | 9.996673 | 55 | 40 |
| 21 | 15 | 9.091262 | 10.908738 | 9.094593 | 10.905407 | 10.003331 | 9.996669 | 45 | 39 |
| 22 | 30 | 9.091516 | 10.908484 | 9.094851 | 10.905149 | 10.003335 | 9.996665 | 30 | 38 |
| 23 | 45 | 9.091770 | 10.908230 | 9.095109 | 10.904891 | 10.003339 | 9.996661 | 15 | 37 |
| 24 | 6 | 9.092024 | 10.907976 | 9.095367 | 10.904633 | 10.003343 | 9.996657 | 54 | 36 |
| 25 | 15 | 9.092277 | 10.907723 | 9.095624 | 10.904376 | 10.003347 | 9.996653 | 45 | 35 |
| 26 | 30 | 9.092530 | 10.907470 | 9.095881 | 10.904119 | 10.003351 | 9.996649 | 30 | 34 |
| 27 | 45 | 9.092784 | 10.907216 | 9.096138 | 10.903862 | 10.003355 | 9.996645 | 15 | 33 |
| 28 | 7 | 9.093037 | 10.906963 | 9.096395 | 10.903605 | 10.003359 | 9.996641 | 53 | 32 |
| 29 | 15 | 9.093290 | 10.906710 | 9.096652 | 10.903348 | 10.003363 | 9.996637 | 45 | 31 |
| 30 | 30 | 9.093542 | 10.906458 | 9.096909 | 10.903091 | 10.003367 | 9.996633 | 30 | 30 |
| 31 | 45 | 9.093795 | 10.906205 | 9.097165 | 10.902835 | 10.003271 | 9.996629 | 15 | 29 |
| 32 | 8 | 9.094047 | 10.905953 | 9.097422 | 10.902578 | 10.003375 | 9.996625 | 52 | 28 |
| 33 | 15 | 9.094300 | 10.905700 | 9.097678 | 10.902322 | 10.003379 | 9.996621 | 45 | 27 |
| 34 | 30 | 9.094552 | 10.905448 | 9.097934 | 10.902066 | 10.003383 | 9.996617 | 30 | 26 |
| 35 | 45 | 9.094804 | 10.905195 | 9.098190 | 10.901810 | 10.003386 | 9.996614 | 15 | 25 |
| 36 | 9 | 9.095056 | 10.904944 | 9.098446 | 10.901554 | 10.003390 | 9.996610 | 51 | 24 |
| 37 | 15 | 9.095307 | 10.904693 | 9.098702 | 10.901298 | 10.003394 | 9.996606 | 45 | 23 |
| 38 | 30 | 9.095559 | 10.904441 | 9.098957 | 10.901043 | 10.003398 | 9.996602 | 30 | 22 |
| 39 | 45 | 9.095810 | 10.904190 | 9.099213 | 10.900787 | 10.003402 | 9.996598 | 15 | 21 |
| 40 | 10 | 9.096061 | 10.903939 | 9.099468 | 10.900532 | 10.003406 | 9.996594 | 50 | 20 |
| 41 | 15 | 9.096313 | 10.903687 | 9.099723 | 10.900277 | 10.003410 | 9.996590 | 45 | 19 |
| 42 | 30 | 9.096564 | 10.903436 | 9.099978 | 10.900022 | 10.003414 | 9.996586 | 30 | 18 |
| 43 | 45 | 9.096814 | 10.903186 | 9.100233 | 10.899767 | 10.003418 | 9.996582 | 15 | 17 |
| 44 | 11 | 9.097065 | 10.902935 | 9.100487 | 10.899513 | 10.003422 | 9.996578 | 49 | 16 |
| 45 | 15 | 9.097316 | 10.902684 | 9.100742 | 10.899258 | 10.003426 | 9.996574 | 45 | 15 |
| 46 | 30 | 9.097566 | 10.902434 | 9.100996 | 10.899004 | 10.003430 | 9.996570 | 30 | 14 |
| 47 | 45 | 9.097816 | 10.902184 | 9.101250 | 10.898750 | 10.003434 | 9.996566 | 15 | 13 |
| 48 | 12 | 9.098066 | 10.901934 | 9.101504 | 10.898496 | 10.003438 | 9.996562 | 48 | 12 |
| 49 | 15 | 9.098316 | 10.901684 | 9.101758 | 10.898242 | 10.003442 | 9.996558 | 45 | 11 |
| 50 | 30 | 9.098566 | 10.901434 | 9.102012 | 10.897988 | 10.003446 | 9.996554 | 30 | 10 |
| 51 | 45 | 9.098816 | 10.901184 | 9.102266 | 10.897734 | 10.003450 | 9.996550 | 15 | 9 |
| 52 | 13 | 9.099065 | 10.900935 | 9.102519 | 10.897481 | 10.003454 | 9.996546 | 47 | 8 |
| 53 | 15 | 9.099314 | 10.900686 | 9.102772 | 10.897228 | 10.003458 | 9.996542 | 45 | 7 |
| 54 | 30 | 9.099564 | 10.900436 | 9.103026 | 10.896974 | 10.003462 | 9.996538 | 30 | 6 |
| 55 | 45 | 9.099813 | 10.900187 | 9.103279 | 10.896721 | 10.003466 | 9.996534 | 15 | 5 |
| 56 | 14 | 9.100062 | 10.899938 | 9.103532 | 10.896468 | 10.003470 | 9.996530 | 46 | 4 |
| 57 | 15 | 9.100310 | 10.899690 | 9.103784 | 10.896216 | 10.003474 | 9.996526 | 45 | 3 |
| 58 | 30 | 9.100559 | 10.899441 | 9.104037 | 10.895963 | 10.003478 | 9.996522 | 30 | 2 |
| 59 | 45 | 9.100807 | 10.899193 | 9.104290 | 10.895710 | 10.003482 | 9.996518 | 15 | 1 |
| 60 | 15 | 9.101056 | 10.898944 | 9.104542 | 10.895458 | 10.003486 | 9.996514 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | | 5h 31m. | LOG. SINES, &c. | | | | | 82 deg. | |

| 0h 29m. | | LOG. SINES, &c. (t) | | | | | 7 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.101056 | 10.898944 | 9.104542 | 10.895458 | 10.003486 | 9.996514 | 45 | 60 |
| 1 | 15 | 9.101304 | 10.898696 | 9.104794 | 10.895206 | 10.003490 | 9.996510 | 45 | 59 |
| 2 | 30 | 9.101552 | 10.898448 | 9.105046 | 10.894954 | 10.003494 | 9.996506 | 30 | 58 |
| 3 | 45 | 9.101800 | 10.898200 | 9.105298 | 10.894702 | 10.003498 | 9.996502 | 15 | 57 |
| 4 | 16 | 9.102048 | 10.897952 | 9.105550 | 10.894450 | 10.003502 | 9.996498 | 44 | 56 |
| 5 | 15 | 9.102295 | 10.897705 | 9.105802 | 10.894198 | 10.003506 | 9.996494 | 45 | 55 |
| 6 | 30 | 9.102543 | 10.897457 | 9.106053 | 10.893947 | 10.003510 | 9.996490 | 30 | 54 |
| 7 | 45 | 9.102790 | 10.897210 | 9.106304 | 10.893696 | 10.003514 | 9.996486 | 15 | 53 |
| 8 | 17 | 9.103037 | 10.896963 | 9.106556 | 10.893444 | 10.003518 | 9.996482 | 43 | 52 |
| 9 | 15 | 9.103284 | 10.896716 | 9.106807 | 10.893193 | 10.003522 | 9.996478 | 45 | 51 |
| 10 | 30 | 9.103531 | 10.896469 | 9.107058 | 10.892942 | 10.003527 | 9.996473 | 30 | 50 |
| 11 | 45 | 9.103778 | 10.896222 | 9.107308 | 10.892692 | 10.003531 | 9.996469 | 15 | 49 |
| 12 | 18 | 9.104025 | 10.895975 | 9.107559 | 10.892441 | 10.003535 | 9.996465 | 42 | 48 |
| 13 | 15 | 9.104271 | 10.895729 | 9.107810 | 10.892190 | 10.003539 | 9.996461 | 45 | 47 |
| 14 | 30 | 9.104517 | 10.895483 | 9.108060 | 10.891940 | 10.003543 | 9.996457 | 30 | 46 |
| 15 | 45 | 9.104764 | 10.895236 | 9.108310 | 10.891690 | 10.003547 | 9.996453 | 15 | 45 |
| 16 | 19 | 9.105010 | 10.894990 | 9.108560 | 10.891440 | 10.003551 | 9.996449 | 41 | 44 |
| 17 | 15 | 9.105255 | 10.894745 | 9.108810 | 10.891190 | 10.003555 | 9.996445 | 45 | 43 |
| 18 | 30 | 9.105501 | 10.894499 | 9.109060 | 10.890940 | 10.003559 | 9.996441 | 30 | 42 |
| 19 | 45 | 9.105747 | 10.894253 | 9.109310 | 10.890690 | 10.003563 | 9.996437 | 15 | 41 |
| 20 | 20 | 9.105992 | 10.894008 | 9.109559 | 10.890441 | 10.003567 | 9.996433 | 40 | 40 |
| 21 | 15 | 9.106238 | 10.893762 | 9.109809 | 10.890191 | 10.003571 | 9.996429 | 45 | 39 |
| 22 | 30 | 9.106483 | 10.893517 | 9.110058 | 10.889942 | 10.003575 | 9.996425 | 30 | 38 |
| 23 | 45 | 9.106728 | 10.893272 | 9.110307 | 10.889693 | 10.003579 | 9.996421 | 15 | 37 |
| 24 | 21 | 9.106973 | 10.893027 | 9.110556 | 10.889444 | 10.003583 | 9.996417 | 39 | 36 |
| 25 | 15 | 9.107218 | 10.892782 | 9.110805 | 10.889195 | 10.003587 | 9.996413 | 45 | 35 |
| 26 | 30 | 9.107462 | 10.892538 | 9.111054 | 10.888946 | 10.003591 | 9.996409 | 30 | 34 |
| 27 | 45 | 9.107707 | 10.892293 | 9.111302 | 10.888698 | 10.003596 | 9.996404 | 15 | 33 |
| 28 | 22 | 9.107951 | 10.892049 | 9.111551 | 10.888449 | 10.003600 | 9.996400 | 38 | 32 |
| 29 | 15 | 9.108195 | 10.891805 | 9.111799 | 10.888201 | 10.003604 | 9.996396 | 45 | 31 |
| 30 | 30 | 9.108439 | 10.891561 | 9.112047 | 10.887953 | 10.003608 | 9.996392 | 30 | 30 |
| 31 | 45 | 9.108683 | 10.891317 | 9.112295 | 10.887705 | 10.003612 | 9.996388 | 15 | 29 |
| 32 | 23 | 9.108927 | 10.891073 | 9.112543 | 10.887457 | 10.003616 | 9.996384 | 37 | 28 |
| 33 | 15 | 9.109171 | 10.890829 | 9.112791 | 10.887209 | 10.003620 | 9.996380 | 45 | 27 |
| 34 | 30 | 9.109414 | 10.890586 | 9.113038 | 10.886962 | 10.003624 | 9.996376 | 30 | 26 |
| 35 | 45 | 9.109658 | 10.890342 | 9.113286 | 10.886714 | 10.003628 | 9.996372 | 15 | 25 |
| 36 | 24 | 9.109901 | 10.890099 | 9.113533 | 10.886467 | 10.003632 | 9.996368 | 36 | 24 |
| 37 | 15 | 9.110144 | 10.889856 | 9.113780 | 10.886220 | 10.003636 | 9.996364 | 45 | 23 |
| 38 | 30 | 9.110387 | 10.889613 | 9.114028 | 10.885972 | 10.003641 | 9.996359 | 30 | 22 |
| 39 | 45 | 9.110630 | 10.889370 | 9.114274 | 10.885726 | 10.003645 | 9.996355 | 15 | 21 |
| 40 | 25 | 9.110873 | 10.889127 | 9.114521 | 10.885479 | 10.003649 | 9.996351 | 35 | 20 |
| 41 | 15 | 9.111115 | 10.888885 | 9.114768 | 10.885232 | 10.003653 | 9.996347 | 45 | 19 |
| 42 | 30 | 9.111358 | 10.888642 | 9.115014 | 10.884986 | 10.003657 | 9.996343 | 30 | 18 |
| 43 | 45 | 9.111600 | 10.888400 | 9.115261 | 10.884739 | 10.003661 | 9.996339 | 15 | 17 |
| 44 | 26 | 9.111842 | 10.888158 | 9.115507 | 10.884493 | 10.003665 | 9.996335 | 34 | 16 |
| 45 | 15 | 9.112084 | 10.887916 | 9.115753 | 10.884247 | 10.003669 | 9.996331 | 45 | 15 |
| 46 | 30 | 9.112326 | 10.887674 | 9.115999 | 10.884001 | 10.003674 | 9.996326 | 30 | 14 |
| 47 | 45 | 9.112568 | 10.887432 | 9.116245 | 10.883755 | 10.003678 | 9.996322 | 15 | 13 |
| 48 | 27 | 9.112809 | 10.887191 | 9.116491 | 10.883509 | 10.003682 | 9.996318 | 33 | 12 |
| 49 | 15 | 9.113051 | 10.886949 | 9.116736 | 10.883264 | 10.003686 | 9.996314 | 45 | 11 |
| 50 | 30 | 9.113292 | 10.886708 | 9.116982 | 10.883018 | 10.003690 | 9.996310 | 30 | 10 |
| 51 | 45 | 9.113533 | 10.886467 | 9.117227 | 10.882773 | 10.003694 | 9.996306 | 15 | 9 |
| 52 | 28 | 9.113774 | 10.886226 | 9.117472 | 10.882528 | 10.003698 | 9.996302 | 32 | 8 |
| 53 | 15 | 9.114015 | 10.885985 | 9.117717 | 10.882283 | 10.003702 | 9.996298 | 45 | 7 |
| 54 | 30 | 9.114256 | 10.885744 | 9.117962 | 10.882038 | 10.003707 | 9.996293 | 30 | 6 |
| 55 | 45 | 9.114496 | 10.885504 | 9.118207 | 10.881793 | 10.003711 | 9.996289 | 15 | 5 |
| 56 | 29 | 9.114737 | 10.885263 | 9.118452 | 10.881548 | 10.003715 | 9.996285 | 31 | 4 |
| 57 | 15 | 9.114977 | 10.885023 | 9.118696 | 10.881304 | 10.003719 | 9.996281 | 45 | 3 |
| 58 | 30 | 9.115218 | 10.884782 | 9.118941 | 10.881059 | 10.003723 | 9.996277 | 30 | 2 |
| 59 | 45 | 9.115458 | 10.884542 | 9.119185 | 10.880815 | 10.003727 | 9.996273 | 15 | 1 |
| 60 | 30 | 9.115698 | 10.884302 | 9.119429 | 10.880571 | 10.003731 | 9.996269 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 30m. | | | | LOG SINES, &c. | | | | 82 deg. | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 0h 30m. | | LOG. SINES, &c. (t.) | | | | 7 deg. | | |
| 0 | 30 | 9.115698 | 10.884302 | 9.119429 | 10.880571 | 10.003731 | 9.996269 | 30 | 60 |
| 1 | 15 | 9.115937 | 10.884063 | 9.119673 | 10.880327 | 10.003736 | 9.996264 | 45 | 59 |
| 2 | 30 | 9.116177 | 10.883823 | 9.119917 | 10.880083 | 10.003740 | 9.996260 | 30 | 58 |
| 3 | 45 | 9.116417 | 10.883583 | 9.120161 | 10.879839 | 10.003744 | 9.996256 | 15 | 57 |
| 4 | 31 | 9.116656 | 10.883344 | 9.120404 | 10.879596 | 10.003748 | 9.996252 | 29 | 56 |
| 5 | 15 | 9.116895 | 10.883105 | 9.120648 | 10.879352 | 10.003752 | 9.996248 | 45 | 55 |
| 6 | 30 | 9.117135 | 10.882865 | 9.120891 | 10.879109 | 10.003756 | 9.996244 | 30 | 54 |
| 7 | 45 | 9.117374 | 10.882626 | 9.121134 | 10.878866 | 10.003761 | 9.996239 | 15 | 53 |
| 8 | 32 | 9.117612 | 10.882388 | 9.121377 | 10.878623 | 10.003765 | 9.996235 | 28 | 52 |
| 9 | 15 | 9.117851 | 10.882149 | 9.121620 | 10.878380 | 10.003769 | 9.996231 | 45 | 51 |
| 10 | 30 | 9.118090 | 10.881910 | 9.121863 | 10.878137 | 10.003773 | 9.996227 | 30 | 50 |
| 11 | 45 | 9.118328 | 10.881672 | 9.122106 | 10.877894 | 10.003777 | 9.996223 | 15 | 49 |
| 12 | 33 | 9.118567 | 10.881433 | 9.122348 | 10.877652 | 10.003782 | 9.996218 | 27 | 48 |
| 13 | 15 | 9.118805 | 10.881195 | 9.122591 | 10.877409 | 10.003786 | 9.996214 | 45 | 47 |
| 14 | 30 | 9.119043 | 10.880957 | 9.122833 | 10.877167 | 10.003790 | 9.996210 | 30 | 46 |
| 15 | 45 | 9.119281 | 10.880719 | 9.123075 | 10.876925 | 10.003794 | 9.996206 | 15 | 45 |
| 16 | 34 | 9.119519 | 10.880481 | 9.123317 | 10.876683 | 10.003798 | 9.996202 | 26 | 44 |
| 17 | 15 | 9.119756 | 10.880244 | 9.123559 | 10.876441 | 10.003803 | 9.996197 | 45 | 43 |
| 18 | 30 | 9.119994 | 10.880006 | 9.123801 | 10.876199 | 10.003807 | 9.996193 | 30 | 42 |
| 19 | 45 | 9.120231 | 10.879769 | 9.124042 | 10.875958 | 10.003811 | 9.996189 | 15 | 41 |
| 20 | 35 | 9.120469 | 10.879531 | 9.124284 | 10.875716 | 10.003815 | 9.996185 | 25 | 40 |
| 21 | 15 | 9.120706 | 10.879294 | 9.124525 | 10.875475 | 10.003819 | 9.996181 | 45 | 39 |
| 22 | 30 | 9.120943 | 10.879057 | 9.124766 | 10.875234 | 10.003824 | 9.996176 | 30 | 38 |
| 23 | 45 | 9.121180 | 10.878820 | 9.125008 | 10.874992 | 10.003828 | 9.996172 | 15 | 37 |
| 24 | 36 | 9.121417 | 10.878583 | 9.125249 | 10.874751 | 10.003832 | 9.996168 | 24 | 36 |
| 25 | 15 | 9.121653 | 10.878347 | 9.125489 | 10.874511 | 10.003836 | 9.996164 | 45 | 35 |
| 26 | 30 | 9.121890 | 10.878110 | 9.125730 | 10.874270 | 10.003840 | 9.996160 | 30 | 34 |
| 27 | 45 | 9.122126 | 10.877874 | 9.125971 | 10.874029 | 10.003845 | 9.996155 | 15 | 33 |
| 28 | 37 | 9.122362 | 10.877638 | 9.126211 | 10.873789 | 10.003849 | 9.996151 | 23 | 32 |
| 29 | 15 | 9.122598 | 10.877402 | 9.126451 | 10.873549 | 10.003853 | 9.996147 | 45 | 31 |
| 30 | 30 | 9.122834 | 10.877166 | 9.126692 | 10.873308 | 10.003857 | 9.996143 | 30 | 30 |
| 31 | 45 | 9.123070 | 10.876930 | 9.126932 | 10.873068 | 10.003862 | 9.996138 | 15 | 29 |
| 32 | 38 | 9.123306 | 10.876694 | 9.127172 | 10.872828 | 10.003866 | 9.996134 | 22 | 28 |
| 33 | 15 | 9.123542 | 10.876458 | 9.127412 | 10.872588 | 10.003870 | 9.996130 | 45 | 27 |
| 34 | 30 | 9.123777 | 10.876223 | 9.127651 | 10.872349 | 10.003874 | 9.996126 | 30 | 26 |
| 35 | 45 | 9.124012 | 10.875988 | 9.127891 | 10.872109 | 10.003878 | 9.996122 | 15 | 25 |
| 36 | 39 | 9.124248 | 10.875752 | 9.128130 | 10.871870 | 10.003883 | 9.996117 | 21 | 24 |
| 37 | 15 | 9.124483 | 10.875517 | 9.128370 | 10.871630 | 10.003887 | 9.996113 | 45 | 23 |
| 38 | 30 | 9.124718 | 10.875282 | 9.128609 | 10.871391 | 10.003891 | 9.996109 | 30 | 22 |
| 39 | 45 | 9.124952 | 10.875048 | 9.128848 | 10.871152 | 10.003895 | 9.996105 | 15 | 21 |
| 40 | 40 | 9.125187 | 10.874813 | 9.129087 | 10.870913 | 10.003900 | 9.996100 | 20 | 20 |
| 41 | 15 | 9.125422 | 10.874578 | 9.129326 | 10.870674 | 10.003904 | 9.996096 | 45 | 19 |
| 42 | 30 | 9.125656 | 10.874344 | 9.129564 | 10.870436 | 10.003908 | 9.996092 | 30 | 18 |
| 43 | 45 | 9.125890 | 10.874110 | 9.129803 | 10.870197 | 10.003912 | 9.996088 | 15 | 17 |
| 44 | 41 | 9.126125 | 10.873875 | 9.130041 | 10.869959 | 10.003917 | 9.996083 | 19 | 16 |
| 45 | 15 | 9.126359 | 10.873641 | 9.130280 | 10.869720 | 10.003921 | 9.996079 | 45 | 15 |
| 46 | 30 | 9.126593 | 10.873407 | 9.130518 | 10.869482 | 10.003925 | 9.996075 | 30 | 14 |
| 47 | 45 | 9.126826 | 10.873174 | 9.130756 | 10.869244 | 10.003929 | 9.996071 | 15 | 13 |
| 48 | 42 | 9.127060 | 10.872940 | 9.130994 | 10.869006 | 10.003934 | 9.996066 | 18 | 12 |
| 49 | 15 | 9.127294 | 10.872706 | 9.131231 | 10.868769 | 10.003938 | 9.996062 | 45 | 11 |
| 50 | 30 | 9.127527 | 10.872473 | 9.131469 | 10.868531 | 10.003942 | 9.996058 | 30 | 10 |
| 51 | 45 | 9.127760 | 10.872240 | 9.131707 | 10.868293 | 10.003947 | 9.996053 | 15 | 9 |
| 52 | 43 | 9.127993 | 10.872007 | 9.131944 | 10.868056 | 10.003951 | 9.996049 | 17 | 8 |
| 53 | 15 | 9.128226 | 10.871774 | 9.132181 | 10.867819 | 10.003955 | 9.996045 | 45 | 7 |
| 54 | 30 | 9.128459 | 10.871541 | 9.132419 | 10.867581 | 10.003959 | 9.996041 | 30 | 6 |
| 55 | 45 | 9.128692 | 10.871308 | 9.132656 | 10.867344 | 10.003964 | 9.996036 | 15 | 5 |
| 56 | 44 | 9.128925 | 10.871075 | 9.132893 | 10.867107 | 10.003968 | 9.996032 | 16 | 4 |
| 57 | 15 | 9.129157 | 10.870843 | 9.133129 | 10.866871 | 10.003972 | 9.996028 | 45 | 3 |
| 58 | 30 | 9.129390 | 10.870610 | 9.133366 | 10.866634 | 10.003977 | 9.996023 | 30 | 2 |
| 59 | 45 | 9.129622 | 10.870378 | 9.133603 | 10.866397 | 10.003981 | 9.996019 | 15 | 1 |
| 60 | 45 | 9.129854 | 10.870146 | 9.133839 | 10.866161 | 10.003985 | 9.996015 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 5h 29m. | | LOG. SINES, &c. | | | | 82 deg. | | |

| | 0h 31m. | | LOG. SINES, &c. (t) | | | 7 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.129854 | 10.870146 | 9.133839 | 10.866161 | 10.003985 | 9.996015 | 15 | 60 |
| 1 | 15 | 9.130086 | 10.869914 | 9.134075 | 10.865925 | 10.003989 | 9.996011 | 45 | 59 |
| 2 | 30 | 9.130318 | 10.869682 | 9.134311 | 10.865689 | 10.003994 | 9.996006 | 30 | 58 |
| 3 | 45 | 9.130550 | 10.869450 | 9.134548 | 10.865452 | 10.003998 | 9.996002 | 15 | 57 |
| 4 | 46 | 9.130781 | 10.869219 | 9.134783 | 10.865217 | 10.004002 | 9.995998 | 14 | 56 |
| 5 | 15 | 9.131013 | 10.868987 | 9.135019 | 10.864981 | 10.004007 | 9.995993 | 45 | 55 |
| 6 | 30 | 9.131244 | 10.868756 | 9.135255 | 10.864745 | 10.004011 | 9.995989 | 30 | 54 |
| 7 | 45 | 9.131475 | 10.868525 | 9.135491 | 10.864509 | 10.004015 | 9.995985 | 15 | 53 |
| 8 | 47 | 9.131706 | 10.868294 | 9.135726 | 10.864274 | 10.004020 | 9.995980 | 13 | 52 |
| 9 | 15 | 9.131937 | 10.868063 | 9.135961 | 10.864039 | 10.004024 | 9.995976 | 45 | 51 |
| 10 | 30 | 9.132168 | 10.867832 | 9.136196 | 10.863804 | 10.004028 | 9.995972 | 30 | 50 |
| 11 | 45 | 9.132399 | 10.867601 | 9.136432 | 10.863568 | 10.004033 | 9.995967 | 15 | 49 |
| 12 | 48 | 9.132630 | 10.867370 | 9.136666 | 10.863334 | 10.004037 | 9.995963 | 12 | 48 |
| 13 | 15 | 9.132860 | 10.867140 | 9.136901 | 10.863099 | 10.004041 | 9.995959 | 45 | 47 |
| 14 | 30 | 9.133091 | 10.866909 | 9.137136 | 10.862864 | 10.004046 | 9.995954 | 30 | 46 |
| 15 | 45 | 9.133321 | 10.866679 | 9.137371 | 10.862629 | 10.004050 | 9.995950 | 15 | 45 |
| 16 | 49 | 9.133551 | 10.866449 | 9.137605 | 10.862395 | 10.004054 | 9.995946 | 11 | 44 |
| 17 | 15 | 9.133781 | 10.866219 | 9.137839 | 10.862161 | 10.004059 | 9.995941 | 45 | 43 |
| 18 | 30 | 9.134011 | 10.865989 | 9.138074 | 10.861926 | 10.004063 | 9.995937 | 30 | 42 |
| 19 | 45 | 9.134241 | 10.865759 | 9.138308 | 10.861692 | 10.004067 | 9.995933 | 15 | 41 |
| 20 | 50 | 9.134470 | 10.865530 | 9.138542 | 10.861458 | 10.004072 | 9.995928 | 10 | 40 |
| 21 | 15 | 9.134700 | 10.865300 | 9.138776 | 10.861224 | 10.004076 | 9.995924 | 45 | 39 |
| 22 | 30 | 9.134929 | 10.865071 | 9.139009 | 10.860991 | 10.004080 | 9.995920 | 30 | 38 |
| 23 | 45 | 9.135158 | 10.864842 | 9.139243 | 10.860757 | 10.004085 | 9.995915 | 15 | 37 |
| 24 | 51 | 9.135387 | 10.864613 | 9.139476 | 10.860524 | 10.004089 | 9.995911 | 9 | 36 |
| 25 | 15 | 9.135616 | 10.864384 | 9.139710 | 10.860290 | 10.004093 | 9.995907 | 45 | 35 |
| 26 | 30 | 9.135845 | 10.864155 | 9.139943 | 10.860057 | 10.004098 | 9.995902 | 30 | 34 |
| 27 | 45 | 9.136074 | 10.863926 | 9.140176 | 10.859824 | 10.004102 | 9.995898 | 15 | 33 |
| 28 | 52 | 9.136303 | 10.863697 | 9.140409 | 10.859591 | 10.004106 | 9.995894 | 8 | 32 |
| 29 | 15 | 9.136531 | 10.863469 | 9.140642 | 10.859358 | 10.004111 | 9.995889 | 45 | 31 |
| 30 | 30 | 9.136760 | 10.863240 | 9.140875 | 10.859125 | 10.004115 | 9.995885 | 30 | 30 |
| 31 | 45 | 9.136988 | 10.863012 | 9.141107 | 10.858893 | 10.004120 | 9.995880 | 15 | 29 |
| 32 | 53 | 9.137216 | 10.862784 | 9.141340 | 10.858660 | 10.004124 | 9.995876 | 7 | 28 |
| 33 | 15 | 9.137444 | 10.862556 | 9.141572 | 10.858428 | 10.004128 | 9.995872 | 45 | 27 |
| 34 | 30 | 9.137672 | 10.862328 | 9.141805 | 10.858195 | 10.004133 | 9.995867 | 30 | 26 |
| 35 | 45 | 9.137900 | 10.862100 | 9.142037 | 10.857963 | 10.004137 | 9.995863 | 15 | 25 |
| 36 | 54 | 9.138127 | 10.861873 | 9.142269 | 10.857731 | 10.004141 | 9.995859 | 6 | 24 |
| 37 | 15 | 9.138355 | 10.861645 | 9.142501 | 10.857499 | 10.004146 | 9.995854 | 45 | 23 |
| 38 | 30 | 9.138582 | 10.861418 | 9.142733 | 10.857267 | 10.004150 | 9.995850 | 30 | 22 |
| 39 | 45 | 9.138810 | 10.861190 | 9.142964 | 10.857036 | 10.004155 | 9.995845 | 15 | 21 |
| 40 | 55 | 9.139037 | 10.860963 | 9.143196 | 10.856804 | 10.004159 | 9.995841 | 5 | 20 |
| 41 | 15 | 9.139264 | 10.860736 | 9.143427 | 10.856573 | 10.004163 | 9.995837 | 45 | 19 |
| 42 | 30 | 9.139491 | 10.860509 | 9.143659 | 10.856341 | 10.004168 | 9.995832 | 30 | 18 |
| 43 | 45 | 9.139718 | 10.860282 | 9.143890 | 10.856110 | 10.004172 | 9.995828 | 15 | 17 |
| 44 | 56 | 9.139944 | 10.860056 | 9.144121 | 10.855879 | 10.004177 | 9.995823 | 4 | 16 |
| 45 | 15 | 9.140171 | 10.859829 | 9.144352 | 10.855648 | 10.004181 | 9.995819 | 45 | 15 |
| 46 | 30 | 9.140397 | 10.859603 | 9.144583 | 10.855417 | 10.004185 | 9.995815 | 30 | 14 |
| 47 | 45 | 9.140624 | 10.859376 | 9.144814 | 10.855186 | 10.004190 | 9.995810 | 15 | 13 |
| 48 | 57 | 9.140850 | 10.859150 | 9.145044 | 10.854956 | 10.004194 | 9.995806 | 3 | 12 |
| 49 | 15 | 9.141076 | 10.858924 | 9.145275 | 10.854725 | 10.004199 | 9.995801 | 45 | 11 |
| 50 | 30 | 9.141302 | 10.858698 | 9.145505 | 10.854495 | 10.004203 | 9.995797 | 30 | 10 |
| 51 | 45 | 9.141528 | 10.858472 | 9.145735 | 10.854265 | 10.004207 | 9.995793 | 15 | 9 |
| 52 | 58 | 9.141754 | 10.858246 | 9.145965 | 10.854035 | 10.004212 | 9.995788 | 2 | 8 |
| 53 | 15 | 9.141979 | 10.858021 | 9.146195 | 10.853805 | 10.004216 | 9.995784 | 45 | 7 |
| 54 | 30 | 9.142205 | 10.857795 | 9.146425 | 10.853575 | 10.004221 | 9.995779 | 30 | 6 |
| 55 | 45 | 9.142430 | 10.857570 | 9.146655 | 10.853345 | 10.004225 | 9.995775 | 15 | 5 |
| 56 | 59 | 9.142655 | 10.857345 | 9.146885 | 10.853115 | 10.004230 | 9.995770 | 1 | 4 |
| 57 | 15 | 9.142881 | 10.857119 | 9.147114 | 10.852886 | 10.004234 | 9.995766 | 45 | 3 |
| 58 | 30 | 9.143106 | 10.856894 | 9.147344 | 10.852656 | 10.004238 | 9.995762 | 30 | 2 |
| 59 | 45 | 9.143330 | 10.856670 | 9.147573 | 10.852427 | 10.004243 | 9.995757 | 15 | 1 |
| 60 | 60 | 9.143555 | 10.856445 | 9.147802 | 10.852198 | 10.004247 | 9.995753 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 5h 28m. | | LOG. SINES, &c. | | | | | 82 deg. | |

| 0h 32m. | | | LOG. SINES, &c. (t.) | | | | 8 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.143555 | 10.856445 | 9.147802 | 10.852198 | 10.004247 | 9.995753 | 60 | 60 |
| 1 | 15 | 9.143780 | 10.856220 | 9.148032 | 10.851968 | 10.004252 | 9.995748 | 45 | 59 |
| 2 | 30 | 9.144004 | 10.855996 | 9.148261 | 10.851739 | 10.004256 | 9.995744 | 30 | 58 |
| 3 | 45 | 9.144229 | 10.855771 | 9.148489 | 10.851511 | 10.004261 | 9.995739 | 15 | 57 |
| 4 | 1 | 9.144453 | 10.855547 | 9.148718 | 10.851282 | 10.004265 | 9.995735 | 59 | 56 |
| 5 | 15 | 9.144677 | 10.855323 | 9.148947 | 10.851053 | 10.004269 | 9.995731 | 45 | 55 |
| 6 | 30 | 9.144901 | 10.855099 | 9.149175 | 10.850825 | 10.004274 | 9.995726 | 30 | 54 |
| 7 | 45 | 9.145125 | 10.854875 | 9.149404 | 10.850596 | 10.004278 | 9.995722 | 15 | 53 |
| 8 | 2 | 9.145349 | 10.854651 | 9.149632 | 10.850368 | 10.004283 | 9.995717 | 58 | 52 |
| 9 | 15 | 9.145573 | 10.854427 | 9.149860 | 10.850140 | 10.004287 | 9.995713 | 45 | 51 |
| 10 | 30 | 9.145797 | 10.854203 | 9.150088 | 10.849912 | 10.004292 | 9.995708 | 30 | 50 |
| 11 | 45 | 9.146020 | 10.853980 | 9.150316 | 10.849684 | 10.004296 | 9.995704 | 15 | 49 |
| 12 | 3 | 9.146243 | 10.853757 | 9.150544 | 10.849456 | 10.004301 | 9.995699 | 57 | 48 |
| 13 | 15 | 9.146467 | 10.853533 | 9.150772 | 10.849228 | 10.004305 | 9.995695 | 45 | 47 |
| 14 | 30 | 9.146690 | 10.853310 | 9.150999 | 10.849001 | 10.004310 | 9.995690 | 30 | 46 |
| 15 | 45 | 9.146913 | 10.853087 | 9.151227 | 10.848773 | 10.004314 | 9.995686 | 15 | 45 |
| 16 | 4 | 9.147136 | 10.852864 | 9.151454 | 10.848546 | 10.004319 | 9.995681 | 56 | 44 |
| 17 | 15 | 9.147359 | 10.852641 | 9.151682 | 10.848318 | 10.004323 | 9.995677 | 45 | 43 |
| 18 | 30 | 9.147581 | 10.852419 | 9.151909 | 10.848091 | 10.004328 | 9.995672 | 30 | 42 |
| 19 | 45 | 9.147804 | 10.852196 | 9.152136 | 10.847864 | 10.004332 | 9.995668 | 15 | 41 |
| 20 | 5 | 9.148026 | 10.851974 | 9.152363 | 10.847637 | 10.004337 | 9.995663 | 55 | 40 |
| 21 | 15 | 9.148248 | 10.851752 | 9.152589 | 10.847411 | 10.004341 | 9.995659 | 45 | 39 |
| 22 | 30 | 9.148471 | 10.851529 | 9.152816 | 10.847184 | 10.004345 | 9.995655 | 30 | 38 |
| 23 | 45 | 9.148693 | 10.851307 | 9.153043 | 10.846957 | 10.004350 | 9.995650 | 15 | 37 |
| 24 | 6 | 9.148915 | 10.851085 | 9.153269 | 10.846731 | 10.004354 | 9.995646 | 54 | 36 |
| 25 | 15 | 9.149137 | 10.850863 | 9.153496 | 10.846504 | 10.004359 | 9.995641 | 45 | 35 |
| 26 | 30 | 9.149358 | 10.850642 | 9.153722 | 10.846278 | 10.004363 | 9.995637 | 30 | 34 |
| 27 | 45 | 9.149580 | 10.850420 | 9.153948 | 10.846052 | 10.004368 | 9.995632 | 15 | 33 |
| 28 | 7 | 9.149801 | 10.850199 | 9.154174 | 10.845826 | 10.004372 | 9.995628 | 53 | 32 |
| 29 | 15 | 9.150023 | 10.849977 | 9.154400 | 10.845600 | 10.004377 | 9.995623 | 45 | 31 |
| 30 | 30 | 9.150244 | 10.849756 | 9.154626 | 10.845374 | 10.004381 | 9.995619 | 30 | 30 |
| 31 | 45 | 9.150465 | 10.849535 | 9.154851 | 10.845149 | 10.004386 | 9.995614 | 15 | 29 |
| 32 | 8 | 9.150686 | 10.849314 | 9.155077 | 10.844923 | 10.004391 | 9.995609 | 52 | 28 |
| 33 | 15 | 9.150907 | 10.849093 | 9.155302 | 10.844698 | 10.004395 | 9.995605 | 45 | 27 |
| 34 | 30 | 9.151128 | 10.848872 | 9.155528 | 10.844472 | 10.004400 | 9.995600 | 30 | 26 |
| 35 | 45 | 9.151349 | 10.848651 | 9.155753 | 10.844247 | 10.004404 | 9.995596 | 15 | 25 |
| 36 | 9 | 9.151569 | 10.848431 | 9.155978 | 10.844022 | 10.004409 | 9.995591 | 51 | 24 |
| 37 | 15 | 9.151790 | 10.848210 | 9.156203 | 10.843797 | 10.004413 | 9.995587 | 45 | 23 |
| 38 | 30 | 9.152010 | 10.847990 | 9.156428 | 10.843572 | 10.004418 | 9.995582 | 30 | 22 |
| 39 | 45 | 9.152230 | 10.847770 | 9.156653 | 10.843347 | 10.004422 | 9.995578 | 15 | 21 |
| 40 | 10 | 9.152451 | 10.847549 | 9.156877 | 10.843123 | 10.004427 | 9.995573 | 50 | 20 |
| 41 | 15 | 9.152671 | 10.847329 | 9.157102 | 10.842898 | 10.004431 | 9.995569 | 45 | 19 |
| 42 | 30 | 9.152891 | 10.847109 | 9.157326 | 10.842674 | 10.004436 | 9.995564 | 30 | 18 |
| 43 | 45 | 9.153110 | 10.846890 | 9.157551 | 10.842449 | 10.004440 | 9.995560 | 15 | 17 |
| 44 | 11 | 9.153330 | 10.846670 | 9.157775 | 10.842225 | 10.004445 | 9.995555 | 49 | 16 |
| 45 | 15 | 9.153550 | 10.846450 | 9.157999 | 10.842001 | 10.004449 | 9.995551 | 45 | 15 |
| 46 | 30 | 9.153769 | 10.846231 | 9.158223 | 10.841777 | 10.004454 | 9.995546 | 30 | 14 |
| 47 | 45 | 9.153988 | 10.846012 | 9.158447 | 10.841553 | 10.004458 | 9.995542 | 15 | 13 |
| 48 | 12 | 9.154208 | 10.845792 | 9.158671 | 10.841329 | 10.004463 | 9.995537 | 48 | 12 |
| 49 | 15 | 9.154427 | 10.845573 | 9.158894 | 10.841106 | 10.004468 | 9.995532 | 45 | 11 |
| 50 | 30 | 9.154646 | 10.845354 | 9.159118 | 10.840882 | 10.004472 | 9.995528 | 30 | 10 |
| 51 | 45 | 9.154865 | 10.845135 | 9.159341 | 10.840659 | 10.004477 | 9.995523 | 15 | 9 |
| 52 | 13 | 9.155083 | 10.844917 | 9.159565 | 10.840435 | 10.004481 | 9.995519 | 47 | 8 |
| 53 | 15 | 9.155302 | 10.844698 | 9.159788 | 10.840212 | 10.004486 | 9.995514 | 45 | 7 |
| 54 | 30 | 9.155521 | 10.844479 | 9.160011 | 10.839989 | 10.004490 | 9.995510 | 30 | 6 |
| 55 | 45 | 9.155739 | 10.844261 | 9.160234 | 10.839766 | 10.004495 | 9.995505 | 15 | 5 |
| 56 | 14 | 9.155957 | 10.844043 | 9.160457 | 10.839543 | 10.004500 | 9.995500 | 46 | 4 |
| 57 | 15 | 9.156176 | 10.843824 | 9.160680 | 10.839320 | 10.004504 | 9.995496 | 45 | 3 |
| 58 | 30 | 9.156394 | 10.843606 | 9.160902 | 10.839098 | 10.004509 | 9.995491 | 30 | 2 |
| 59 | 45 | 9.156612 | 10.843388 | 9.161125 | 10.838875 | 10.004513 | 9.995487 | 15 | 1 |
| 60 | 15 | 9.156830 | 10.843170 | 9.161347 | 10.838653 | 10.004518 | 9.995482 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine | ″ ′ | sec. |
| 5h 27m. | | | LOG. SINES, &c. | | | | 81 deg. | | |

| 0h 33m. | | | LOG. SINES, &c. (t.) | | | | 8 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.156830 | 10.843170 | 9.161347 | 10.838653 | 10.004518 | 9.995482 | 45 | 60 |
| 1 | 15 | 9.157047 | 10.842953 | 9.161570 | 10.838430 | 10.004522 | 9.995478 | 45 | 59 |
| 2 | 30 | 9.157265 | 10.842735 | 9.161792 | 10.838208 | 10.004527 | 9.995473 | 30 | 58 |
| 3 | 45 | 9.157482 | 10.842518 | 9.162014 | 10.837986 | 10.004532 | 9.995468 | 15 | 57 |
| 4 | 16 | 9.157700 | 10.842300 | 9.162236 | 10.837764 | 10.004536 | 9.995464 | 44 | 56 |
| 5 | 15 | 9.157917 | 10.842083 | 9.162458 | 10.837542 | 10.004541 | 9.995459 | 45 | 55 |
| 6 | 30 | 9.158134 | 10.841866 | 9.162680 | 10.837320 | 10.004545 | 9.995455 | 30 | 54 |
| 7 | 45 | 9.158352 | 10.841648 | 9.162901 | 10.837099 | 10.004550 | 9.995450 | 15 | 53 |
| 8 | 17 | 9.158569 | 10.841431 | 9.163123 | 10.836877 | 10.004555 | 9.995445 | 43 | 52 |
| 9 | 15 | 9.158785 | 10.841215 | 9.163344 | 10.836656 | 10.004559 | 9.995441 | 45 | 51 |
| 10 | 30 | 9.159002 | 10.840998 | 9.163566 | 10.836434 | 10.004564 | 9.995436 | 30 | 50 |
| 11 | 45 | 9.159219 | 10.840781 | 9.163787 | 10.836213 | 10.004568 | 9.995432 | 15 | 49 |
| 12 | 18 | 9.159435 | 10.840565 | 9.164008 | 10.835992 | 10.004573 | 9.995427 | 42 | 48 |
| 13 | 15 | 9.159652 | 10.840348 | 9.164229 | 10.835771 | 10.004578 | 9.995422 | 45 | 47 |
| 14 | 30 | 9.159868 | 10.840132 | 9.164450 | 10.835550 | 10.004582 | 9.995418 | 30 | 46 |
| 15 | 45 | 9.160084 | 10.839916 | 9.164671 | 10.835329 | 10.004587 | 9.995413 | 15 | 45 |
| 16 | 19 | 9.160300 | 10.839700 | 9.164892 | 10.835108 | 10.004591 | 9.995409 | 41 | 44 |
| 17 | 15 | 9.160516 | 10.839484 | 9.165112 | 10.834888 | 10.004596 | 9.995404 | 45 | 43 |
| 18 | 30 | 9.160732 | 10.839268 | 9.165333 | 10.834667 | 10.004601 | 9.995399 | 30 | 42 |
| 19 | 45 | 9.160948 | 10.839052 | 9.165553 | 10.834447 | 10.004605 | 9.995395 | 15 | 41 |
| 20 | 20 | 9.161164 | 10.838836 | 9.165774 | 10.834226 | 10.004610 | 9.995390 | 40 | 40 |
| 21 | 15 | 9.161379 | 10.838621 | 9.165994 | 10.834006 | 10.004614 | 9.995386 | 45 | 39 |
| 22 | 30 | 9.161595 | 10.838405 | 9.166214 | 10.833786 | 10.004619 | 9.995381 | 30 | 38 |
| 23 | 45 | 9.161810 | 10.838190 | 9.166434 | 10.833566 | 10.004624 | 9.995376 | 15 | 37 |
| 24 | 21 | 9.162025 | 10.837975 | 9.166654 | 10.833346 | 10.004628 | 9.995372 | 39 | 36 |
| 25 | 15 | 9.162241 | 10.837759 | 9.166873 | 10.833127 | 10.004633 | 9.995367 | 45 | 35 |
| 26 | 30 | 9.162456 | 10.837544 | 9.167093 | 10.832907 | 10.004638 | 9.995362 | 30 | 34 |
| 27 | 45 | 9.162670 | 10.837330 | 9.167313 | 10.832687 | 10.004642 | 9.995358 | 15 | 33 |
| 28 | 22 | 9.162885 | 10.837115 | 9.167532 | 10.832468 | 10.004647 | 9.995353 | 38 | 32 |
| 29 | 15 | 9.163100 | 10.836900 | 9.167751 | 10.832249 | 10.004652 | 9.995348 | 45 | 31 |
| 30 | 30 | 9.163315 | 10.836685 | 9.167971 | 10.832029 | 10.004656 | 9.995344 | 30 | 30 |
| 31 | 45 | 9.163529 | 10.836471 | 9.168190 | 10.831810 | 10.004661 | 9.995339 | 15 | 29 |
| 32 | 23 | 9.163743 | 10.836257 | 9.168409 | 10.831591 | 10.004666 | 9.995334 | 37 | 28 |
| 33 | 15 | 9.163958 | 10.836042 | 9.168628 | 10.831372 | 10.004670 | 9.995330 | 45 | 27 |
| 34 | 30 | 9.164172 | 10.835828 | 9.168847 | 10.831153 | 10.004675 | 9.995325 | 30 | 26 |
| 35 | 45 | 9.164386 | 10.835614 | 9.169065 | 10.830935 | 10.004680 | 9.995320 | 15 | 25 |
| 36 | 24 | 9.164600 | 10.835400 | 9.169284 | 10.830716 | 10.004684 | 9.995316 | 36 | 24 |
| 37 | 15 | 9.164814 | 10.835186 | 9.169502 | 10.830498 | 10.004689 | 9.995311 | 45 | 23 |
| 38 | 30 | 9.165027 | 10.834973 | 9.169721 | 10.830279 | 10.004694 | 9.995306 | 30 | 22 |
| 39 | 45 | 9.165241 | 10.834759 | 9.169939 | 10.830061 | 10.004698 | 9.995302 | 15 | 21 |
| 40 | 25 | 9.165454 | 10.834546 | 9.170157 | 10.829843 | 10.004703 | 9.995297 | 35 | 20 |
| 41 | 15 | 9.165668 | 10.834332 | 9.170375 | 10.829625 | 10.004708 | 9.995292 | 45 | 19 |
| 42 | 30 | 9.165881 | 10.834119 | 9.170593 | 10.829407 | 10.004712 | 9.995288 | 30 | 18 |
| 43 | 45 | 9.166094 | 10.833906 | 9.170811 | 10.829189 | 10.004717 | 9.995283 | 15 | 17 |
| 44 | 26 | 9.166307 | 10.833693 | 9.171029 | 10.828971 | 10.004722 | 9.995278 | 34 | 16 |
| 45 | 15 | 9.166520 | 10.833480 | 9.171246 | 10.828754 | 10.004726 | 9.995274 | 45 | 15 |
| 46 | 30 | 9.166733 | 10.833267 | 9.171464 | 10.828536 | 10.004731 | 9.995269 | 30 | 14 |
| 47 | 45 | 9.166946 | 10.833054 | 9.171681 | 10.828319 | 10.004736 | 9.995264 | 15 | 13 |
| 48 | 27 | 9.167159 | 10.832841 | 9.171899 | 10.828101 | 10.004740 | 9.995260 | 33 | 12 |
| 49 | 15 | 9.167371 | 10.832629 | 9.172116 | 10.827884 | 10.004745 | 9.995255 | 45 | 11 |
| 50 | 30 | 9.167584 | 10.832416 | 9.172333 | 10.827667 | 10.004750 | 9.995250 | 30 | 10 |
| 51 | 45 | 9.167796 | 10.832204 | 9.172550 | 10.827450 | 10.004754 | 9.995246 | 15 | 9 |
| 52 | 28 | 9 168008 | 10.831992 | 9.172767 | 10.827233 | 10.004759 | 9.995241 | 32 | 8 |
| 53 | 15 | 9 168220 | 10.831780 | 9.172984 | 10.827016 | 10.004764 | 9.995236 | 45 | 7 |
| 54 | 30 | 9 168432 | 10.831568 | 9.173201 | 10.826799 | 10.004769 | 9.995231 | 30 | 6 |
| 55 | 45 | 9.168644 | 10.831356 | 9.173417 | 10.826583 | 10.004773 | 9.995227 | 15 | 5 |
| 56 | 29 | 9.168856 | 10.831144 | 9.173634 | 10.826366 | 10.004778 | 9.995222 | 31 | 4 |
| 57 | 15 | 9.169068 | 10.830932 | 9.173850 | 10.826150 | 10.004783 | 9.995217 | 45 | 3 |
| 58 | 30 | 9.169279 | 10.830721 | 9.174066 | 10.825934 | 10.004787 | 9.995213 | 30 | 2 |
| 59 | 45 | 9.169491 | 10.830509 | 9.174283 | 10.825717 | 10.004792 | 9.995208 | 15 | 1 |
| 60 | 30 | 9.169702 | 10.830298 | 9.174499 | 10.825501 | 10.004797 | 9.995203 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 26m. | | | LOG. SINES, &c. | | | | 81 deg. | | |

| 0h 34m. | | | LOG. SINES, &c. (t.) | | | | 8 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.169702 | 10.830298 | 9.174499 | 10.825501 | 10.004797 | 9.995203 | 30 | 60 |
| 1 | 15 | 9.169913 | 10.830087 | 9.174715 | 10.825285 | 10.004802 | 9.995198 | 45 | 59 |
| 2 | 30 | 9.170124 | 10.829876 | 9.174931 | 10.825069 | 10.004806 | 9.995194 | 30 | 58 |
| 3 | 45 | 9.170336 | 10.829664 | 9.175146 | 10.824854 | 10.004811 | 9.995189 | 15 | 57 |
| 4 | 31 | 9.170546 | 10.829454 | 9.175362 | 10.824638 | 10.004816 | 9.995184 | 29 | 56 |
| 5 | 15 | 9.170757 | 10.829243 | 9.175578 | 10.824422 | 10.004820 | 9.995180 | 45 | 55 |
| 6 | 30 | 9.170968 | 10.829032 | 9.175793 | 10.824207 | 10.004825 | 9.995175 | 30 | 54 |
| 7 | 45 | 9.171179 | 10.828821 | 9.176009 | 10.823991 | 10.004830 | 9.995170 | 15 | 53 |
| 8 | 32 | 9.171389 | 10.828611 | 9.176224 | 10.823776 | 10.004835 | 9.995165 | 28 | 52 |
| 9 | 15 | 9.171600 | 10.828400 | 9.176439 | 10.823561 | 10.004839 | 9.995161 | 45 | 51 |
| 10 | 30 | 9.171810 | 10.828190 | 9.176654 | 10.823346 | 10.004844 | 9.995156 | 30 | 50 |
| 11 | 45 | 9.172020 | 10.827980 | 9.176869 | 10.823131 | 10.004849 | 9.995151 | 15 | 49 |
| 12 | 33 | 9.172230 | 10.827770 | 9.177084 | 10.822916 | 10.004854 | 9.995146 | 27 | 48 |
| 13 | 15 | 9.172440 | 10.827560 | 9.177299 | 10.822701 | 10.004858 | 9.995142 | 45 | 47 |
| 14 | 30 | 9.172650 | 10.827350 | 9.177513 | 10.822487 | 10.004863 | 9.995137 | 30 | 46 |
| 15 | 45 | 9.172860 | 10.827140 | 9.177728 | 10.822272 | 10.004868 | 9.995132 | 15 | 45 |
| 16 | 34 | 9.173070 | 10.826930 | 9.177942 | 10.822058 | 10.004873 | 9.995127 | 26 | 44 |
| 17 | 15 | 9.173279 | 10.826721 | 9.178157 | 10.821843 | 10.004877 | 9.995123 | 45 | 43 |
| 18 | 30 | 9.173489 | 10.826511 | 9.178371 | 10.821629 | 10.004882 | 9.995118 | 30 | 42 |
| 19 | 45 | 9.173698 | 10.826302 | 9.178585 | 10.821415 | 10.004887 | 9.995113 | 15 | 41 |
| 20 | 35 | 9.173908 | 10.826092 | 9.178799 | 10.821201 | 10.004892 | 9.995108 | 25 | 40 |
| 21 | 15 | 9.174117 | 10.825883 | 9.179013 | 10.820987 | 10.004896 | 9.995104 | 45 | 39 |
| 22 | 30 | 9.174326 | 10.825674 | 9.179227 | 10.820773 | 10.004901 | 9.995099 | 30 | 38 |
| 23 | 45 | 9.174535 | 10.825465 | 9.179441 | 10.820559 | 10.004906 | 9.995094 | 15 | 37 |
| 24 | 36 | 9.174744 | 10.825256 | 9.179655 | 10.820345 | 10.004911 | 9.995089 | 24 | 36 |
| 25 | 15 | 9.174953 | 10.825047 | 9.179868 | 10.820132 | 10.004916 | 9.995084 | 45 | 35 |
| 26 | 30 | 9.175161 | 10.824839 | 9.180082 | 10.819918 | 10.004920 | 9.995080 | 30 | 34 |
| 27 | 45 | 9.175370 | 10.824630 | 9.180295 | 10.819705 | 10.004925 | 9.995075 | 15 | 33 |
| 28 | 37 | 9.175578 | 10.824422 | 9.180508 | 10.819492 | 10.004930 | 9.995070 | 23 | 32 |
| 29 | 15 | 9.175787 | 10.824213 | 9.180721 | 10.819279 | 10.004935 | 9.995065 | 45 | 31 |
| 30 | 30 | 9.175995 | 10.824005 | 9.180934 | 10.819066 | 10.004939 | 9.995061 | 30 | 30 |
| 31 | 45 | 9.176203 | 10.823797 | 9.181147 | 10.818853 | 10.004944 | 9.995056 | 15 | 29 |
| 32 | 38 | 9.176411 | 10.823589 | 9.181360 | 10.818640 | 10.004949 | 9.995051 | 22 | 28 |
| 33 | 15 | 9.176619 | 10.823381 | 9.181573 | 10.818427 | 10.004954 | 9.995046 | 45 | 27 |
| 34 | 30 | 9.176827 | 10.823173 | 9.181786 | 10.818214 | 10.004959 | 9.995041 | 30 | 26 |
| 35 | 45 | 9.177035 | 10.822965 | 9.181998 | 10.818002 | 10.004963 | 9.995037 | 15 | 25 |
| 36 | 39 | 9.177242 | 10.822758 | 9.182211 | 10.817789 | 10.004968 | 9.995032 | 21 | 24 |
| 37 | 15 | 9.177450 | 10.822550 | 9.182423 | 10.817577 | 10.004973 | 9.995027 | 45 | 23 |
| 38 | 30 | 9.177657 | 10.822343 | 9.182635 | 10.817365 | 10.004978 | 9.995022 | 30 | 22 |
| 39 | 45 | 9.177865 | 10.822135 | 9.182847 | 10.817153 | 10.004983 | 9.995017 | 15 | 21 |
| 40 | 40 | 9.178072 | 10.821928 | 9.183059 | 10.816941 | 10.004987 | 9.995013 | 20 | 20 |
| 41 | 15 | 9.178279 | 10.821721 | 9.183271 | 10.816729 | 10.004992 | 9.995008 | 45 | 19 |
| 42 | 30 | 9.178486 | 10.821514 | 9.183483 | 10.816517 | 10.004997 | 9.995003 | 30 | 18 |
| 43 | 45 | 9.178693 | 10.821307 | 9.183695 | 10.816305 | 10.005002 | 9.994998 | 15 | 17 |
| 44 | 41 | 9.178900 | 10.821100 | 9.183907 | 10.816093 | 10.005007 | 9.994993 | 19 | 16 |
| 45 | 15 | 9.179107 | 10.820893 | 9.184118 | 10.815882 | 10.005012 | 9.994988 | 45 | 15 |
| 46 | 30 | 9.179313 | 10.820687 | 9.184330 | 10.815670 | 10.005016 | 9.994984 | 30 | 14 |
| 47 | 45 | 9.179520 | 10.820480 | 9.184541 | 10.815459 | 10.005021 | 9.994979 | 15 | 13 |
| 48 | 42 | 9.179726 | 10.820274 | 9.184752 | 10.815248 | 10.005026 | 9.994974 | 18 | 12 |
| 49 | 15 | 9.179933 | 10.820067 | 9.184964 | 10.815036 | 10.005031 | 9.994969 | 45 | 11 |
| 50 | 30 | 9.180139 | 10.819861 | 9.185175 | 10.814825 | 10.005036 | 9.994964 | 30 | 10 |
| 51 | 45 | 9.180345 | 10.819655 | 9.185386 | 10.814614 | 10.005041 | 9.994959 | 15 | 9 |
| 52 | 43 | 9.180551 | 10.819449 | 9.185597 | 10.814403 | 10.005045 | 9.994955 | 17 | 8 |
| 53 | 15 | 9.180757 | 10.819243 | 9.185807 | 10.814193 | 10.005050 | 9.994950 | 45 | 7 |
| 54 | 30 | 9.180963 | 10.819037 | 9.186018 | 10.813982 | 10.005055 | 9.994945 | 30 | 6 |
| 55 | 45 | 9.181169 | 10.818831 | 9.186229 | 10.813771 | 10.005060 | 9.994940 | 15 | 5 |
| 56 | 44 | 9.181374 | 10.818626 | 9.186439 | 10.813561 | 10.005065 | 9.994935 | 16 | 4 |
| 57 | 15 | 9.181580 | 10.818420 | 9.186649 | 10.813351 | 10.005070 | 9.994930 | 45 | 3 |
| 58 | 30 | 9.181785 | 10.818215 | 9.186860 | 10.813140 | 10.005075 | 9.994925 | 30 | 2 |
| 59 | 45 | 9.181991 | 10.818009 | 9.187070 | 10.812930 | 10.005079 | 9.994921 | 15 | 1 |
| 60 | 45 | 9.182196 | 10.817804 | 9.187280 | 10.812720 | 10.005084 | 9.994916 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 25m. | | | LOG. SINES, &c. | | | | 81 deg. | | |

| $0^h\ 35^m$. | | LOG. SINES, &c. (t.) | | | | 8 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.182196 | 10.817804 | 9.187280 | 10.812720 | 10.005084 | 9.994916 | 15 | 60 |
| 1 | 15 | 9.182401 | 10.817599 | 9.187490 | 10.812510 | 10.005089 | 9.994911 | 45 | 59 |
| 2 | 30 | 9.182606 | 10.817394 | 9.187700 | 10.812300 | 10.005094 | 9.994906 | 30 | 58 |
| 3 | 45 | 9.182811 | 10.817189 | 9.187910 | 10.812090 | 10.005099 | 9.994901 | 15 | 57 |
| 4 | 46 | 9.183016 | 10.816984 | 9.188120 | 10.811880 | 10.005104 | 9.994896 | 14 | 56 |
| 5 | 15 | 9.183221 | 10.816779 | 9.188329 | 10.811671 | 10.005109 | 9.994891 | 45 | 55 |
| 6 | 30 | 9.183425 | 10.816575 | 9.188539 | 10.811461 | 10.005113 | 9.994887 | 30 | 54 |
| 7 | 45 | 9.183630 | 10.816370 | 9.188748 | 10.811252 | 10.005118 | 9.994882 | 15 | 53 |
| 8 | 47 | 9.183834 | 10.816166 | 9.188957 | 10.811043 | 10.005123 | 9.994877 | 13 | 52 |
| 9 | 15 | 9.184039 | 10.815961 | 9.189167 | 10.810833 | 10.005128 | 9.994872 | 45 | 51 |
| 10 | 30 | 9.184243 | 10.815757 | 9.189376 | 10.810624 | 10.005133 | 9.994867 | 30 | 50 |
| 11 | 45 | 9.184447 | 10.815553 | 9.189585 | 10.810415 | 10.005138 | 9.994862 | 15 | 49 |
| 12 | 48 | 9.184651 | 10.815349 | 9.189794 | 10.810206 | 10.005143 | 9.994857 | 12 | 48 |
| 13 | 15 | 9.184855 | 10.815145 | 9.190003 | 10.809997 | 10.005148 | 9.994852 | 45 | 47 |
| 14 | 30 | 9.185059 | 10.814941 | 9.190211 | 10.809789 | 10.005153 | 9.994847 | 30 | 46 |
| 15 | 45 | 9.185263 | 10.814737 | 9.190420 | 10.809580 | 10.005157 | 9.994843 | 15 | 45 |
| 16 | 49 | 9.185466 | 10.814534 | 9.190629 | 10.809371 | 10.005162 | 9.994838 | 11 | 44 |
| 17 | 15 | 9.185670 | 10.814330 | 9.190837 | 10.809163 | 10.005167 | 9.994833 | 45 | 43 |
| 18 | 30 | 9.185873 | 10.814127 | 9.191046 | 10.808954 | 10.005172 | 9.994828 | 30 | 42 |
| 19 | 45 | 9.186077 | 10.813923 | 9.191254 | 10.808746 | 10.005177 | 9.994823 | 15 | 41 |
| 20 | 50 | 9.186280 | 10.813720 | 9.191462 | 10.808538 | 10.005182 | 9.994818 | 10 | 40 |
| 21 | 15 | 9.186483 | 10.813517 | 9.191670 | 10.808330 | 10.005187 | 9.994813 | 45 | 39 |
| 22 | 30 | 9.186686 | 10.813314 | 9.191878 | 10.808122 | 10.005192 | 9.994808 | 30 | 38 |
| 23 | 45 | 9.186889 | 10.813111 | 9.192086 | 10.807914 | 10.005197 | 9.994803 | 15 | 37 |
| 24 | 51 | 9.187092 | 10.812908 | 9.192294 | 10.807706 | 10.005202 | 9.994798 | 9 | 36 |
| 25 | 15 | 9.187295 | 10.812705 | 9.192502 | 10.807498 | 10.005206 | 9.994794 | 45 | 35 |
| 26 | 30 | 9.187498 | 10.812502 | 9.192709 | 10.807291 | 10.005211 | 9.994789 | 30 | 34 |
| 27 | 45 | 9.187700 | 10.812300 | 9.192917 | 10.807083 | 10.005216 | 9.994784 | 15 | 33 |
| 28 | 52 | 9.187903 | 10.812097 | 9.193124 | 10.806876 | 10.005221 | 9.994779 | 8 | 32 |
| 29 | 15 | 9.188105 | 10.811895 | 9.193331 | 10.806669 | 10.005226 | 9.994774 | 45 | 31 |
| 30 | 30 | 9.188308 | 10.811692 | 9.193539 | 10.806461 | 10.005231 | 9.994769 | 30 | 30 |
| 31 | 45 | 9.188510 | 10.811490 | 9.193746 | 10.806254 | 10.005236 | 9.994764 | 15 | 29 |
| 32 | 53 | 9.188712 | 10.811288 | 9.193953 | 10.806047 | 10.005241 | 9.994759 | 7 | 28 |
| 33 | 15 | 9.188914 | 10.811086 | 9.194160 | 10.805840 | 10.005246 | 9.994754 | 45 | 27 |
| 34 | 30 | 9.189116 | 10.810884 | 9.194367 | 10.805633 | 10.005251 | 9.994749 | 30 | 26 |
| 35 | 45 | 9.189318 | 10.810682 | 9.194573 | 10.805427 | 10.005256 | 9.994744 | 15 | 25 |
| 36 | 54 | 9.189519 | 10.810481 | 9.194780 | 10.805220 | 10.005261 | 9.994739 | 6 | 24 |
| 37 | 15 | 9.189721 | 10.810279 | 9.194987 | 10.805013 | 10.005266 | 9.994734 | 45 | 23 |
| 38 | 30 | 9.189923 | 10.810077 | 9.195193 | 10.804807 | 10.005271 | 9.994729 | 30 | 22 |
| 39 | 45 | 9.190124 | 10.809876 | 9.195400 | 10.804600 | 10.005276 | 9.994724 | 15 | 21 |
| 40 | 55 | 9.190325 | 10.809675 | 9.195606 | 10.804394 | 10.005281 | 9.994719 | 5 | 20 |
| 41 | 15 | 9.190527 | 10.809473 | 9.195812 | 10.804188 | 10.005286 | 9.994714 | 45 | 19 |
| 42 | 30 | 9.190728 | 10.809272 | 9.196018 | 10.803982 | 10.005290 | 9.994710 | 30 | 18 |
| 43 | 45 | 9.190929 | 10.809071 | 9.196224 | 10.803776 | 10.005295 | 9.994705 | 15 | 17 |
| 44 | 56 | 9.191130 | 10.808870 | 9.196430 | 10.803570 | 10.005300 | 9.994700 | 4 | 16 |
| 45 | 15 | 9.191331 | 10.808669 | 9.196636 | 10.803364 | 10.005305 | 9.994695 | 45 | 15 |
| 46 | 30 | 9.191531 | 10.808469 | 9.196842 | 10.803158 | 10.005310 | 9.994690 | 30 | 14 |
| 47 | 45 | 9.191732 | 10.808268 | 9.197047 | 10.802953 | 10.005315 | 9.994685 | 15 | 13 |
| 48 | 57 | 9.191933 | 10.808067 | 9.197253 | 10.802747 | 10.005320 | 9.994680 | 3 | 12 |
| 49 | 15 | 9.192133 | 10.807867 | 9.197458 | 10.802542 | 10.005325 | 9.994675 | 45 | 11 |
| 50 | 30 | 9.192334 | 10.807666 | 9.197664 | 10.802336 | 10.005330 | 9.994670 | 30 | 10 |
| 51 | 45 | 9.192534 | 10.807466 | 9.197869 | 10.802131 | 10.005335 | 9.994665 | 15 | 9 |
| 52 | 58 | 9.192734 | 10.807266 | 9.198074 | 10.801926 | 10.005340 | 9.994660 | 2 | 8 |
| 53 | 15 | 9.192934 | 10.807066 | 9.198279 | 10.801721 | 10.005345 | 9.994655 | 45 | 7 |
| 54 | 30 | 9.193134 | 10.806866 | 9.198484 | 10.801516 | 10.005350 | 9.994650 | 30 | 6 |
| 55 | 45 | 9.193334 | 10.806666 | 9.198689 | 10.801311 | 10.005355 | 9.994645 | 15 | 5 |
| 56 | 59 | 9.193534 | 10.806466 | 9.198894 | 10.801106 | 10.005360 | 9.994640 | 1 | 4 |
| 57 | 15 | 9.193734 | 10.806266 | 9.199099 | 10.800901 | 10.005365 | 9.994635 | 45 | 3 |
| 58 | 30 | 9.193933 | 10.806067 | 9.199303 | 10.800697 | 10.005370 | 9.994630 | 30 | 2 |
| 59 | 45 | 9.194133 | 10.805867 | 9.199508 | 10.800492 | 10.005375 | 9.994625 | 15 | 1 |
| 60 | 60 | 9.194332 | 10.805668 | 9.199712 | 10.800288 | 10.005380 | 9.994620 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| $5^h\ 24^m$. | | LOG. SINES, &c. | | | | 81 deg. | | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 0h 36m. | | LOG. SINES, &c. (t.) | | | | | 9 deg. | |
| 0 | 0 | 9.194332 | 10.805668 | 9.199712 | 10.800288 | 10.005380 | 9.994620 | 60 | 60 |
| 1 | 15 | 9.194532 | 10.805468 | 9.199917 | 10.800083 | 10.005385 | 9.994615 | 45 | 59 |
| 2 | 30 | 9.194731 | 10.805269 | 9.200121 | 10.799879 | 10.005390 | 9.994610 | 30 | 58 |
| 3 | 45 | 9.194930 | 10.805070 | 9.200325 | 10.799675 | 10.005395 | 9.994605 | 15 | 57 |
| 4 | 1 | 9.195129 | 10.804871 | 9.200529 | 10.799471 | 10.005400 | 9.994600 | 59 | 56 |
| 5 | 15 | 9.195328 | 10.804672 | 9.200733 | 10.799267 | 10.005405 | 9.994595 | 45 | 55 |
| 6 | 30 | 9.195527 | 10.804473 | 9.200937 | 10.799063 | 10.005410 | 9.994590 | 30 | 54 |
| 7 | 45 | 9.195726 | 10.804274 | 9.201141 | 10.798859 | 10.005415 | 9.994585 | 15 | 53 |
| 8 | 2 | 9.195925 | 10.804075 | 9.201345 | 10.798655 | 10.005420 | 9.994580 | 58 | 52 |
| 9 | 15 | 9.196123 | 10.803877 | 9.201548 | 10.798452 | 10.005425 | 9.994575 | 45 | 51 |
| 10 | 30 | 9.196322 | 10.803678 | 9.201752 | 10.798248 | 10.005430 | 9.994570 | 30 | 50 |
| 11 | 45 | 9.196520 | 10.803480 | 9.201955 | 10.798045 | 10.005435 | 9.994565 | 15 | 49 |
| 12 | 3 | 9.196719 | 10.803281 | 9.202159 | 10.797841 | 10.005440 | 9.994560 | 57 | 48 |
| 13 | 15 | 9.196917 | 10.803083 | 9.202362 | 10.797638 | 10.005445 | 9.994555 | 45 | 47 |
| 14 | 30 | 9.197115 | 10.802885 | 9.202565 | 10.797435 | 10.005450 | 9.994550 | 30 | 46 |
| 15 | 45 | 9.197313 | 10.802687 | 9.202768 | 10.797232 | 10.005455 | 9.994545 | 15 | 45 |
| 16 | 4 | 9.197511 | 10.802489 | 9.202971 | 10.797029 | 10.005460 | 9.994540 | 56 | 44 |
| 17 | 15 | 9.197709 | 10.802291 | 9.203174 | 10.796826 | 10.005466 | 9.994534 | 45 | 43 |
| 18 | 30 | 9.197907 | 10.802093 | 9.203377 | 10.796623 | 10.005471 | 9.994529 | 30 | 42 |
| 19 | 45 | 9.198104 | 10.801896 | 9.203580 | 10.796420 | 10.005476 | 9.994524 | 15 | 41 |
| 20 | 5 | 9.198302 | 10.801698 | 9.203782 | 10.796218 | 10.005481 | 9.994519 | 55 | 40 |
| 21 | 15 | 9.198499 | 10.801501 | 9.203985 | 10.796015 | 10.005486 | 9.994514 | 45 | 39 |
| 22 | 30 | 9.198697 | 10.801303 | 9.204187 | 10.795813 | 10.005491 | 9.994509 | 30 | 38 |
| 23 | 45 | 9.198894 | 10.801106 | 9.204390 | 10.795610 | 10.005496 | 9.994504 | 15 | 37 |
| 24 | 6 | 9.199091 | 10.800909 | 9.204592 | 10.795408 | 10.005501 | 9.994499 | 54 | 36 |
| 25 | 15 | 9.199288 | 10.800712 | 9.204794 | 10.795206 | 10.005506 | 9.994494 | 45 | 35 |
| 26 | 30 | 9.199485 | 10.800515 | 9.204996 | 10.795004 | 10.005511 | 9.994489 | 30 | 34 |
| 27 | 45 | 9.199682 | 10.800318 | 9.205198 | 10.794802 | 10.005516 | 9.994484 | 15 | 33 |
| 28 | 7 | 9.199879 | 10.800121 | 9.205400 | 10.794600 | 10.005521 | 9.994479 | 53 | 32 |
| 29 | 15 | 9.200076 | 10.799924 | 9.205602 | 10.794398 | 10.005526 | 9.994474 | 45 | 31 |
| 30 | 30 | 9.200273 | 10.799727 | 9.205804 | 10.794196 | 10.005531 | 9.994469 | 30 | 30 |
| 31 | 45 | 9.200469 | 10.799531 | 9.206006 | 10.793994 | 10.005536 | 9.994464 | 15 | 29 |
| 32 | 8 | 9.200666 | 10.799334 | 9.206207 | 10.793793 | 10.005541 | 9.994459 | 52 | 28 |
| 33 | 15 | 9.200862 | 10.799138 | 9.206409 | 10.793591 | 10.005546 | 9.994454 | 45 | 27 |
| 34 | 30 | 9.201059 | 10.798941 | 9.206610 | 10.793390 | 10.005552 | 9.994448 | 30 | 26 |
| 35 | 45 | 9.201255 | 10.798745 | 9.206811 | 10.793189 | 10.005557 | 9.994443 | 15 | 25 |
| 36 | 9 | 9.201451 | 10.798549 | 9.207013 | 10.792987 | 10.005562 | 9.994438 | 51 | 24 |
| 37 | 15 | 9.201647 | 10.798353 | 9.207214 | 10.792786 | 10.005567 | 9.994433 | 45 | 23 |
| 38 | 30 | 9.201843 | 10.798157 | 9.207415 | 10.792585 | 10.005572 | 9.994428 | 30 | 22 |
| 39 | 45 | 9.202039 | 10.797961 | 9.207616 | 10.792384 | 10.005577 | 9.994423 | 15 | 21 |
| 40 | 10 | 9.202234 | 10.797766 | 9.207816 | 10.792184 | 10.005582 | 9.994418 | 50 | 20 |
| 41 | 15 | 9.202430 | 10.797570 | 9.208017 | 10.791983 | 10.005587 | 9.994413 | 45 | 19 |
| 42 | 30 | 9.202626 | 10.797374 | 9.208218 | 10.791782 | 10.005592 | 9.994408 | 30 | 18 |
| 43 | 45 | 9.202821 | 10.797179 | 9.208419 | 10.791581 | 10.005597 | 9.994403 | 15 | 17 |
| 44 | 11 | 9.203017 | 10.796983 | 9.208619 | 10.791381 | 10.005603 | 9.994397 | 49 | 16 |
| 45 | 15 | 9.203212 | 10.796788 | 9.208819 | 10.791181 | 10.005608 | 9.994392 | 45 | 15 |
| 46 | 30 | 9.203407 | 10.796593 | 9.209020 | 10.790980 | 10.005613 | 9.994387 | 30 | 14 |
| 47 | 45 | 9.203602 | 10.796398 | 9.209220 | 10.790780 | 10.005618 | 9.994382 | 15 | 13 |
| 48 | 12 | 9.203797 | 10.796203 | 9.209420 | 10.790580 | 10.005623 | 9.994377 | 48 | 12 |
| 49 | 15 | 9.203992 | 10.796008 | 9.209620 | 10.790380 | 10.005628 | 9.994372 | 45 | 11 |
| 50 | 30 | 9.204187 | 10.795813 | 9.209820 | 10.790180 | 10.005633 | 9.994367 | 30 | 10 |
| 51 | 45 | 9.204382 | 10.795618 | 9.210020 | 10.789980 | 10.005638 | 9.994362 | 15 | 9 |
| 52 | 13 | 9.204577 | 10.795423 | 9.210220 | 10.789780 | 10.005643 | 9.994357 | 47 | 8 |
| 53 | 15 | 9.204771 | 10.795229 | 9.210420 | 10.789580 | 10.005649 | 9.994351 | 45 | 7 |
| 54 | 30 | 9.204966 | 10.795034 | 9.210619 | 10.789381 | 10.005654 | 9.994346 | 30 | 6 |
| 55 | 45 | 9.205160 | 10.794840 | 9.210819 | 10.789181 | 10.005659 | 9.994341 | 15 | 5 |
| 56 | 14 | 9.205354 | 10.794646 | 9.211018 | 10.788982 | 10.005664 | 9.994336 | 46 | 4 |
| 57 | 15 | 9.205549 | 10.794451 | 9.211218 | 10.788782 | 10.005669 | 9.994331 | 45 | 3 |
| 58 | 30 | 9.205743 | 10.794257 | 9.211417 | 10.788583 | 10.005674 | 9.994326 | 30 | 2 |
| 59 | 45 | 9.205937 | 10.794063 | 9.211616 | 10.788384 | 10.005679 | 9.994321 | 15 | 1 |
| 60 | 15 | 9.206131 | 10.793869 | 9.211815 | 10.788185 | 10.005684 | 9.994316 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ | sec. |
| | 5h 23m | | LOG. SINES, &c. | | | | | 80 deg. | |

| 0h 37m. | | | LOG. SINES, &c. (t) | | | 9 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.206131 | 10.793869 | 9.211815 | 10.788185 | 10.005684 | 9.994316 | 45 | 60 |
| 1 | 15 | 9.206325 | 10.793675 | 9.212014 | 10.787986 | 10.005690 | 9.994310 | 45 | 59 |
| 2 | 30 | 9.206519 | 10.793481 | 9.212213 | 10.787787 | 10.005695 | 9.994305 | 30 | 58 |
| 3 | 45 | 9.206712 | 10.793288 | 9.212412 | 10.787588 | 10.005700 | 9.994300 | 15 | 57 |
| 4 | 16 | 9.206906 | 10.793094 | 9.212611 | 10.787389 | 10.005705 | 9.994295 | 44 | 56 |
| 5 | 15 | 9.207099 | 10.792901 | 9.212810 | 10.787190 | 10.005710 | 9.994290 | 45 | 55 |
| 6 | 30 | 9.207293 | 10.792707 | 9.213008 | 10.786992 | 10.005715 | 9.994285 | 30 | 54 |
| 7 | 45 | 9.207486 | 10.792514 | 9.213207 | 10.786793 | 10.005721 | 9.994279 | 15 | 53 |
| 8 | 17 | 9.207679 | 10.792321 | 9.213405 | 10.786595 | 10.005726 | 9.994274 | 43 | 52 |
| 9 | 15 | 9.207873 | 10.792127 | 9.213603 | 10.786397 | 10.005731 | 9.994269 | 45 | 51 |
| 10 | 30 | 9.208066 | 10.791934 | 9.213802 | 10.786198 | 10.005736 | 9.994264 | 30 | 50 |
| 11 | 45 | 9.208259 | 10.791741 | 9.214000 | 10.786000 | 10.005741 | 9.994259 | 15 | 49 |
| 12 | 18 | 9.208452 | 10.791548 | 9.214198 | 10.785802 | 10.005746 | 9.994254 | 42 | 48 |
| 13 | 15 | 9.208644 | 10.791356 | 9.214396 | 10.785604 | 10.005752 | 9.994248 | 45 | 47 |
| 14 | 30 | 9.208837 | 10.791163 | 9.214594 | 10.785406 | 10.005757 | 9.994243 | 30 | 46 |
| 15 | 45 | 9.209030 | 10.790970 | 9.214792 | 10.785208 | 10.005762 | 9.994238 | 15 | 45 |
| 16 | 19 | 9.209222 | 10.790778 | 9.214989 | 10.785011 | 10.005767 | 9.994233 | 41 | 44 |
| 17 | 15 | 9.209415 | 10.790585 | 9.215187 | 10.784813 | 10.005772 | 9.994228 | 45 | 43 |
| 18 | 30 | 9.209607 | 10.790393 | 9.215385 | 10.784615 | 10.005777 | 9.994223 | 30 | 42 |
| 19 | 45 | 9.209799 | 10.790201 | 9.215582 | 10.784418 | 10.005783 | 9.994217 | 15 | 41 |
| 20 | 20 | 9.209992 | 10.790008 | 9.215779 | 10.784221 | 10.005788 | 9.994212 | 40 | 40 |
| 21 | 15 | 9.210184 | 10.789816 | 9.215977 | 10.784023 | 10.005793 | 9.994207 | 45 | 39 |
| 22 | 30 | 9.210376 | 10.789624 | 9.216174 | 10.783826 | 10.005798 | 9.994202 | 30 | 38 |
| 23 | 45 | 9.210568 | 10.789432 | 9.216371 | 10.783629 | 10.005803 | 9.994197 | 15 | 37 |
| 24 | 21 | 9.210760 | 10.789240 | 9.216568 | 10.783432 | 10.005809 | 9.994191 | 39 | 36 |
| 25 | 15 | 9.210951 | 10.789049 | 9.216765 | 10.783235 | 10.005814 | 9.994186 | 45 | 35 |
| 26 | 30 | 9.211143 | 10.788857 | 9.216962 | 10.783038 | 10.005819 | 9.994181 | 30 | 34 |
| 27 | 45 | 9.211335 | 10.788665 | 9.217159 | 10.782841 | 10.005824 | 9.994176 | 15 | 33 |
| 28 | 22 | 9.211526 | 10.788474 | 9.217356 | 10.782644 | 10.005829 | 9.994171 | 38 | 32 |
| 29 | 15 | 9.211718 | 10.788282 | 9.217552 | 10.782448 | 10.005835 | 9.994165 | 45 | 31 |
| 30 | 30 | 9.211909 | 10.788091 | 9.217749 | 10.782251 | 10 005840 | 9.994160 | 30 | 30 |
| 31 | 45 | 9.212100 | 10.787900 | 9.217945 | 10.782055 | 10.005845 | 9.994155 | 15 | 29 |
| 32 | 23 | 9.212291 | 10.787709 | 9.218142 | 10.781858 | 10.005850 | 9.994150 | 37 | 28 |
| 33 | 15 | 9.212482 | 10.787518 | 9.218338 | 10.781662 | 10.005856 | 9.994144 | 45 | 27 |
| 34 | 30 | 9.212673 | 10.787327 | 9.218534 | 10.781466 | 10.005861 | 9.994139 | 30 | 26 |
| 35 | 45 | 9.212864 | 10.787136 | 9.218730 | 10.781270 | 10.005866 | 9.994134 | 15 | 25 |
| 36 | 24 | 9.213055 | 10.786945 | 9.218926 | 10.781074 | 10.005871 | 9.994129 | 36 | 24 |
| 37 | 15 | 9.213246 | 10.786754 | 9.219122 | 10.780878 | 10.005876 | 9.994124 | 45 | 23 |
| 38 | 30 | 9.213437 | 10.786563 | 9.219318 | 10.780682 | 10.005882 | 9.994118 | 30 | 22 |
| 39 | 45 | 9.213627 | 10.786373 | 9.219514 | 10.780486 | 10.005887 | 9.994113 | 15 | 21 |
| 40 | 25 | 9.213818 | 10.786182 | 9.219710 | 10.780290 | 10.005892 | 9.994108 | 35 | 20 |
| 41 | 15 | 9.214008 | 10.785992 | 9.219905 | 10.780095 | 10.005897 | 9.994103 | 45 | 19 |
| 42 | 30 | 9.214198 | 10.785802 | 9.220101 | 10.779899 | 10.005903 | 9.994097 | 30 | 18 |
| 43 | 45 | 9.214389 | 10.785611 | 9.220296 | 10.779704 | 10.005908 | 9.994092 | 15 | 17 |
| 44 | 26 | 9.214579 | 10.785421 | 9.220492 | 10.779508 | 10.005913 | 9.994087 | 34 | 16 |
| 45 | 15 | 9.214769 | 10.785231 | 9.220687 | 10.779313 | 10.005918 | 9.994082 | 45 | 15 |
| 46 | 30 | 9.214959 | 10.785041 | 9.220882 | 10.779118 | 10.005924 | 9.994076 | 30 | 14 |
| 47 | 45 | 9.215149 | 10.784851 | 9.221077 | 10.778923 | 10.005929 | 9.994071 | 15 | 13 |
| 48 | 27 | 9.215338 | 10.784662 | 9.221272 | 10.778728 | 10.005934 | 9.994066 | 33 | 12 |
| 49 | 15 | 9.215528 | 10.784472 | 9.221467 | 10.778533 | 10.005939 | 9.994061 | 45 | 11 |
| 50 | 30 | 9.215718 | 10.784282 | 9.221662 | 10.778338 | 10.005945 | 9.994055 | 30 | 10 |
| 51 | 45 | 9.215907 | 10.784093 | 9.221857 | 10.778143 | 10.005950 | 9.994050 | 15 | 9 |
| 52 | 28 | 9.216097 | 10.783903 | 9.222052 | 10.777948 | 10.005955 | 9.994045 | 32 | 8 |
| 53 | 15 | 9.216286 | 10.783714 | 9.222246 | 10.777754 | 10.005960 | 9.994040 | 45 | 7 |
| 54 | 30 | 9.216475 | 10.783525 | 9.222441 | 10.777559 | 10.005966 | 9.994034 | 30 | 6 |
| 55 | 45 | 9.216664 | 10.783336 | 9.222635 | 10.777365 | 10.005971 | 9.994029 | 15 | 5 |
| 56 | 29 | 9.216854 | 10.783146 | 9.222830 | 10.777170 | 10.005976 | 9.994024 | 31 | 4 |
| 57 | 15 | 9.217043 | 10.782957 | 9.223024 | 10.776976 | 10.005982 | 9.994018 | 45 | 3 |
| 58 | 30 | 9.217232 | 10.782768 | 9.223218 | 10.776782 | 10.005987 | 9.994013 | 30 | 2 |
| 59 | 45 | 9 217420 | 10.782580 | 9.223412 | 10.776588 | 10.005992 | 9 994008 | 15 | 1 |
| 60 | 30 | 9.217609 | 10.782391 | 9.223606 | 10.776394 | 10.005997 | 9.994003 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 22m. | | | LOG. SINES, &c. | | | | | 80 deg. | |

| 0h 38m. | | | LOG. SINES, &c. (t.) | | | 9 deg | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.217609 | 10.782391 | 9.223606 | 10.776394 | 10.005997 | 9.994003 | 30 | 60 |
| 1 | 15 | 9.217798 | 10.782202 | 9.223800 | 10.776200 | 10.006003 | 9.993997 | 45 | 59 |
| 2 | 30 | 9.217986 | 10.782014 | 9.223994 | 10.776006 | 10.006008 | 9.993992 | 30 | 58 |
| 3 | 45 | 9.218175 | 10.781825 | 9.224188 | 10.775812 | 10.006013 | 9.993987 | 15 | 57 |
| 4 | 31 | 9.218363 | 10.781637 | 9.224382 | 10.775618 | 10.006019 | 9.993981 | 29 | 56 |
| 5 | 15 | 9.218552 | 10.781448 | 9.224576 | 10.775424 | 10.006024 | 9.993976 | 45 | 55 |
| 6 | 30 | 9.218740 | 10.781260 | 9.224769 | 10.775231 | 10.006029 | 9.993971 | 30 | 54 |
| 7 | 45 | 9.218928 | 10.781072 | 9.224963 | 10.775037 | 10.006034 | 9.993966 | 15 | 53 |
| 8 | 32 | 9.219116 | 10.780884 | 9.225156 | 10.774844 | 10.006040 | 9.993960 | 28 | 52 |
| 9 | 15 | 9.219304 | 10.780696 | 9.225349 | 10.774651 | 10.006045 | 9.993955 | 45 | 51 |
| 10 | 30 | 9.219492 | 10.780508 | 9.225543 | 10.774457 | 10.006050 | 9.993950 | 30 | 50 |
| 11 | 45 | 9.219680 | 10.780320 | 9.225736 | 10.774264 | 10.006056 | 9.993944 | 15 | 49 |
| 12 | 33 | 9.219868 | 10.780132 | 9.225929 | 10.774071 | 10.006061 | 9.993939 | 27 | 48 |
| 13 | 15 | 9.220056 | 10.779944 | 9.226122 | 10.773878 | 10.006066 | 9.993934 | 45 | 47 |
| 14 | 30 | 9.220243 | 10.779757 | 9.226315 | 10.773685 | 10.006072 | 9.993928 | 30 | 46 |
| 15 | 45 | 9.220431 | 10.779569 | 9.226508 | 10.773492 | 10.006077 | 9.993923 | 15 | 45 |
| 16 | 34 | 9.220618 | 10.779382 | 9.226700 | 10.773300 | 10.006082 | 9.993918 | 26 | 44 |
| 17 | 15 | 9.220805 | 10.779195 | 9.226893 | 10.773107 | 10.006088 | 9.993912 | 45 | 43 |
| 18 | 30 | 9.220993 | 10.779007 | 9.227086 | 10.772914 | 10.006093 | 9.993907 | 30 | 42 |
| 19 | 45 | 9.221180 | 10.778820 | 9.227278 | 10.772722 | 10.006098 | 9.993902 | 15 | 41 |
| 20 | 35 | 9.221367 | 10.778633 | 9.227471 | 10.772529 | 10.006104 | 9.993896 | 25 | 40 |
| 21 | 15 | 9.221554 | 10.778446 | 9.227663 | 10.772337 | 10.006109 | 9.993891 | 45 | 39 |
| 22 | 30 | 9.221741 | 10.778259 | 9.227855 | 10.772145 | 10.006114 | 9.993886 | 30 | 38 |
| 23 | 45 | 9.221928 | 10.778072 | 9.228047 | 10.771953 | 10.006120 | 9.993880 | 15 | 37 |
| 24 | 36 | 9.222115 | 10.777885 | 9.228239 | 10.771761 | 10.006125 | 9.993875 | 24 | 36 |
| 25 | 15 | 9.222301 | 10.777699 | 9.228431 | 10.771569 | 10.006130 | 9.993870 | 45 | 35 |
| 26 | 30 | 9.222488 | 10.777512 | 9.228623 | 10.771377 | 10.006136 | 9.993864 | 30 | 34 |
| 27 | 45 | 9.222674 | 10.777326 | 9.228815 | 10.771185 | 10.006141 | 9.993859 | 15 | 33 |
| 28 | 37 | 9.222861 | 10.777139 | 9.229007 | 10.770993 | 10.006146 | 9.993854 | 23 | 32 |
| 29 | 15 | 9.223047 | 10.776953 | 9.229199 | 10.770801 | 10.006152 | 9.993848 | 45 | 31 |
| 30 | 30 | 9.223234 | 10.776766 | 9.229390 | 10.770610 | 10.006157 | 9.993843 | 30 | 30 |
| 31 | 45 | 9.223420 | 10.776580 | 9.229582 | 10.770418 | 10.006162 | 9.993838 | 15 | 29 |
| 32 | 38 | 9.223606 | 10.776394 | 9.229773 | 10.770227 | 10.006168 | 9.993832 | 22 | 28 |
| 33 | 15 | 9.223792 | 10.776208 | 9.229965 | 10.770035 | 10.006173 | 9.993827 | 45 | 27 |
| 34 | 30 | 9.223978 | 10.776022 | 9.230156 | 10.769844 | 10.006178 | 9.993822 | 30 | 26 |
| 35 | 45 | 9.224164 | 10.775836 | 9.230347 | 10.769653 | 10.006184 | 9.993816 | 15 | 25 |
| 36 | 39 | 9.224349 | 10.775651 | 9.230539 | 10.769461 | 10.006189 | 9 993811 | 21 | 24 |
| 37 | 15 | 9.224535 | 10.775465 | 9.230730 | 10.769270 | 10.006195 | 9.993805 | 45 | 23 |
| 38 | 30 | 9.224721 | 10.775279 | 9.230921 | 10.769079 | 10.006200 | 9.993800 | 30 | 22 |
| 39 | 45 | 9.224906 | 10.775094 | 9.231112 | 10.768888 | 10.006205 | 9.993795 | 15 | 21 |
| 40 | 40 | 9.225092 | 10.774908 | 9.231302 | 10.768698 | 10.006211 | 9.993789 | 20 | 20 |
| 41 | 15 | 9.225277 | 10.774723 | 9.231493 | 10.768507 | 10.006216 | 9.993784 | 45 | 19 |
| 42 | 30 | 9.225462 | 10.774538 | 9.231684 | 10.768316 | 10.006221 | 9.993779 | 30 | 18 |
| 43 | 45 | 9.225648 | 10.774352 | 9.231874 | 10.768126 | 10.006227 | 9.993773 | 15 | 17 |
| 44 | 41 | 9.225833 | 10.774167 | 9.232065 | 10.767935 | 10.006232 | 9.993768 | 19 | 16 |
| 45 | 15 | 9.226018 | 10.773982 | 9.232255 | 10.767745 | 10.006238 | 9.993762 | 45 | 15 |
| 46 | 30 | 9.226203 | 10.773797 | 9.232446 | 10.767554 | 10.006243 | 9.993757 | 30 | 14 |
| 47 | 45 | 9.226388 | 10.773612 | 9.232636 | 10.767364 | 10.006248 | 9.993752 | 15 | 13 |
| 48 | 42 | 9.226572 | 10.773428 | 9.232826 | 10.767174 | 10.006254 | 9.993746 | 18 | 12 |
| 49 | 15 | 9.226757 | 10.773243 | 9.233016 | 10.766984 | 10.006259 | 9.993741 | 45 | 11 |
| 50 | 30 | 9.226942 | 10.773058 | 9.233206 | 10.766794 | 10.006265 | 9.993735 | 30 | 10 |
| 51 | 45 | 9.227126 | 10.772874 | 9.233396 | 10.766604 | 10.006270 | 9.993730 | 15 | 9 |
| 52 | 43 | 9.227311 | 10.772689 | 9.233586 | 10.766414 | 10.006275 | 9.993725 | 17 | 8 |
| 53 | 15 | 9.227495 | 10.772505 | 9.233776 | 10.766224 | 10.006281 | 9.993719 | 45 | 7 |
| 54 | 30 | 9.227680 | 10.772320 | 9.233966 | 10.766034 | 10.006286 | 9.993714 | 30 | 6 |
| 55 | 45 | 9.227864 | 10.772136 | 9.234155 | 10.765845 | 10.006292 | 9.993708 | 15 | 5 |
| 56 | 44 | 9.228048 | 10.771952 | 9.234345 | 10.765655 | 10.006297 | 9.993703 | 16 | 4 |
| 57 | 15 | 9.228232 | 10.771768 | 9.234535 | 10.765465 | 10.006302 | 9.993698 | 45 | 3 |
| 58 | 30 | 9.228416 | 10.771584 | 9.234724 | 10.765276 | 10.006308 | 9.993692 | 30 | 2 |
| 59 | 45 | 9.228600 | 10.771400 | 9.234913 | 10.765087 | 10.006313 | 9.993687 | 15 | 1 |
| 60 | 45 | 9.228784 | 10.771216 | 9.235103 | 10.764897 | 10.006319 | 9.993681 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 21m. | | | LOG. SINES, &c. | | | | | 80 deg. | |

| 0h 39m. | | | LOG. SINES, &c. (t) | | | | 9 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
| 0 | 45 | 9.228784 | 10.771216 | 9.235103 | 10.764897 | 10.006319 | 9.993681 | 15 | 60 |
| 1 | 15 | 9.228968 | 10.771032 | 9.235292 | 10.764708 | 10.006324 | 9.993676 | 45 | 59 |
| 2 | 30 | 9.229151 | 10.770849 | 9.235481 | 10.764519 | 10.006330 | 9.993670 | 30 | 58 |
| 3 | 45 | 9.229335 | 10.770665 | 9.235670 | 10.764330 | 10.006335 | 9.993665 | 15 | 57 |
| 4 | 46 | 9.229518 | 10.770482 | 9.235859 | 10.764141 | 10.006340 | 9.993660 | 14 | 56 |
| 5 | 15 | 9.229702 | 10.770298 | 9.236048 | 10.763952 | 10.006346 | 9.993654 | 45 | 55 |
| 6 | 30 | 9.229885 | 10.770115 | 9.236237 | 10.763763 | 10.006351 | 9.993649 | 30 | 54 |
| 7 | 45 | 9.230069 | 10.769931 | 9.236425 | 10.763575 | 10.006357 | 9.993643 | 15 | 53 |
| 8 | 47 | 9.230252 | 10.769748 | 9.236614 | 10.763386 | 10.006362 | 9.993638 | 13 | 52 |
| 9 | 15 | 9.230435 | 10.769565 | 9.236802 | 10.763198 | 10.006368 | 9.993632 | 45 | 51 |
| 10 | 30 | 9.230618 | 10.769382 | 9.236991 | 10.763009 | 10.006373 | 9.993627 | 30 | 50 |
| 11 | 45 | 9.230801 | 10.769199 | 9.237179 | 10.762821 | 10.006379 | 9.993621 | 15 | 49 |
| 12 | 48 | 9.230984 | 10.769016 | 9.237368 | 10.762632 | 10.006384 | 9.993616 | 12 | 48 |
| 13 | 15 | 9.231167 | 10.768833 | 9.237556 | 10.762444 | 10.006389 | 9.993611 | 45 | 47 |
| 14 | 30 | 9.231349 | 10.768651 | 9.237744 | 10.762256 | 10.006395 | 9.993605 | 30 | 46 |
| 15 | 45 | 9.231532 | 10.768468 | 9.237932 | 10.762068 | 10.006400 | 9.993600 | 15 | 45 |
| 16 | 49 | 9.231714 | 10.768286 | 9.238120 | 10.761880 | 10.006406 | 9.993594 | 11 | 44 |
| 17 | 15 | 9.231897 | 10.768103 | 9.238308 | 10.761692 | 10.006411 | 9.993589 | 45 | 43 |
| 18 | 30 | 9.232079 | 10.767921 | 9.238496 | 10.761504 | 10.006417 | 9.993583 | 30 | 42 |
| 19 | 45 | 9.232262 | 10.767738 | 9.238684 | 10.761316 | 10.006422 | 9.993578 | 15 | 41 |
| 20 | 50 | 9.232444 | 10.767556 | 9.238872 | 10.761128 | 10.006428 | 9.993572 | 10 | 40 |
| 21 | 15 | 9.232626 | 10.767374 | 9.239059 | 10.760941 | 10.006433 | 9.993567 | 45 | 39 |
| 22 | 30 | 9.232808 | 10.767192 | 9.239247 | 10.760753 | 10.006439 | 9.993561 | 30 | 38 |
| 23 | 45 | 9.232990 | 10.767010 | 9.239434 | 10.760566 | 10.006444 | 9.993556 | 15 | 37 |
| 24 | 51 | 9.233172 | 10.766828 | 9.239622 | 10.760378 | 10.006450 | 9.993550 | 9 | 36 |
| 25 | 15 | 9.233354 | 10.766646 | 9.239809 | 10.760191 | 10.006455 | 9.993545 | 45 | 35 |
| 26 | 30 | 9.233536 | 10.766464 | 9.239996 | 10.760004 | 10.006461 | 9.993539 | 30 | 34 |
| 27 | 45 | 9.233718 | 10.766282 | 9.240184 | 10.759816 | 10.006466 | 9.993534 | 15 | 33 |
| 28 | 52 | 9.233899 | 10.766101 | 9.240371 | 10.759629 | 10.006472 | 9.993528 | 8 | 32 |
| 29 | 15 | 9.234081 | 10.765919 | 9.240558 | 10.759442 | 10.006477 | 9.993523 | 45 | 31 |
| 30 | 30 | 9.234262 | 10.765738 | 9.240745 | 10.759255 | 10.006483 | 9.993517 | 30 | 30 |
| 31 | 45 | 9.234444 | 10.765556 | 9.240932 | 10.759068 | 10.006488 | 9.993512 | 15 | 29 |
| 32 | 53 | 9.234625 | 10.765375 | 9.241118 | 10.758882 | 10.006494 | 9.993506 | 7 | 28 |
| 33 | 15 | 9.234806 | 10.765194 | 9.241305 | 10.758695 | 10.006499 | 9.993501 | 45 | 27 |
| 34 | 30 | 9.234987 | 10.765013 | 9.241492 | 10.758508 | 10.006505 | 9.993495 | 30 | 26 |
| 35 | 45 | 9.235168 | 10.764832 | 9.241678 | 10.758322 | 10.006510 | 9.993490 | 15 | 25 |
| 36 | 54 | 9.235349 | 10.764651 | 9.241865 | 10.758135 | 10.006516 | 9.993484 | 6 | 24 |
| 37 | 15 | 9.235530 | 10.764470 | 9.242051 | 10.757949 | 10.006521 | 9.993479 | 45 | 23 |
| 38 | 30 | 9.235711 | 10.764289 | 9.242238 | 10.757762 | 10.006527 | 9.993473 | 30 | 22 |
| 39 | 45 | 9.235892 | 10.764108 | 9.242424 | 10.757576 | 10.006532 | 9.993468 | 15 | 21 |
| 40 | 55 | 9.236073 | 10.763927 | 9.242610 | 10.757390 | 10.006538 | 9.993462 | 5 | 20 |
| 41 | 15 | 9.236253 | 10.763747 | 9.242796 | 10.757204 | 10.006543 | 9.993457 | 45 | 19 |
| 42 | 30 | 9.236434 | 10.763566 | 9.242982 | 10.757018 | 10.006549 | 9.993451 | 30 | 18 |
| 43 | 45 | 9.236614 | 10.763386 | 9.243168 | 10.756832 | 10.006554 | 9.993446 | 15 | 17 |
| 44 | 56 | 9.236795 | 10.763205 | 9.243354 | 10.756646 | 10.006560 | 9.993440 | 4 | 16 |
| 45 | 15 | 9.236975 | 10.763025 | 9.243540 | 10.756460 | 10.006565 | 9.993435 | 45 | 15 |
| 46 | 30 | 9.237155 | 10.762845 | 9.243726 | 10.756274 | 10.006571 | 9.993429 | 30 | 14 |
| 47 | 45 | 9.237335 | 10.762665 | 9.243912 | 10.756088 | 10.006576 | 9.993424 | 15 | 13 |
| 48 | 57 | 9.237515 | 10.762485 | 9.244097 | 10.755903 | 10.006582 | 9.993418 | 3 | 12 |
| 49 | 15 | 9.237695 | 10.762305 | 9.244283 | 10.755717 | 10.006587 | 9.993413 | 45 | 11 |
| 50 | 30 | 9.237875 | 10.762125 | 9.244468 | 10.755532 | 10.006593 | 9.993407 | 30 | 10 |
| 51 | 45 | 9.238055 | 10.761945 | 9.244654 | 10.755346 | 10.006599 | 9.993401 | 15 | 9 |
| 52 | 58 | 9.238235 | 10.761765 | 9.244839 | 10.755161 | 10.006604 | 9.993396 | 2 | 8 |
| 53 | 15 | 9.238415 | 10.761585 | 9.245024 | 10.754976 | 10.006610 | 9.993390 | 45 | 7 |
| 54 | 30 | 9.238594 | 10.761406 | 9.245209 | 10.754791 | 10.006615 | 9.993385 | 30 | 6 |
| 55 | 45 | 9.238774 | 10.761226 | 9.245394 | 10.754606 | 10.006621 | 9.993379 | 15 | 5 |
| 56 | 59 | 9.238953 | 10.761047 | 9.245579 | 10.754421 | 10.006626 | 9.993374 | 1 | 4 |
| 57 | 15 | 9.239132 | 10.760868 | 9.245764 | 10.754236 | 10.006632 | 9.993368 | 45 | 3 |
| 58 | 30 | 9.239312 | 10.760688 | 9.245949 | 10.754051 | 10.006637 | 9.993363 | 30 | 2 |
| 59 | 45 | 9.239491 | 10.760509 | 9.246134 | 10.753866 | 10.006643 | 9.993357 | 15 | 1 |
| 60 | 60 | 9.239670 | 10.760330 | 9.246319 | 10.753681 | 10.006649 | 9.993351 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ | sec. |
| 5h 20m. | | | LOG. SINES, &c. | | | | 80 deg. | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $0^h\ 40^m$. | | LOG. SINES, &c. (t.) | | | | 10 deg. | | |
| 0 | 0 | 9.239670 | 10.760330 | 9.246319 | 10.753681 | 10.006649 | 9.993351 | 60 | 60 |
| 1 | 15 | 9.239849 | 10.760151 | 9.246503 | 10.753497 | 10.006654 | 9.993346 | 45 | 59 |
| 2 | 30 | 9.240028 | 10.759972 | 9.246688 | 10.753312 | 10.006660 | 9.993340 | 30 | 58 |
| 3 | 45 | 9.240207 | 10.759793 | 9.246872 | 10.753128 | 10.006665 | 9.993335 | 15 | 57 |
| 4 | 1 | 9.240386 | 10.759614 | 9.247057 | 10.752943 | 10.006671 | 9.993329 | 59 | 56 |
| 5 | 15 | 9.240565 | 10.759435 | 9.247241 | 10.752759 | 10.006676 | 9.993324 | 45 | 55 |
| 6 | 30 | 9.240744 | 10.759256 | 9.247425 | 10.752575 | 10.006682 | 9.993318 | 30 | 54 |
| 7 | 45 | 9.240922 | 10.759078 | 9.247610 | 10.752390 | 10.006688 | 9.993312 | 15 | 53 |
| 8 | 2 | 9.241101 | 10.758899 | 9.247794 | 10.752206 | 10.006693 | 9.993307 | 58 | 52 |
| 9 | 15 | 9.241279 | 10.758721 | 9.247978 | 10.752022 | 10.006699 | 9.993301 | 45 | 51 |
| 10 | 30 | 9.241458 | 10.758542 | 9.248162 | 10.751838 | 10.006704 | 9.993296 | 30 | 50 |
| 11 | 45 | 9.241636 | 10.758364 | 9.248346 | 10.751654 | 10.006710 | 9.993290 | 15 | 49 |
| 12 | 3 | 9.241814 | 10.758186 | 9.248530 | 10.751470 | 10.006716 | 9.993284 | 57 | 48 |
| 13 | 15 | 9.241992 | 10.758008 | 9.248713 | 10.751287 | 10.006721 | 9.993279 | 45 | 47 |
| 14 | 30 | 9.242170 | 10.757830 | 9.248897 | 10.751103 | 10.006727 | 9.993273 | 30 | 46 |
| 15 | 45 | 9.242348 | 10.757652 | 9.249081 | 10.750919 | 10.006732 | 9.993268 | 15 | 45 |
| 16 | 4 | 9.242526 | 10.757474 | 9.249264 | 10.750736 | 10.006738 | 9.993262 | 56 | 44 |
| 17 | 15 | 9.242704 | 10.757296 | 9.249448 | 10.750552 | 10.006744 | 9.993256 | 45 | 43 |
| 18 | 30 | 9.242882 | 10.757118 | 9.249631 | 10.750369 | 10.006749 | 9.993251 | 30 | 42 |
| 19 | 45 | 9.243060 | 10.756940 | 9.249814 | 10.750186 | 10.006755 | 9.993245 | 15 | 41 |
| 20 | 5 | 9.243237 | 10.756768 | 9.249998 | 10.750002 | 10.006760 | 9.993240 | 55 | 40 |
| 21 | 15 | 9.243415 | 10.756585 | 9.250181 | 10.749819 | 10.006766 | 9.993234 | 45 | 39 |
| 22 | 30 | 9.243592 | 10.756408 | 9.250364 | 10.749636 | 10.006772 | 9.993228 | 30 | 38 |
| 23 | 45 | 9.243770 | 10.756230 | 9.250547 | 10.749453 | 10.006777 | 9.993223 | 15 | 37 |
| 24 | 6 | 9.243947 | 10.756053 | 9.250730 | 10.749270 | 10.006783 | 9.993217 | 54 | 36 |
| 25 | 15 | 9.244124 | 10.755876 | 9.250913 | 10.749087 | 10.006789 | 9.993211 | 45 | 35 |
| 26 | 30 | 9.244302 | 10.755698 | 9.251096 | 10.748904 | 10.006794 | 9.993206 | 30 | 34 |
| 27 | 45 | 9.244479 | 10.755521 | 9.251278 | 10.748722 | 10.006800 | 9.993200 | 15 | 33 |
| 28 | 7 | 9.244656 | 10.755344 | 9.251461 | 10.748539 | 10.006805 | 9.993195 | 53 | 32 |
| 29 | 15 | 9.244833 | 10.755167 | 9.251644 | 10.748356 | 10.006811 | 9.993189 | 45 | 31 |
| 30 | 30 | 9.245010 | 10.754990 | 9.251826 | 10.748174 | 10.006817 | 9.993183 | 30 | 30 |
| 31 | 45 | 9.245186 | 10.754814 | 9.252009 | 10.747991 | 10.006822 | 9.993178 | 15 | 29 |
| 32 | 8 | 9.245363 | 10.754637 | 9.252191 | 10.747809 | 10.006828 | 9.993172 | 52 | 28 |
| 33 | 15 | 9.245540 | 10.754460 | 9.252373 | 10.747627 | 10.006834 | 9.993166 | 45 | 27 |
| 34 | 30 | 9.245716 | 10.754284 | 9.252556 | 10.747444 | 10.006839 | 9.993161 | 30 | 26 |
| 35 | 45 | 9.245893 | 10.754107 | 9.252738 | 10.747262 | 10.006845 | 9.993155 | 15 | 25 |
| 36 | 9 | 9.246069 | 10.753931 | 9.252920 | 10.747080 | 10.006851 | 9.993149 | 51 | 24 |
| 37 | 15 | 9.246246 | 10.753754 | 9.253102 | 10.746898 | 10.006856 | 9.993144 | 45 | 23 |
| 38 | 30 | 9.246422 | 10.753578 | 9.253284 | 10.746716 | 10.006862 | 9.993138 | 30 | 22 |
| 39 | 45 | 9.246598 | 10.753402 | 9.253466 | 10.746534 | 10.006868 | 9.993132 | 15 | 21 |
| 40 | 10 | 9.246775 | 10.753225 | 9.253648 | 10.746352 | 10.006873 | 9.993127 | 50 | 20 |
| 41 | 15 | 9.246951 | 10.753049 | 9.253829 | 10.746171 | 10.006879 | 9.993121 | 45 | 19 |
| 42 | 30 | 9.247127 | 10.752873 | 9.254011 | 10.745989 | 10.006885 | 9.993115 | 30 | 18 |
| 43 | 45 | 9.247303 | 10.752697 | 9.254193 | 10.745807 | 10.006890 | 9.993110 | 15 | 17 |
| 44 | 11 | 9.247478 | 10.752522 | 9.254374 | 10.745626 | 10.006896 | 9.993104 | 49 | 16 |
| 45 | 15 | 9.247654 | 10.752346 | 9.254556 | 10.745444 | 10.006902 | 9.993098 | 45 | 15 |
| 46 | 30 | 9.247830 | 10.752170 | 9.254737 | 10.745263 | 10.006907 | 9.993093 | 30 | 14 |
| 47 | 45 | 9.248006 | 10.751994 | 9.254918 | 10.745082 | 10.006913 | 9.993087 | 15 | 13 |
| 48 | 12 | 9.248181 | 10.751819 | 9.255100 | 10.744900 | 10.006919 | 9.993081 | 48 | 12 |
| 49 | 15 | 9.248357 | 10.751643 | 9.255281 | 10.744719 | 10.006924 | 9.993076 | 45 | 11 |
| 50 | 30 | 9.248532 | 10.751468 | 9.255462 | 10.744538 | 10.006930 | 9.993070 | 30 | 10 |
| 51 | 45 | 9.248707 | 10.751293 | 9.255643 | 10.744357 | 10.006936 | 9.993064 | 15 | 9 |
| 52 | 13 | 9.248883 | 10.751117 | 9.255824 | 10.744176 | 10.006941 | 9.993059 | 47 | 8 |
| 53 | 15 | 9.249058 | 10.750942 | 9.256005 | 10.743995 | 10.006947 | 9.993053 | 45 | 7 |
| 54 | 30 | 9.249233 | 10.750767 | 9.256186 | 10.743814 | 10.006953 | 9.993047 | 30 | 6 |
| 55 | 45 | 9.249408 | 10.750592 | 9.256366 | 10.743634 | 10.006958 | 9.993042 | 15 | 5 |
| 56 | 14 | 9.249583 | 10.750417 | 9.256547 | 10.743453 | 10.006964 | 9.993036 | 46 | 4 |
| 57 | 15 | 9.249758 | 10.750242 | 9.256728 | 10.743272 | 10.006970 | 9.993030 | 45 | 3 |
| 58 | 30 | 9.249933 | 10.750067 | 9.256908 | 10.743092 | 10.006976 | 9.993024 | 30 | 2 |
| 59 | 45 | 9.250107 | 10.749893 | 9.257089 | 10.742911 | 10.006981 | 9.993019 | 15 | 1 |
| 60 | 15 | 9.250282 | 10.749718 | 9.257269 | 10.742731 | 10.006987 | 9.993013 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine | ″ ′ | sec. |
| | $5^h\ 19^m$. | | LOG. SINES, &c. | | | | 79 deg. | | |

| 0h 41m. | | | LOG. SINES, &c. (t) | | | | 10 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.250282 | 10.749718 | 9.257269 | 10.742731 | 10.006987 | 9.993013 | 45 | 60 |
| 1 | 15 | 9.250457 | 10.749543 | 9.257449 | 10.742551 | 10.006993 | 9.993007 | 45 | 59 |
| 2 | 30 | 9.250631 | 10.749369 | 9.257630 | 10.742370 | 10.006998 | 9.993002 | 30 | 58 |
| 3 | 45 | 9.250806 | 10.749194 | 9.257810 | 10.742190 | 10.007004 | 9.992996 | 15 | 57 |
| 4 | 16 | 9.250980 | 10.749020 | 9.257990 | 10.742010 | 10.007010 | 9.992990 | 44 | 56 |
| 5 | 15 | 9.251155 | 10.748845 | 9.258170 | 10.741830 | 10.007016 | 9.992984 | 45 | 55 |
| 6 | 30 | 9.251329 | 10.748671 | 9.258350 | 10.741650 | 10.007021 | 9.992979 | 30 | 54 |
| 7 | 45 | 9.251503 | 10.748497 | 9.258530 | 10.741470 | 10.007027 | 9.992973 | 15 | 53 |
| 8 | 17 | 9.251677 | 10.748323 | 9.258710 | 10.741290 | 10.007033 | 9.992967 | 43 | 52 |
| 9 | 15 | 9.251851 | 10.748149 | 9.258890 | 10.741110 | 10.007038 | 9.992962 | 45 | 51 |
| 10 | 30 | 9.252025 | 10.747975 | 9.259069 | 10.740931 | 10.007044 | 9.992956 | 30 | 50 |
| 11 | 45 | 9.252199 | 10.747801 | 9.259249 | 10.740751 | 10.007050 | 9.992950 | 15 | 49 |
| 12 | 18 | 9.252373 | 10.747627 | 9.259428 | 10.740572 | 10.007056 | 9.992944 | 42 | 48 |
| 13 | 15 | 9.252547 | 10.747453 | 9.259608 | 10.740392 | 10.007061 | 9.992939 | 45 | 47 |
| 14 | 30 | 9.252720 | 10.747280 | 9.259787 | 10.740213 | 10.007067 | 9.992933 | 30 | 46 |
| 15 | 45 | 9.252894 | 10.747106 | 9.259967 | 10.740033 | 10.007073 | 9.992927 | 15 | 45 |
| 16 | 19 | 9.253067 | 10.746933 | 9.260146 | 10.739854 | 10.007079 | 9.992921 | 41 | 44 |
| 17 | 15 | 9.253241 | 10.746759 | 9.260325 | 10.739675 | 10.007084 | 9.992916 | 45 | 43 |
| 18 | 30 | 9.253414 | 10.746586 | 9.260504 | 10.739496 | 10.007090 | 9.992910 | 30 | 42 |
| 19 | 45 | 9.253588 | 10.746412 | 9.260683 | 10.739317 | 10.007096 | 9.992904 | 15 | 41 |
| 20 | 20 | 9.253761 | 10.746239 | 9.260862 | 10.739138 | 10.007102 | 9.992898 | 40 | 40 |
| 21 | 15 | 9.253934 | 10.746066 | 9.261041 | 10.738959 | 10.007107 | 9.992893 | 45 | 39 |
| 22 | 30 | 9.254107 | 10.745893 | 9.261220 | 10.738780 | 10.007113 | 9.992887 | 30 | 38 |
| 23 | 45 | 9.254280 | 10.745720 | 9.261399 | 10.738601 | 10.007119 | 9.992881 | 15 | 37 |
| 24 | 21 | 9.254453 | 10.745547 | 9.261578 | 10.738422 | 10.007125 | 9.992875 | 39 | 36 |
| 25 | 15 | 9.254626 | 10.745374 | 9.261757 | 10.738243 | 10.007131 | 9.992869 | 45 | 35 |
| 26 | 30 | 9.254799 | 10.745201 | 9.261935 | 10.738065 | 10.007136 | 9.992864 | 30 | 34 |
| 27 | 45 | 9.254972 | 10.745028 | 9.262114 | 10.737886 | 10.007142 | 9.992858 | 15 | 33 |
| 28 | 22 | 9.255144 | 10.744856 | 9.262292 | 10.737708 | 10.007148 | 9.992852 | 38 | 32 |
| 29 | 15 | 9.255317 | 10.744683 | 9.262470 | 10.737530 | 10.007154 | 9.992846 | 45 | 31 |
| 30 | 30 | 9.255489 | 10.744511 | 9.262649 | 10.737351 | 10 007159 | 9.992841 | 30 | 30 |
| 31 | 45 | 9.255662 | 10.744338 | 9.262827 | 10.737173 | 10.007165 | 9.992835 | 15 | 29 |
| 32 | 23 | 9.255834 | 10.744166 | 9.263005 | 10.736995 | 10.007171 | 9.992829 | 37 | 28 |
| 33 | 15 | 9.256007 | 10.743993 | 9.263183 | 10.736817 | 10.007177 | 9.992823 | 45 | 27 |
| 34 | 30 | 9.256179 | 10.743821 | 9.263361 | 10.736639 | 10.007183 | 9.992817 | 30 | 26 |
| 35 | 45 | 9.256351 | 10.743649 | 9.263539 | 10.736461 | 10.007188 | 9.992812 | 15 | 25 |
| 36 | 24 | 9.256523 | 10.743477 | 9.263717 | 10.736283 | 10.007194 | 9.992806 | 36 | 24 |
| 37 | 15 | 9.256695 | 10.743305 | 9.263895 | 10.736105 | 10.007200 | 9.992800 | 45 | 23 |
| 38 | 30 | 9.256867 | 10.743133 | 9.264073 | 10.735927 | 10.007206 | 9.992794 | 30 | 22 |
| 39 | 45 | 9.257039 | 10.742961 | 9.264251 | 10.735749 | 10.007212 | 9.992788 | 15 | 21 |
| 40 | 25 | 9.257211 | 10.742789 | 9.264428 | 10.735572 | 10.007217 | 9.992783 | 35 | 20 |
| 41 | 15 | 9.257383 | 10.742617 | 9.264606 | 10.735394 | 10.007223 | 9.992777 | 45 | 19 |
| 42 | 30 | 9.257554 | 10.742446 | 9.264783 | 10.735217 | 10.007229 | 9.992771 | 30 | 18 |
| 43 | 45 | 9.257726 | 10.742274 | 9.264961 | 10.735039 | 10.007235 | 9.992765 | 15 | 17 |
| 44 | 26 | 9.257898 | 10.742102 | 9.265138 | 10.734862 | 10.007241 | 9.992759 | 34 | 16 |
| 45 | 15 | 9.258069 | 10.741931 | 9.265315 | 10.734685 | 10.007246 | 9.992754 | 45 | 15 |
| 46 | 30 | 9.258241 | 10.741759 | 9.265493 | 10.734507 | 10.007252 | 9.992748 | 30 | 14 |
| 47 | 45 | 9.258412 | 10.741588 | 9.265670 | 10.734330 | 10.007258 | 9.992742 | 15 | 13 |
| 48 | 27 | 9.258583 | 10.741417 | 9.265847 | 10.734153 | 10.007264 | 9.992736 | 33 | 12 |
| 49 | 15 | 9.258754 | 10.741246 | 9.266024 | 10.733976 | 10.007270 | 9.992730 | 45 | 11 |
| 50 | 30 | 9.258925 | 10.741075 | 9.266201 | 10.733799 | 10.007276 | 9.992724 | 30 | 10 |
| 51 | 45 | 9.259097 | 10.740903 | 9.266378 | 10.733622 | 10.007281 | 9.992719 | 15 | 9 |
| 52 | 28 | 9.259268 | 10.740732 | 9.266555 | 10.733445 | 10.007287 | 9.992713 | 32 | 8 |
| 53 | 15 | 9.259438 | 10.740562 | 9.266731 | 10.733269 | 10.007293 | 9.992707 | 45 | 7 |
| 54 | 30 | 9.259609 | 10.740391 | 9.266908 | 10.733092 | 10.007299 | 9.992701 | 30 | 6 |
| 55 | 45 | 9.259780 | 10.740220 | 9.267085 | 10.732915 | 10.007305 | 9.992695 | 15 | 5 |
| 56 | 29 | 9.259951 | 10.740049 | 9.267261 | 10.732739 | 10.007311 | 9.992689 | 31 | 4 |
| 57 | 15 | 9.260121 | 10.739879 | 9.267438 | 10.732562 | 10.007316 | 9.992684 | 45 | 3 |
| 58 | 30 | 9.260292 | 10.739708 | 9.267614 | 10.732386 | 10.007322 | 9.992678 | 30 | 2 |
| 59 | 45 | 9.260463 | 10.739537 | 9.267791 | 10.732209 | 10.007328 | 9.992672 | 15 | 1 |
| 60 | 30 | 9.260633 | 10.739367 | 9.267967 | 10.732033 | 10.007334 | 9.992666 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 18m. | | | LOG. SINES, &c. | | | | 79 deg. | | |

| 0h 42m. | | LOG. SINES, &c. (t.) | | | | | 10 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.260633 | 10.739367 | 9.267967 | 10.732033 | 10.007334 | 9.992666 | 30 | 60 |
| 1 | 15 | 9.260803 | 10.739197 | 9.268143 | 10.731857 | 10.007340 | 9.992660 | 45 | 59 |
| 2 | 30 | 9.260974 | 10.739026 | 9.268319 | 10.731681 | 10.007346 | 9.992654 | 30 | 58 |
| 3 | 45 | 9.261144 | 10.738856 | 9.268495 | 10.731505 | 10.007351 | 9.992649 | 15 | 57 |
| 4 | 31 | 9.261314 | 10.738686 | 9.268671 | 10.731329 | 10.007357 | 9.992643 | 29 | 56 |
| 5 | 15 | 9.261484 | 10.738516 | 9.268847 | 10.731153 | 10.007363 | 9.992637 | 45 | 55 |
| 6 | 30 | 9.261654 | 10.738346 | 9.269023 | 10.730977 | 10.007369 | 9.992631 | 30 | 54 |
| 7 | 45 | 9.261824 | 10.738176 | 9.269199 | 10.730801 | 10.007375 | 9.992625 | 15 | 53 |
| 8 | 32 | 9.261994 | 10.738006 | 9.269375 | 10.730625 | 10.007381 | 9.992619 | 28 | 52 |
| 9 | 15 | 9.262164 | 10.737836 | 9.269551 | 10.730449 | 10.007387 | 9.992613 | 45 | 51 |
| 10 | 30 | 9.262334 | 10.737666 | 9.269726 | 10.730274 | 10.007393 | 9.992607 | 30 | 50 |
| 11 | 45 | 9.262503 | 10.737497 | 9.269902 | 10.730098 | 10.007398 | 9.992602 | 15 | 49 |
| 12 | 33 | 9.262673 | 10.737327 | 9.270077 | 10.729923 | 10.007404 | 9.992596 | 27 | 48 |
| 13 | 15 | 9.262842 | 10.737158 | 9.270253 | 10.729747 | 10.007410 | 9.992590 | 45 | 47 |
| 14 | 30 | 9.263012 | 10.736988 | 9.270428 | 10.729572 | 10.007416 | 9.992584 | 30 | 46 |
| 15 | 45 | 9.263181 | 10.736819 | 9.270603 | 10.729397 | 10.007422 | 9.992578 | 15 | 45 |
| 16 | 34 | 9.263351 | 10.736649 | 9.270779 | 10.729221 | 10.007428 | 9.992572 | 26 | 44 |
| 17 | 15 | 9.263520 | 10.736480 | 9.270954 | 10.729046 | 10.007434 | 9.992566 | 45 | 43 |
| 18 | 30 | 9.263689 | 10.736311 | 9.271129 | 10.728871 | 10.007440 | 9.992560 | 30 | 42 |
| 19 | 45 | 9.263858 | 10.736142 | 9.271304 | 10.728696 | 10.007446 | 9.992554 | 15 | 41 |
| 20 | 35 | 9.264027 | 10.735973 | 9.271479 | 10.728521 | 10.007451 | 9.992549 | 25 | 40 |
| 21 | 15 | 9.264196 | 10.735804 | 9.271654 | 10.728346 | 10.007457 | 9.992543 | 45 | 39 |
| 22 | 30 | 9.264365 | 10.735635 | 9.271829 | 10.728171 | 10.007463 | 9.992537 | 30 | 38 |
| 23 | 45 | 9.264534 | 10.735466 | 9.272003 | 10.727997 | 10.007469 | 9.992531 | 15 | 37 |
| 24 | 36 | 9.264703 | 10.735297 | 9.272178 | 10.727822 | 10.007475 | 9.992525 | 24 | 36 |
| 25 | 15 | 9.264872 | 10.735128 | 9.272353 | 10.727647 | 10.007481 | 9.992519 | 45 | 35 |
| 26 | 30 | 9.265040 | 10.734960 | 9.272527 | 10.727473 | 10.007487 | 9.992513 | 30 | 34 |
| 27 | 45 | 9.265209 | 10.734791 | 9.272702 | 10.727298 | 10.007493 | 9.992507 | 15 | 33 |
| 28 | 37 | 9.265377 | 10.734623 | 9.272876 | 10.727124 | 10.007499 | 9.992501 | 23 | 32 |
| 29 | 15 | 9.265546 | 10.734454 | 9.273051 | 10.726949 | 10.007505 | 9.992495 | 45 | 31 |
| 30 | 30 | 9.265714 | 10.734286 | 9.273225 | 10.726775 | 10.007511 | 9.992489 | 30 | 30 |
| 31 | 45 | 9.265883 | 10.734117 | 9.273399 | 10.726601 | 10.007517 | 9.992483 | 15 | 29 |
| 32 | 38 | 9.266051 | 10.733949 | 9.273573 | 10.726427 | 10.007522 | 9.992478 | 22 | 28 |
| 33 | 15 | 9.266219 | 10.733781 | 9.273747 | 10.726253 | 10.007528 | 9.992472 | 45 | 27 |
| 34 | 30 | 9.266387 | 10.733613 | 9.273921 | 10.726079 | 10.007534 | 9.992466 | 30 | 26 |
| 35 | 45 | 9.266555 | 10.733445 | 9.274095 | 10.725905 | 10.007540 | 9.992460 | 15 | 25 |
| 36 | 39 | 9.266723 | 10.733277 | 9.274269 | 10.725731 | 10.007546 | 9.992454 | 21 | 24 |
| 37 | 15 | 9.266891 | 10.733109 | 9.274443 | 10.725557 | 10.007552 | 9.992448 | 45 | 23 |
| 38 | 30 | 9.267059 | 10.732941 | 9.274617 | 10.725383 | 10.007558 | 9.992442 | 30 | 22 |
| 39 | 45 | 9.267227 | 10.732773 | 9.274791 | 10.725209 | 10.007564 | 9.992436 | 15 | 21 |
| 40 | 40 | 9.267394 | 10.732606 | 9.274964 | 10.725036 | 10.007570 | 9.992430 | 20 | 20 |
| 41 | 15 | 9.267562 | 10.732438 | 9.275138 | 10.724862 | 10.007576 | 9.992424 | 45 | 19 |
| 42 | 30 | 9.267730 | 10.732270 | 9.275312 | 10.724688 | 10.007582 | 9.992418 | 30 | 18 |
| 43 | 45 | 9.267897 | 10.732103 | 9.275485 | 10.724515 | 10.007588 | 9.992412 | 15 | 17 |
| 44 | 41 | 9.268065 | 10.731935 | 9.275658 | 10.724342 | 10.007594 | 9.992406 | 19 | 16 |
| 45 | 15 | 9.268232 | 10.731768 | 9 275832 | 10.724168 | 10.007600 | 9.992400 | 45 | 15 |
| 46 | 30 | 9.268399 | 10.731601 | 9.276005 | 10.723995 | 10.007606 | 9.992394 | 30 | 14 |
| 47 | 45 | 9.268567 | 10.731433 | 9.276178 | 10.723822 | 10.007612 | 9.992388 | 15 | 13 |
| 48 | 42 | 9.268734 | 10.731266 | 9.276351 | 10.723649 | 10.007618 | 9.992382 | 18 | 12 |
| 49 | 15 | 9.268901 | 10.731099 | 9.276524 | 10.723476 | 10.007624 | 9.992376 | 45 | 11 |
| 50 | 30 | 9.269068 | 10.730932 | 9.276697 | 10.723303 | 10.007630 | 9.992370 | 30 | 10 |
| 51 | 45 | 9.269235 | 10.730765 | 9.276870 | 10.723130 | 10.007636 | 9.992364 | 15 | 9 |
| 52 | 43 | 9.269402 | 10.730598 | 9.277043 | 10.722957 | 10.007642 | 9.992358 | 17 | 8 |
| 53 | 15 | 9.269569 | 10.730431 | 9.277216 | 10.722784 | 10.007648 | 9.992352 | 45 | 7 |
| 54 | 30 | 9.269735 | 10.730265 | 9.277389 | 10.722611 | 10.007653 | 9.992347 | 30 | 6 |
| 55 | 45 | 9.269902 | 10.730098 | 9.277562 | 10.722438 | 10.007659 | 9.992341 | 15 | 5 |
| 56 | 44 | 9.270069 | 10.729931 | 9.277734 | 10.722266 | 10.007665 | 9.992335 | 16 | 4 |
| 57 | 15 | 9.270235 | 10.729765 | 9.277907 | 10.722093 | 10.007671 | 9.992329 | 45 | 3 |
| 58 | 30 | 9.270402 | 10.729598 | 9.278079 | 10.721921 | 10.007677 | 9.992323 | 30 | 2 |
| 59 | 45 | 9.270568 | 10.729432 | 9.278252 | 10.721748 | 10.007683 | 9.992317 | 15 | 1 |
| 60 | 45 | 9.270735 | 10.729265 | 9.278424 | 10.721576 | 10.007689 | 9.992311 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 17m. | | LOG. SINES, &c. | | | | | 79 deg. | | |

| 0h 48m. | | | LOG. SINES, &c. (t.) | | | | 10 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.270735 | 10.729265 | 9.278424 | 10.721576 | 10.007689 | 9.992311 | 15 | 60 |
| 1 | 15 | 9.270901 | 10.729099 | 9.278596 | 10.721404 | 10.007695 | 9.992305 | 45 | 59 |
| 2 | 30 | 9.271067 | 10.728933 | 9.278769 | 10.721231 | 10.007701 | 9.992299 | 30 | 58 |
| 3 | 45 | 9.271234 | 10.728766 | 9.278941 | 10.721059 | 10.007707 | 9.992293 | 15 | 57 |
| 4 | 46 | 9.271400 | 10.728600 | 9.279113 | 10.720887 | 10.007713 | 9.992287 | 14 | 56 |
| 5 | 15 | 9.271566 | 10.728434 | 9.279285 | 10.720715 | 10.007719 | 9.992281 | 45 | 55 |
| 6 | 30 | 9.271732 | 10.728268 | 9.279457 | 10.720543 | 10.007725 | 9.992275 | 30 | 54 |
| 7 | 45 | 9.271898 | 10.728102 | 9.279629 | 10.720371 | 10.007731 | 9.992269 | 15 | 53 |
| 8 | 47 | 9.272063 | 10.727937 | 9.279801 | 10.720199 | 10.007737 | 9.992263 | 13 | 52 |
| 9 | 15 | 9.272229 | 10.727771 | 9.279973 | 10.720027 | 10.007743 | 9.992257 | 45 | 51 |
| 10 | 30 | 9.272395 | 10.727605 | 9.280144 | 10.719856 | 10.007749 | 9.992251 | 30 | 50 |
| 11 | 45 | 9.272561 | 10.727439 | 9.280316 | 10.719684 | 10.007756 | 9.992244 | 15 | 49 |
| 12 | 48 | 9.272726 | 10.727274 | 9.280488 | 10.719512 | 10.007762 | 9.992238 | 12 | 48 |
| 13 | 15 | 9.272892 | 10.727108 | 9.280659 | 10.719341 | 10.007768 | 9.992232 | 45 | 47 |
| 14 | 30 | 9.273057 | 10.726943 | 9.280831 | 10.719169 | 10.007774 | 9.992226 | 30 | 46 |
| 15 | 45 | 9.273223 | 10.726777 | 9.281002 | 10.718998 | 10.007780 | 9.992220 | 15 | 45 |
| 16 | 49 | 9.273388 | 10.726612 | 9.281174 | 10.718826 | 10.007786 | 9.992214 | 11 | 44 |
| 17 | 15 | 9.273553 | 10.726447 | 9.281345 | 10.718655 | 10.007792 | 9.992208 | 45 | 43 |
| 18 | 30 | 9.273718 | 10.726282 | 9.281516 | 10.718484 | 10.007798 | 9.992202 | 30 | 42 |
| 19 | 45 | 9.273884 | 10.726116 | 9.281687 | 10.718313 | 10.007804 | 9.992196 | 15 | 41 |
| 20 | 50 | 9.274049 | 10.725951 | 9.281858 | 10.718142 | 10.007810 | 9.992190 | 10 | 40 |
| 21 | 15 | 9.274214 | 10.725786 | 9.282029 | 10.717971 | 10.007816 | 9.992184 | 45 | 39 |
| 22 | 30 | 9.274379 | 10.725621 | 9.282200 | 10.717800 | 10.007822 | 9.992178 | 30 | 38 |
| 23 | 45 | 9.274543 | 10.725457 | 9.282371 | 10.717629 | 10.007828 | 9.992172 | 15 | 37 |
| 24 | 51 | 9.274708 | 10.725292 | 9.282542 | 10.717458 | 10.007834 | 9.992166 | 9 | 36 |
| 25 | 15 | 9.274873 | 10.725127 | 9.282713 | 10.717287 | 10.007840 | 9.992160 | 45 | 35 |
| 26 | 30 | 9.275038 | 10.724962 | 9.282884 | 10.717116 | 10.007846 | 9.992154 | 30 | 34 |
| 27 | 45 | 9.275202 | 10.724798 | 9.283054 | 10.716946 | 10.007852 | 9.992148 | 15 | 33 |
| 28 | 52 | 9.275367 | 10.724633 | 9.283225 | 10.716775 | 10.007858 | 9.992142 | 8 | 32 |
| 29 | 15 | 9.275531 | 10.724469 | 9.283396 | 10.716604 | 10.007864 | 9.992136 | 45 | 31 |
| 30 | 30 | 9.275696 | 10.724304 | 9.283566 | 10.716434 | 10.007870 | 9.992130 | 30 | 30 |
| 31 | 45 | 9.275860 | 10.724140 | 9.283737 | 10.716263 | 10.007876 | 9.992124 | 15 | 29 |
| 32 | 53 | 9.276024 | 10.723976 | 9.283907 | 10.716093 | 10.007883 | 9.992117 | 7 | 28 |
| 33 | 15 | 9.276189 | 10.723811 | 9.284077 | 10.715923 | 10.007889 | 9.992111 | 45 | 27 |
| 34 | 30 | 9.276353 | 10.723647 | 9.284247 | 10.715753 | 10.007895 | 9.992105 | 30 | 26 |
| 35 | 45 | 9.276517 | 10.723483 | 9.284418 | 10.715582 | 10.007901 | 9.992099 | 15 | 25 |
| 36 | 54 | 9.276681 | 10.723319 | 9.284588 | 10.715412 | 10.007907 | 9.992093 | 6 | 24 |
| 37 | 15 | 9.276845 | 10.723155 | 9.284758 | 10.715242 | 10.007913 | 9.992087 | 45 | 23 |
| 38 | 30 | 9.277009 | 10.722991 | 9.284928 | 10.715072 | 10.007919 | 9.992081 | 30 | 22 |
| 39 | 45 | 9.277173 | 10.722827 | 9.285098 | 10.714902 | 10.007925 | 9.992075 | 15 | 21 |
| 40 | 55 | 9.277337 | 10.722663 | 9.285268 | 10.714732 | 10.007931 | 9.992069 | 5 | 20 |
| 41 | 15 | 9.277500 | 10.722500 | 9.285437 | 10.714563 | 10.007937 | 9.992063 | 45 | 19 |
| 42 | 30 | 9.277664 | 10.722336 | 9.285607 | 10.714393 | 10.007943 | 9.992057 | 30 | 18 |
| 43 | 45 | 9.277827 | 10.722173 | 9.285777 | 10.714223 | 10.007949 | 9.992051 | 15 | 17 |
| 44 | 56 | 9.277991 | 10.722009 | 9.285947 | 10.714053 | 10.007956 | 9.992044 | 4 | 16 |
| 45 | 15 | 9.278154 | 10.721846 | 9.286116 | 10.713884 | 10.007962 | 9.992038 | 45 | 15 |
| 46 | 30 | 9.278318 | 10.721682 | 9.286286 | 10.713714 | 10.007968 | 9.992032 | 30 | 14 |
| 47 | 45 | 9.278481 | 10.721519 | 9.286455 | 10.713545 | 10.007974 | 9.992026 | 15 | 13 |
| 48 | 57 | 9.278644 | 10.721356 | 9.286624 | 10.713376 | 10.007980 | 9.992020 | 3 | 12 |
| 49 | 15 | 9.278808 | 10.721192 | 9.286794 | 10.713206 | 10.007986 | 9.992014 | 45 | 11 |
| 50 | 30 | 9.278971 | 10.721029 | 9.286963 | 10.713037 | 10.007992 | 9.992008 | 30 | 10 |
| 51 | 45 | 9.279134 | 10.720866 | 9.287132 | 10.712868 | 10.007998 | 9.992002 | 15 | 9 |
| 52 | 58 | 9.279297 | 10.720703 | 9.287301 | 10.712699 | 10.008004 | 9.991996 | 2 | 8 |
| 53 | 15 | 9.279460 | 10.720540 | 9.287470 | 10.712530 | 10.008011 | 9.991989 | 45 | 7 |
| 54 | 30 | 9.279623 | 10.720377 | 9.287639 | 10.712361 | 10.008017 | 9.991983 | 30 | 6 |
| 55 | 45 | 9.279786 | 10.720214 | 9.287808 | 10.712192 | 10.008023 | 9.991977 | 15 | 5 |
| 56 | 59 | 9.279948 | 10.720052 | 9.287977 | 10.712023 | 10.008029 | 9.991971 | 1 | 4 |
| 57 | 15 | 9.280111 | 10.719889 | 9.288146 | 10.711854 | 10.008035 | 9.991965 | 45 | 3 |
| 58 | 30 | 9.280274 | 10.719726 | 9.288315 | 10.711685 | 10.008041 | 9.991959 | 30 | 2 |
| 59 | 45 | 9.280436 | 10.719564 | 9.288484 | 10.711516 | 10.008047 | 9.991953 | 15 | 1 |
| 60 | 60 | 9.280599 | 10.719401 | 9.288652 | 10.711348 | 10.008053 | 9.991947 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 16m. | | | LOG. SINES, &c. | | | | 79 deg. | | |

| | 0h 44m. | | LOG. SINES, &c. (t.) | | | 11 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.280599 | 10.719401 | 9.288652 | 10.711348 | 10.008053 | 9.991947 | 60 | 60 |
| 1 | 15 | 9.280761 | 10.719239 | 9.288821 | 10.711179 | 10.008060 | 9.991940 | 45 | 59 |
| 2 | 30 | 9.280924 | 10.719076 | 9.288989 | 10.711011 | 10.008066 | 9.991934 | 30 | 58 |
| 3 | 45 | 9.281086 | 10.718914 | 9.289158 | 10.710842 | 10.008072 | 9.991928 | 15 | 57 |
| 4 | 1 | 9.281248 | 10.718752 | 9.289326 | 10.710674 | 10.008078 | 9.991922 | 59 | 56 |
| 5 | 15 | 9.281410 | 10.718590 | 9.289495 | 10.710505 | 10.008084 | 9.991916 | 45 | 55 |
| 6 | 30 | 9.281573 | 10.718427 | 9.289663 | 10.710337 | 10.008090 | 9.991910 | 30 | 54 |
| 7 | 45 | 9.281735 | 10.718265 | 9.289831 | 10.710169 | 10.008097 | 9.991903 | 15 | 53 |
| 8 | 2 | 9.281897 | 10.718103 | 9.289999 | 10.710001 | 10.008103 | 9.991897 | 58 | 52 |
| 9 | 15 | 9.282059 | 10.717941 | 9.290167 | 10.709833 | 10.008109 | 9.991891 | 45 | 51 |
| 10 | 30 | 9.282220 | 10.717780 | 9.290335 | 10.709665 | 10.008115 | 9.991885 | 30 | 50 |
| 11 | 45 | 9.282382 | 10.717618 | 9.290503 | 10.709497 | 10.008121 | 9.991879 | 15 | 49 |
| 12 | 3 | 9.282544 | 10.717456 | 9.290671 | 10.709329 | 10.008127 | 9.991873 | 57 | 48 |
| 13 | 15 | 9.282706 | 10.717294 | 9.290839 | 10.709161 | 10.008133 | 9.991867 | 45 | 47 |
| 14 | 30 | 9.282867 | 10.717133 | 9.291007 | 10.708993 | 10.008140 | 9.991860 | 30 | 46 |
| 15 | 45 | 9.283029 | 10.716971 | 9.291175 | 10.708825 | 10.008146 | 9.991854 | 15 | 45 |
| 16 | 4 | 9.283190 | 10.716810 | 9.291342 | 10.708658 | 10.008152 | 9.991848 | 56 | 44 |
| 17 | 15 | 9.283352 | 10.716648 | 9.291510 | 10.708490 | 10.008158 | 9.991842 | 45 | 43 |
| 18 | 30 | 9.283513 | 10.716487 | 9.291678 | 10.708322 | 10.008164 | 9.991836 | 30 | 42 |
| 19 | 45 | 9.283675 | 10.716325 | 9.291845 | 10.708155 | 10.008171 | 9.991829 | 15 | 41 |
| 20 | 5 | 9.283836 | 10.716164 | 9.292013 | 10.707987 | 10.008177 | 9.991823 | 55 | 40 |
| 21 | 15 | 9.283997 | 10.716003 | 9.292180 | 10.707820 | 10.008183 | 9.991817 | 45 | 39 |
| 22 | 30 | 9.284158 | 10.715842 | 9.292347 | 10.707653 | 10.008189 | 9.991811 | 30 | 38 |
| 23 | 45 | 9.284319 | 10.715681 | 9.292514 | 10.707486 | 10.008195 | 9.991805 | 15 | 37 |
| 24 | 6 | 9.284480 | 10.715520 | 9.292682 | 10.707318 | 10.008201 | 9.991799 | 54 | 36 |
| 25 | 15 | 9.284641 | 10.715359 | 9.292849 | 10.707151 | 10.008208 | 9.991792 | 45 | 35 |
| 26 | 30 | 9.284802 | 10.715198 | 9.293016 | 10.706984 | 10.008214 | 9.991786 | 30 | 34 |
| 27 | 45 | 9.284963 | 10.715037 | 9.293183 | 10.706817 | 10.008220 | 9.991780 | 15 | 33 |
| 28 | 7 | 9.285124 | 10.714876 | 9.293350 | 10.706650 | 10.008226 | 9.991774 | 53 | 32 |
| 29 | 15 | 9.285284 | 10.714716 | 9.293517 | 10.706483 | 10.008233 | 9.991767 | 45 | 31 |
| 30 | 30 | 9.285445 | 10.714555 | 9.293684 | 10.706316 | 10.008239 | 9.991761 | 30 | 30 |
| 31 | 45 | 9.285606 | 10.714394 | 9.293850 | 10.706150 | 10.008245 | 9.991755 | 15 | 29 |
| 32 | 8 | 9.285766 | 10.714234 | 9.294017 | 10.705983 | 10.008251 | 9.991749 | 52 | 28 |
| 33 | 15 | 9.285927 | 10.714073 | 9.294184 | 10.705816 | 10.008257 | 9.991743 | 45 | 27 |
| 34 | 30 | 9.286087 | 10.713913 | 9.294350 | 10.705650 | 10.008264 | 9.991736 | 30 | 26 |
| 35 | 45 | 9.286247 | 10.713753 | 9.294517 | 10.705483 | 10.008270 | 9.991730 | 15 | 25 |
| 36 | 9 | 9.286408 | 10.713592 | 9.294684 | 10.705316 | 10.008276 | 9.991724 | 51 | 24 |
| 37 | 15 | 9.286568 | 10.713432 | 9.294850 | 10.705150 | 10.008282 | 9.991718 | 45 | 23 |
| 38 | 30 | 9.286728 | 10.713272 | 9.295016 | 10.704984 | 10.008288 | 9.991712 | 30 | 22 |
| 39 | 45 | 9.286888 | 10.713112 | 9.295183 | 10.704817 | 10.008295 | 9.991705 | 15 | 21 |
| 40 | 10 | 9.287048 | 10.712952 | 9.295349 | 10.704651 | 10.008301 | 9.991699 | 50 | 20 |
| 41 | 15 | 9.287208 | 10.712792 | 9.295515 | 10.704485 | 10.008307 | 9.991693 | 45 | 19 |
| 42 | 30 | 9.287368 | 10.712632 | 9.295681 | 10.704319 | 10.008313 | 9.991687 | 30 | 18 |
| 43 | 45 | 9.287528 | 10.712472 | 9.295847 | 10.704153 | 10.008320 | 9.991680 | 15 | 17 |
| 44 | 11 | 9.287687 | 10.712313 | 9.296013 | 10.703987 | 10.008326 | 9.991674 | 49 | 16 |
| 45 | 15 | 9.287847 | 10.712153 | 9.296179 | 10.703821 | 10.008332 | 9.991668 | 45 | 15 |
| 46 | 30 | 9.288007 | 10.711993 | 9.296345 | 10.703655 | 10.008338 | 9.991662 | 30 | 14 |
| 47 | 45 | 9.288166 | 10.711834 | 9.296511 | 10.703489 | 10.008345 | 9.991655 | 15 | 13 |
| 48 | 12 | 9.288326 | 10.711674 | 9.296677 | 10.703323 | 10.008351 | 9.991649 | 48 | 12 |
| 49 | 15 | 9.288485 | 10.711515 | 9.296843 | 10.703157 | 10.008357 | 9.991643 | 45 | 11 |
| 50 | 30 | 9.288645 | 10.711355 | 9.297008 | 10.702992 | 10.008363 | 9.991637 | 30 | 10 |
| 51 | 45 | 9.288804 | 10.711196 | 9.297174 | 10.702826 | 10.008370 | 9.991630 | 15 | 9 |
| 52 | 13 | 9.288964 | 10.711036 | 9.297339 | 10.702661 | 10.008376 | 9.991624 | 47 | 8 |
| 53 | 15 | 9.289123 | 10.710877 | 9.297505 | 10.702495 | 10.008382 | 9.991618 | 45 | 7 |
| 54 | 30 | 9.289282 | 10.710718 | 9.297670 | 10.702330 | 10.008388 | 9.991612 | 30 | 6 |
| 55 | 45 | 9.289441 | 10.710559 | 9.297836 | 10.702164 | 10.008395 | 9.991605 | 15 | 5 |
| 56 | 14 | 9.289600 | 10.710400 | 9.298001 | 10.701999 | 10.008401 | 9.991599 | 46 | 4 |
| 57 | 15 | 9.289759 | 10.710241 | 9.298166 | 10.701834 | 10.008407 | 9.991593 | 45 | 3 |
| 58 | 30 | 9.289918 | 10.710082 | 9.298332 | 10.701668 | 10.008414 | 9.991586 | 30 | 2 |
| 59 | 45 | 9.290077 | 10.709923 | 9.298497 | 10.701503 | 10.008420 | 9.991580 | 15 | 1 |
| 60 | 15 | 9.290236 | 10.709764 | 9.298662 | 10.701338 | 10.008426 | 9.991574 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 5h 15m. | | LOG. SINES, &c. | | | | 78 deg. | | |

| 0h 45m. | | LOG. SINES, &c. (t.) | | | | | 11 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.290236 | 10.709764 | 9.298662 | 10.701338 | 10.008426 | 9.991574 | 15 | 60 |
| 1 | 15 | 9.290394 | 10.709606 | 9.298827 | 10.701173 | 10.008432 | 9.991568 | 45 | 59 |
| 2 | 30 | 9.290553 | 10.709447 | 9.298992 | 10.701008 | 10.008439 | 9.991561 | 30 | 58 |
| 3 | 45 | 9.290712 | 10.709288 | 9.299157 | 10.700843 | 10.008445 | 9.991555 | 15 | 57 |
| 4 | 16 | 9.290870 | 10.709130 | 9.299322 | 10.700678 | 10.008451 | 9.991549 | 44 | 56 |
| 5 | 15 | 9.291029 | 10.708971 | 9.299486 | 10.700514 | 10.008458 | 9.991542 | 45 | 55 |
| 6 | 30 | 9.291187 | 10.708813 | 9.299651 | 10.700349 | 10.008464 | 9.991536 | 30 | 54 |
| 7 | 45 | 9.291346 | 10.708654 | 9.299816 | 10.700184 | 10.008470 | 9.991530 | 15 | 53 |
| 8 | 17 | 9.291504 | 10.708496 | 9.299980 | 10.700020 | 10.008476 | 9.991524 | 43 | 52 |
| 9 | 15 | 9.291662 | 10.708338 | 9.300145 | 10.699855 | 10.008483 | 9.991517 | 45 | 51 |
| 10 | 30 | 9.291820 | 10.708180 | 9.300309 | 10.699691 | 10.008489 | 9.991511 | 30 | 50 |
| 11 | 45 | 9.291979 | 10.708021 | 9.300474 | 10.699526 | 10.008495 | 9.991505 | 15 | 49 |
| 12 | 18 | 9.292137 | 10.707863 | 9.300638 | 10.699362 | 10.008502 | 9.991498 | 42 | 48 |
| 13 | 15 | 9.292295 | 10.707705 | 9.300803 | 10.699197 | 10.008508 | 9.991492 | 45 | 47 |
| 14 | 30 | 9.292453 | 10.707547 | 9.300967 | 10.699033 | 10.008514 | 9.991486 | 30 | 46 |
| 15 | 45 | 9.292611 | 10.707389 | 9.301131 | 10.698869 | 10.008521 | 9.991479 | 15 | 45 |
| 16 | 19 | 9.292768 | 10.707232 | 9.301295 | 10.698705 | 10.008527 | 9.991473 | 41 | 44 |
| 17 | 15 | 9.292926 | 10.707074 | 9.301459 | 10.698541 | 10.008533 | 9.991467 | 45 | 43 |
| 18 | 30 | 9.293084 | 10.706916 | 9.301623 | 10.698377 | 10.008540 | 9.991460 | 30 | 42 |
| 19 | 45 | 9.293242 | 10.706758 | 9.301787 | 10.698213 | 10.008546 | 9.991454 | 15 | 41 |
| 20 | 20 | 9.293399 | 10.706601 | 9.301951 | 10.698049 | 10.008552 | 9.991448 | 40 | 40 |
| 21 | 15 | 9.293557 | 10.706443 | 9.302115 | 10.697885 | 10.008559 | 9.991441 | 45 | 39 |
| 22 | 30 | 9.293714 | 10.706286 | 9.302279 | 10.697721 | 10.008565 | 9.991435 | 30 | 38 |
| 23 | 45 | 9.293872 | 10.706128 | 9.302443 | 10.697557 | 10.008571 | 9.991429 | 15 | 37 |
| 24 | 21 | 9.294029 | 10.705971 | 9.302607 | 10.697393 | 10.008578 | 9.991422 | 39 | 36 |
| 25 | 15 | 9.294186 | 10.705814 | 9.302770 | 10.697230 | 10.008584 | 9.991416 | 45 | 35 |
| 26 | 30 | 9.294344 | 10.705656 | 9.302934 | 10.697066 | 10.008590 | 9.991410 | 30 | 34 |
| 27 | 45 | 9.294501 | 10.705499 | 9.303097 | 10.696903 | 10.008597 | 9.991403 | 15 | 33 |
| 28 | 22 | 9.294658 | 10.705342 | 9.303261 | 10.696739 | 10.008603 | 9.991397 | 38 | 32 |
| 29 | 15 | 9.294815 | 10.705185 | 9.303424 | 10.696576 | 10.008609 | 9.991391 | 45 | 31 |
| 30 | 30 | 9.294972 | 10.705028 | 9.303588 | 10.696412 | 10.008616 | 9.991384 | 30 | 30 |
| 31 | 45 | 9.295129 | 10.704871 | 9.303751 | 10.696249 | 10.008622 | 9.991378 | 15 | 29 |
| 32 | 23 | 9.295286 | 10.704714 | 9.303914 | 10.696086 | 10.008628 | 9.991372 | 37 | 28 |
| 33 | 15 | 9.295443 | 10.704557 | 9.304077 | 10.695923 | 10.008635 | 9.991365 | 45 | 27 |
| 34 | 30 | 9.295600 | 10.704400 | 9.304241 | 10.695759 | 10.008641 | 9.991359 | 30 | 26 |
| 35 | 45 | 9.295756 | 10.704244 | 9.304404 | 10.695596 | 10.008647 | 9.991353 | 15 | 25 |
| 36 | 24 | 9.295913 | 10.704087 | 9.304567 | 10.695433 | 10.008654 | 9.991346 | 36 | 24 |
| 37 | 15 | 9.296070 | 10.703930 | 9.304730 | 10.695270 | 10.008660 | 9.991340 | 45 | 23 |
| 38 | 30 | 9.296226 | 10.703774 | 9.304893 | 10.695107 | 10.008667 | 9.991333 | 30 | 22 |
| 39 | 45 | 9.296383 | 10.703617 | 9.305055 | 10.694945 | 10.008673 | 9.991327 | 15 | 21 |
| 40 | 25 | 9.296539 | 10.703461 | 9.305218 | 10.694782 | 10.008679 | 9.991321 | 35 | 20 |
| 41 | 15 | 9.296695 | 10.703305 | 9.305381 | 10.694619 | 10.008686 | 9.991314 | 45 | 19 |
| 42 | 30 | 9.296852 | 10.703148 | 9.305544 | 10.694456 | 10.008692 | 9.991308 | 30 | 18 |
| 43 | 45 | 9.297008 | 10.702992 | 9.305706 | 10.694294 | 10.008698 | 9.991302 | 15 | 17 |
| 44 | 26 | 9.297164 | 10.702836 | 9.305869 | 10.694131 | 10.008705 | 9.991295 | 34 | 16 |
| 45 | 15 | 9.297320 | 10.702680 | 9.306031 | 10.693969 | 10.008711 | 9.991289 | 45 | 15 |
| 46 | 30 | 9.297476 | 10.702524 | 9.306194 | 10.693806 | 10.008718 | 9.991282 | 30 | 14 |
| 47 | 45 | 9.297632 | 10.702368 | 9.306356 | 10.693644 | 10.008724 | 9.991276 | 15 | 13 |
| 48 | 27 | 9.297788 | 10.702212 | 9.306519 | 10.693481 | 10.008730 | 9.991270 | 33 | 12 |
| 49 | 15 | 9.297944 | 10.702056 | 9.306681 | 10.693319 | 10.008737 | 9.991263 | 45 | 11 |
| 50 | 30 | 9.298100 | 10.701900 | 9.306843 | 10.693157 | 10.008743 | 9.991257 | 30 | 10 |
| 51 | 45 | 9.298256 | 10.701744 | 9.307005 | 10.692995 | 10.008750 | 9.991250 | 15 | 9 |
| 52 | 28 | 9.298412 | 10.701588 | 9.307167 | 10.692833 | 10.008756 | 9.991244 | 32 | 8 |
| 53 | 15 | 9.298567 | 10.701433 | 9.307330 | 10.692670 | 10.008762 | 9.991238 | 45 | 7 |
| 54 | 30 | 9.298723 | 10.701277 | 9.307492 | 10.692508 | 10.008769 | 9.991231 | 30 | 6 |
| 55 | 45 | 9.298878 | 10.701122 | 9.307654 | 10.692346 | 10.008775 | 9.991225 | 15 | 5 |
| 56 | 29 | 9.299034 | 10.700966 | 9.307815 | 10.692185 | 10.008782 | 9.991218 | 31 | 4 |
| 57 | 15 | 9.299189 | 10.700811 | 9.307977 | 10.692023 | 10.008788 | 9.991212 | 45 | 3 |
| 58 | 30 | 9.299345 | 10.700655 | 9.308139 | 10.691861 | 10.008794 | 9.991206 | 30 | 2 |
| 59 | 45 | 9.299500 | 10.700500 | 9.308301 | 10.691699 | 10.008801 | 9.991199 | 15 | 1 |
| 60 | 30 | 9.299655 | 10.700345 | 9.308463 | 10.691537 | 10.008807 | 9.991193 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec |
| 5h 14m. | | | LOG. SINES, &c. | | | | 78 deg | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $0^h\ 46^m$. | | LOG. SINES, &c. (t.) | | | | 11 deg. | | |
| 0 | 30 | 9.299655 | 10.700345 | 9.308463 | 10.691537 | 10.008807 | 9.991193 | 30 | 60 |
| 1 | 15 | 9.299810 | 10.700190 | 9.308624 | 10.691376 | 10.008814 | 9.991186 | 45 | 59 |
| 2 | 30 | 9.299966 | 10.700034 | 9.308786 | 10.691214 | 10.008820 | 9.991180 | 30 | 58 |
| 3 | 45 | 9.300121 | 10.699879 | 9.308947 | 10.691053 | 10.008827 | 9.991173 | 15 | 57 |
| 4 | 31 | 9.300276 | 10.699724 | 9.309109 | 10.690891 | 10.008833 | 9.991167 | 29 | 56 |
| 5 | 15 | 9.300431 | 10.699569 | 9.309270 | 10.690730 | 10.008840 | 9.991160 | 45 | 55 |
| 6 | 30 | 9.300586 | 10.699414 | 9.309432 | 10.690568 | 10.008846 | 9.991154 | 30 | 54 |
| 7 | 45 | 9.300740 | 10.699260 | 9.309593 | 10.690407 | 10.008852 | 9.991148 | 15 | 53 |
| 8 | 32 | 9.300895 | 10.699105 | 9.309754 | 10.690246 | 10.008859 | 9.991141 | 28 | 52 |
| 9 | 15 | 9.301050 | 10.698950 | 9.309915 | 10.690085 | 10.008865 | 9.991135 | 45 | 51 |
| 10 | 30 | 9.301205 | 10.698795 | 9.310076 | 10.689924 | 10.008872 | 9.991128 | 30 | 50 |
| 11 | 45 | 9.301359 | 10.698641 | 9.310237 | 10.689763 | 10.008878 | 9.991122 | 15 | 49 |
| 12 | 33 | 9.301514 | 10.698486 | 9.310398 | 10.689602 | 10.008885 | 9.991115 | 27 | 48 |
| 13 | 15 | 9.301668 | 10.698332 | 9.310559 | 10.689441 | 10.008891 | 9.991109 | 45 | 47 |
| 14 | 30 | 9.301823 | 10.698177 | 9.310720 | 10.689280 | 10.008898 | 9.991102 | 30 | 46 |
| 15 | 45 | 9.301977 | 10.698023 | 9.310881 | 10.689119 | 10.008904 | 9.991096 | 15 | 45 |
| 16 | 34 | 9.302132 | 10.697868 | 9.311042 | 10.688958 | 10.008910 | 9.991090 | 26 | 44 |
| 17 | 15 | 9.302286 | 10.697714 | 9.311203 | 10.688797 | 10.008917 | 9.991083 | 45 | 43 |
| 18 | 30 | 9.302440 | 10.697560 | 9.311363 | 10.688637 | 10.008923 | 9.991077 | 30 | 42 |
| 19 | 45 | 9.302594 | 10.697406 | 9.311524 | 10.688476 | 10.008930 | 9.991070 | 15 | 41 |
| 20 | 35 | 9.302748 | 10.697252 | 9.311685 | 10.688315 | 10.008936 | 9.991064 | 25 | 40 |
| 21 | 15 | 9.302903 | 10.697097 | 9.311845 | 10.688155 | 10.008943 | 9.991057 | 45 | 39 |
| 22 | 30 | 9.303057 | 10.696943 | 9.312006 | 10.687994 | 10.008949 | 9.991051 | 30 | 38 |
| 23 | 45 | 9.303210 | 10.696790 | 9.312166 | 10.687834 | 10.008956 | 9.991044 | 15 | 37 |
| 24 | 36 | 9.303364 | 10.696636 | 9.312327 | 10.687673 | 10.008962 | 9.991038 | 24 | 36 |
| 25 | 15 | 9.303518 | 10.696482 | 9.312487 | 10.687513 | 10.008969 | 9.991031 | 45 | 35 |
| 26 | 30 | 9.303672 | 10.696328 | 9.312647 | 10.687353 | 10.008975 | 9.991025 | 30 | 34 |
| 27 | 45 | 9.303826 | 10.696174 | 9.312807 | 10.687193 | 10.008982 | 9.991018 | 15 | 33 |
| 28 | 37 | 9.303979 | 10.696021 | 9.312967 | 10.687033 | 10.008988 | 9.991012 | 23 | 32 |
| 29 | 15 | 9.304133 | 10.695867 | 9.313128 | 10.686872 | 10.008995 | 9.991005 | 45 | 31 |
| 30 | 30 | 9.304286 | 10.695714 | 9.313288 | 10.686712 | 10.009001 | 9.990999 | 30 | 30 |
| 31 | 45 | 9.304440 | 10.695560 | 9.313448 | 10.686552 | 10.009008 | 9.990992 | 15 | 29 |
| 32 | 38 | 9.304593 | 10.695407 | 9.313608 | 10.686392 | 10.009014 | 9.990986 | 22 | 28 |
| 33 | 15 | 9.304747 | 10.695253 | 9.313767 | 10.686233 | 10.009021 | 9.990979 | 45 | 27 |
| 34 | 30 | 9.304900 | 10.695100 | 9.313927 | 10.686073 | 10.009027 | 9.990973 | 30 | 26 |
| 35 | 45 | 9.305053 | 10.694947 | 9.314087 | 10.685913 | 10.009034 | 9.990966 | 15 | 25 |
| 36 | 39 | 9.305207 | 10.694793 | 9.314247 | 10.685753 | 10.009040 | 9.990960 | 21 | 24 |
| 37 | 15 | 9.305360 | 10.694640 | 9.314406 | 10.685594 | 10.009047 | 9.990953 | 45 | 23 |
| 38 | 30 | 9.305513 | 10.694487 | 9.314566 | 10.685434 | 10.009053 | 9.990947 | 30 | 22 |
| 39 | 45 | 9.305666 | 10.694334 | 9.314726 | 10.685274 | 10.009060 | 9.990940 | 15 | 21 |
| 40 | 40 | 9.305819 | 10.694181 | 9.314885 | 10.685115 | 10.009066 | 9.990934 | 20 | 20 |
| 41 | 15 | 9.305972 | 10.694028 | 9.315045 | 10.684955 | 10.009073 | 9.990927 | 45 | 19 |
| 42 | 30 | 9.306125 | 10.693875 | 9.315204 | 10.684796 | 10.009079 | 9.990921 | 30 | 18 |
| 43 | 45 | 9.306277 | 10.693723 | 9.315363 | 10.684637 | 10.009086 | 9.990914 | 15 | 17 |
| 44 | 41 | 9.306430 | 10.693570 | 9.315523 | 10.684477 | 10.009092 | 9.990908 | 19 | 16 |
| 45 | 15 | 9.306583 | 10.693417 | 9.315682 | 10.684318 | 10.009099 | 9.990901 | 45 | 15 |
| 46 | 30 | 9.306736 | 10.693264 | 9.315841 | 10.684159 | 10.009105 | 9.990895 | 30 | 14 |
| 47 | 45 | 9.306888 | 10.693112 | 9.316000 | 10.684000 | 10.009112 | 9.990888 | 15 | 13 |
| 48 | 42 | 9.307041 | 10.692959 | 9.316159 | 10.683841 | 10.009119 | 9.990881 | 18 | 12 |
| 49 | 15 | 9.307193 | 10.692807 | 9.316318 | 10.683682 | 10.009125 | 9.990875 | 45 | 11 |
| 50 | 30 | 9.307346 | 10.692654 | 9.316477 | 10.683523 | 10.009132 | 9.990868 | 30 | 10 |
| 51 | 45 | 9.307498 | 10.692502 | 9.316636 | 10.683364 | 10.009138 | 9.990862 | 15 | 9 |
| 52 | 43 | 9.307650 | 10.692350 | 9.316795 | 10.683205 | 10.009145 | 9.990855 | 17 | 8 |
| 53 | 15 | 9.307803 | 10.692197 | 9.316954 | 10.683046 | 10.009151 | 9.990849 | 45 | 7 |
| 54 | 30 | 9.307955 | 10.692045 | 9.317112 | 10.682888 | 10.009158 | 9.990842 | 30 | 6 |
| 55 | 45 | 9.308107 | 10.691893 | 9.317271 | 10.682729 | 10.009164 | 9.990836 | 15 | 5 |
| 56 | 44 | 9.308259 | 10.691741 | 9.317430 | 10.682570 | 10.009171 | 9.990829 | 16 | 4 |
| 57 | 15 | 9.308411 | 10.691589 | 9.317588 | 10.682412 | 10.009177 | 9.990823 | 45 | 3 |
| 58 | 30 | 9.308563 | 10.691437 | 9.317747 | 10.682253 | 10.009184 | 9.990816 | 30 | 2 |
| 59 | 45 | 9.308715 | 10.691285 | 9.317905 | 10.682095 | 10.009191 | 9.990809 | 15 | 1 |
| 60 | 45 | 9.308867 | 10.691133 | 9.318064 | 10.681936 | 10.009197 | 9.990803 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | $5^h\ 13^m$ | | LOG. SINES, &c. | | | | 78 deg. | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $0^h\ 47^m$ | LOG. SINES, &c. (t) | | | | | | 11 deg | |
| 0 | 45 | 9.308867 | 10.691133 | 9.318064 | 10.681936 | 10.009197 | 9.990803 | 15 | 60 |
| 1 | 15 | 9.309019 | 10.690981 | 9.318222 | 10.681778 | 10.009204 | 9.990796 | 45 | 59 |
| 2 | 30 | 9.309170 | 10.690830 | 9.318381 | 10.681619 | 10.009210 | 9.990790 | 30 | 58 |
| 3 | 45 | 9.309322 | 10.690678 | 9.318539 | 10.681461 | 10.009217 | 9.990783 | 15 | 57 |
| 4 | 46 | 9.309474 | 10.690526 | 9.318697 | 10.681303 | 10.009223 | 9.990777 | 14 | 56 |
| 5 | 15 | 9.309625 | 10.690375 | 9.318855 | 10.681145 | 10.009230 | 9.990770 | 45 | 55 |
| 6 | 30 | 9.309777 | 10.690223 | 9.319013 | 10.680987 | 10.009237 | 9.990763 | 30 | 54 |
| 7 | 45 | 9.309928 | 10.690072 | 9.319171 | 10.680829 | 10.009243 | 9.990757 | 15 | 53 |
| 8 | 47 | 9.310080 | 10.689920 | 9.319329 | 10.680671 | 10.009250 | 9.990750 | 13 | 52 |
| 9 | 15 | 9.310231 | 10.689769 | 9.319487 | 10.680513 | 10.009256 | 9.990744 | 45 | 51 |
| 10 | 30 | 9.310382 | 10.689618 | 9.319645 | 10.680355 | 10.009263 | 9.990737 | 30 | 50 |
| 11 | 45 | 9.310534 | 10.689466 | 9.319803 | 10.680197 | 10.009270 | 9.990730 | 15 | 49 |
| 12 | 48 | 9.310685 | 10.689315 | 9.319961 | 10.680039 | 10.009276 | 9.990724 | 12 | 48 |
| 13 | 15 | 9.310836 | 10.689164 | 9.320119 | 10.679881 | 10.009283 | 9.990717 | 45 | 47 |
| 14 | 30 | 9.310987 | 10.689013 | 9.320276 | 10.679724 | 10.009289 | 9.990711 | 30 | 46 |
| 15 | 45 | 9.311138 | 10.688862 | 9.320434 | 10.679566 | 10.009296 | 9.990704 | 15 | 45 |
| 16 | 49 | 9.311289 | 10.688711 | 9.320592 | 10.679408 | 10.009303 | 9.990697 | 11 | 44 |
| 17 | 15 | 9.311440 | 10.688560 | 9.320749 | 10.679251 | 10.009309 | 9.990691 | 45 | 43 |
| 18 | 30 | 9.311591 | 10.688409 | 9.320907 | 10.679093 | 10.009316 | 9.990684 | 30 | 42 |
| 19 | 45 | 9.311742 | 10.688258 | 9.321064 | 10.678936 | 10.009322 | 9.990678 | 15 | 41 |
| 20 | 50 | 9.311893 | 10.688107 | 9.321222 | 10.678778 | 10.009329 | 9.990671 | 10 | 40 |
| 21 | 15 | 9.312043 | 10.687957 | 9.321379 | 10.678621 | 10.009336 | 9.990664 | 45 | 39 |
| 22 | 30 | 9.312194 | 10.687806 | 9.321536 | 10.678464 | 10.009342 | 9.990658 | 30 | 38 |
| 23 | 45 | 9.312345 | 10.687655 | 9.321693 | 10.678307 | 10.009349 | 9.990651 | 15 | 37 |
| 24 | 51 | 9.312495 | 10.687505 | 9.321851 | 10.678149 | 10.009356 | 9.990644 | 9 | 36 |
| 25 | 15 | 9.312646 | 10.687354 | 9.322008 | 10.677992 | 10.009362 | 9.990638 | 45 | 35 |
| 26 | 30 | 9.312796 | 10.687204 | 9.322165 | 10.677835 | 10.009369 | 9.990631 | 30 | 34 |
| 27 | 45 | 9.312946 | 10.687054 | 9.322322 | 10.677678 | 10.009375 | 9.990625 | 15 | 33 |
| 28 | 52 | 9.313097 | 10.686903 | 9.322479 | 10.677521 | 10.009382 | 9.990618 | 8 | 32 |
| 29 | 15 | 9.313247 | 10.686753 | 9.322636 | 10.677364 | 10.009389 | 9.990611 | 45 | 31 |
| 30 | 30 | 9.313397 | 10.686603 | 9.322793 | 10.677207 | 10.009395 | 9.990605 | 30 | 30 |
| 31 | 45 | 9.313547 | 10.686453 | 9.322949 | 10.677051 | 10.009402 | 9.990598 | 15 | 29 |
| 32 | 53 | 9.313698 | 10.686302 | 9.323106 | 10.676894 | 10.009409 | 9.990591 | 7 | 28 |
| 33 | 15 | 9.313848 | 10.686152 | 9.323263 | 10.676737 | 10.009415 | 9.990585 | 45 | 27 |
| 34 | 30 | 9.313998 | 10.686002 | 9.323419 | 10.676581 | 10.009422 | 9.990578 | 30 | 26 |
| 35 | 45 | 9.314148 | 10.685852 | 9.323576 | 10.676424 | 10.009429 | 9.990571 | 15 | 25 |
| 36 | 54 | 9.314297 | 10.685703 | 9.323733 | 10.676267 | 10.009435 | 9.990565 | 6 | 24 |
| 37 | 15 | 9.314447 | 10.685553 | 9.323889 | 10.676111 | 10.009442 | 9.990558 | 45 | 23 |
| 38 | 30 | 9.314597 | 10.685403 | 9.324046 | 10.675954 | 10.009449 | 9.990551 | 30 | 22 |
| 39 | 45 | 9.314747 | 10.685253 | 9.324202 | 10.675798 | 10.009455 | 9.990545 | 15 | 21 |
| 40 | 55 | 9.314896 | 10.685104 | 9.324358 | 10.675642 | 10.009462 | 9.990538 | 5 | 20 |
| 41 | 15 | 9.315046 | 10.684954 | 9.324515 | 10.675485 | 10.009469 | 9.990531 | 45 | 19 |
| 42 | 30 | 9.315196 | 10.684804 | 9.324671 | 10.675329 | 10.009475 | 9.990525 | 30 | 1 |
| 43 | 45 | 9.315345 | 10.684655 | 9.324827 | 10.675173 | 10.009482 | 9.990518 | 15 | 17 |
| 44 | 56 | 9.315495 | 10.684505 | 9.324983 | 10.675017 | 10.009489 | 9.990511 | 4 | 16 |
| 45 | 15 | 9.315644 | 10.684356 | 9.325139 | 10.674861 | 10.009495 | 9.990505 | 45 | 15 |
| 46 | 30 | 9.315793 | 10.684207 | 9.325295 | 10.674705 | 10.009502 | 9.990498 | 30 | 14 |
| 47 | 45 | 9.315943 | 10.684057 | 9.325451 | 10.674549 | 10.009509 | 9.990491 | 15 | 13 |
| 48 | 57 | 9.316092 | 10.683908 | 9.325607 | 10.674393 | 10.009515 | 9.990485 | 3 | 12 |
| 49 | 15 | 9.316241 | 10.683759 | 9.325763 | 10.674237 | 10.009522 | 9.990478 | 45 | 11 |
| 50 | 30 | 9.316390 | 10.683610 | 9.325919 | 10.674081 | 10.009529 | 9.990471 | 30 | 10 |
| 51 | 45 | 9.316539 | 10.683461 | 9.326075 | 10.673925 | 10.009535 | 9.990465 | 15 | 9 |
| 52 | 58 | 9.316688 | 10.683312 | 9.326230 | 10.673770 | 10.009542 | 9.990458 | 2 | 8 |
| 53 | 15 | 9.316837 | 10.683163 | 9.326386 | 10.673614 | 10.009549 | 9.990451 | 45 | 7 |
| 54 | 30 | 9.316986 | 10.683014 | 9.326542 | 10.673458 | 10.009555 | 9.990445 | 30 | 6 |
| 55 | 45 | 9.317135 | 10.682865 | 9.326697 | 10.673303 | 10.009562 | 9.990438 | 15 | 5 |
| 56 | 59 | 9.317284 | 10.682716 | 9.326853 | 10.673147 | 10.009569 | 9.990431 | 1 | 4 |
| 57 | 15 | 9.317433 | 10.682567 | 9.327008 | 10.672992 | 10.009576 | 9.990424 | 45 | 3 |
| 58 | 30 | 9.317582 | 10.682418 | 9.327164 | 10.672836 | 10.009582 | 9.990416 | 30 | 2 |
| 59 | 45 | 9.317730 | 10.682270 | 9.327319 | 10.672681 | 10.009589 | 9.990411 | 15 | 1 |
| 60 | 60 | 9.317879 | 10.682121 | 9.327474 | 10.672526 | 10.009596 | 9.990404 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | $5^h\ 12^m$. | LOG. SINES, &c. | | | | | | 78 deg. | |

| 0h 48m. | | | LOG. SINES, &c. (t.) | | | | 12 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.317879 | 10.682121 | 9.327474 | 10.672526 | 10.009596 | 9.990404 | 60 | 60 |
| 1 | 15 | 9.318027 | 10.681973 | 9.327630 | 10.672370 | 10.009602 | 9.990398 | 45 | 59 |
| 2 | 30 | 9.318176 | 10.681824 | 9.327785 | 10.672215 | 10.009609 | 9.990391 | 30 | 58 |
| 3 | 45 | 9.318324 | 10.681676 | 9.327940 | 10.672060 | 10.009616 | 9.990384 | 15 | 57 |
| 4 | 1 | 9.318473 | 10.681527 | 9.328095 | 10.671905 | 10.009623 | 9.990377 | 59 | 56 |
| 5 | 15 | 9.318621 | 10.681379 | 9.328250 | 10.671750 | 10.009629 | 9.990371 | 45 | 55 |
| 6 | 30 | 9.318769 | 10.681231 | 9.328405 | 10.671595 | 10.009636 | 9.990364 | 30 | 54 |
| 7 | 45 | 9.318918 | 10.681082 | 9.328560 | 10.671440 | 10.009643 | 9.990357 | 15 | 53 |
| 8 | 2 | 9.319066 | 10.680934 | 9.328715 | 10.671285 | 10.009649 | 9.990351 | 58 | 52 |
| 9 | 15 | 9.319214 | 10.680786 | 9.328870 | 10.671130 | 10.009656 | 9.990344 | 45 | 51 |
| 10 | 30 | 9.319362 | 10.680638 | 9.329025 | 10.670975 | 10.009663 | 9.990337 | 30 | 50 |
| 11 | 45 | 9.319510 | 10.680490 | 9.329180 | 10.670820 | 10.009670 | 9.990330 | 15 | 49 |
| 12 | 3 | 9.319658 | 10.680342 | 9.329334 | 10.670666 | 10.009676 | 9.990324 | 57 | 48 |
| 13 | 15 | 9.319806 | 10.680194 | 9.329489 | 10.670511 | 10.009683 | 9.990317 | 45 | 47 |
| 14 | 30 | 9.319954 | 10.680046 | 9.329644 | 10.670356 | 10.009690 | 9.990310 | 30 | 46 |
| 15 | 45 | 9.320102 | 10.679898 | 9.329798 | 10.670202 | 10.009697 | 9.990303 | 15 | 45 |
| 16 | 4 | 9.320249 | 10.679751 | 9.329953 | 10.670047 | 10.009703 | 9.990297 | 56 | 44 |
| 17 | 15 | 9.320397 | 10.679603 | 9.330107 | 10.669893 | 10.009710 | 9.990290 | 45 | 43 |
| 18 | 30 | 9.320545 | 10.679455 | 9.330262 | 10.669738 | 10.009717 | 9.990283 | 30 | 42 |
| 19 | 45 | 9.320692 | 10.679308 | 9.330416 | 10.669584 | 10.009724 | 9.990276 | 15 | 41 |
| 20 | 5 | 9.320840 | 10.679160 | 9.330570 | 10.669430 | 10.009730 | 9.990270 | 55 | 40 |
| 21 | 15 | 9.320987 | 10.679013 | 9.330725 | 10.669275 | 10.009737 | 9.990263 | 45 | 39 |
| 22 | 30 | 9.321135 | 10.678865 | 9.330879 | 10.669121 | 10.009744 | 9.990256 | 30 | 38 |
| 23 | 45 | 9.321282 | 10.678718 | 9.331033 | 10.668967 | 10.009751 | 9.990249 | 15 | 37 |
| 24 | 6 | 9.321430 | 10.678570 | 9.331187 | 10.668813 | 10.009757 | 9.990243 | 54 | 36 |
| 25 | 15 | 9.321577 | 10.678423 | 9.331341 | 10.668659 | 10.009764 | 9.990236 | 45 | 35 |
| 26 | 30 | 9.321724 | 10.678276 | 9.331495 | 10.668505 | 10.009771 | 9.990229 | 30 | 34 |
| 27 | 45 | 9.321871 | 10.678129 | 9.331649 | 10.668351 | 10.009778 | 9.990222 | 15 | 33 |
| 28 | 7 | 9.322019 | 10.677981 | 9.331803 | 10.668197 | 10.009785 | 9.990215 | 53 | 32 |
| 29 | 15 | 9.322166 | 10.677834 | 9.331957 | 10.668043 | 10.009791 | 9.990209 | 45 | 31 |
| 30 | 30 | 9.322313 | 10.677687 | 9.332111 | 10.667889 | 10.009798 | 9.990202 | 30 | 30 |
| 31 | 45 | 9.322460 | 10.677540 | 9.332265 | 10.667735 | 10.009805 | 9.990195 | 15 | 29 |
| 32 | 8 | 9.322607 | 10.677393 | 9.332418 | 10.667582 | 10.009812 | 9.990188 | 52 | 28 |
| 33 | 15 | 9.322753 | 10.677247 | 9.332572 | 10.667428 | 10.009818 | 9.990182 | 45 | 27 |
| 34 | 30 | 9.322900 | 10.677100 | 9.332726 | 10.667274 | 10.009825 | 9.990175 | 30 | 26 |
| 35 | 45 | 9.323047 | 10.676953 | 9.332879 | 10.667121 | 10.009832 | 9.990168 | 15 | 25 |
| 36 | 9 | 9.323194 | 10.676806 | 9.333033 | 10.666967 | 10.009839 | 9.990161 | 51 | 24 |
| 37 | 15 | 9.323340 | 10.676660 | 9.333186 | 10.666814 | 10.009846 | 9.990154 | 45 | 23 |
| 38 | 30 | 9.323487 | 10.676513 | 9.333340 | 10.666660 | 10.009852 | 9.990148 | 30 | 22 |
| 39 | 45 | 9.323634 | 10.676366 | 9.333493 | 10.666507 | 10.009859 | 9.990141 | 15 | 21 |
| 40 | 10 | 9.323780 | 10.676220 | 9.333646 | 10.666354 | 10.009866 | 9.990134 | 50 | 20 |
| 41 | 15 | 9.323927 | 10.676073 | 9.333799 | 10.666201 | 10.009873 | 9.990127 | 45 | 19 |
| 42 | 30 | 9.324073 | 10.675927 | 9.333953 | 10.666047 | 10.009880 | 9.990120 | 30 | 18 |
| 43 | 45 | 9.324219 | 10.675781 | 9.334106 | 10.665894 | 10.009887 | 9.990113 | 15 | 17 |
| 44 | 11 | 9.324366 | 10.675634 | 9.334259 | 10.665741 | 10.009893 | 9.990107 | 49 | 16 |
| 45 | 15 | 9.324512 | 10.675488 | 9.334412 | 10.665588 | 10.009900 | 9.990100 | 45 | 15 |
| 46 | 30 | 9.324658 | 10.675342 | 9.334565 | 10.665435 | 10.009907 | 9.990093 | 30 | 14 |
| 47 | 45 | 9.324804 | 10.675196 | 9.334718 | 10.665282 | 10.009914 | 9.990086 | 15 | 13 |
| 48 | 12 | 9.324950 | 10.675050 | 9.334871 | 10.665129 | 10.009921 | 9.990079 | 48 | 12 |
| 49 | 15 | 9.325096 | 10.674904 | 9.335024 | 10.664976 | 10.009927 | 9.990073 | 45 | 11 |
| 50 | 30 | 9.325242 | 10.674758 | 9.335177 | 10.664823 | 10.009934 | 9.990066 | 30 | 10 |
| 51 | 45 | 9.325388 | 10.674612 | 9.335330 | 10.664670 | 10.009941 | 9.990059 | 15 | 9 |
| 52 | 13 | 9.325534 | 10.674466 | 9.335482 | 10.664518 | 10.009948 | 9.990052 | 47 | 8 |
| 53 | 15 | 9.325680 | 10.674320 | 9.335635 | 10.664365 | 10.009955 | 9.990045 | 45 | 7 |
| 54 | 30 | 9.325826 | 10.674174 | 9.335788 | 10.664212 | 10.009962 | 9.990038 | 30 | 6 |
| 55 | 45 | 9.325972 | 10.674028 | 9.335940 | 10.664060 | 10.009969 | 9.990031 | 15 | 5 |
| 56 | 14 | 9.326117 | 10.673883 | 9.336093 | 10.663907 | 10.009975 | 9.990025 | 46 | 4 |
| 57 | 15 | 9.326263 | 10.673737 | 9.336245 | 10.663755 | 10.009982 | 9.990018 | 45 | 3 |
| 58 | 30 | 9.326409 | 10.673591 | 9.336398 | 10.663602 | 10.009989 | 9.990011 | 30 | 2 |
| 59 | 45 | 9.326554 | 10.673446 | 9.336550 | 10.663450 | 10.009996 | 9.990004 | 15 | 1 |
| 60 | 15 | 9.326700 | 10.673300 | 9.336702 | 10.663298 | 10.010003 | 9.989997 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine | ″ ′ | sec. |
| 5h 11m. | | | LOG. SINES, &c. | | | | 77 deg. | | |

| 0h 49m | | | LOG. SINES, &c. (t.) | | | | 12 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.326700 | 10.673300 | 9.336702 | 10.663298 | 10.010003 | 9.989997 | 45 | 60 |
| 1 | 15 | 9.326845 | 10.673155 | 9.336855 | 10.663145 | 10.010010 | 9.989990 | 45 | 59 |
| 2 | 30 | 9.326990 | 10.673010 | 9.337007 | 10.662993 | 10.010016 | 9.989984 | 30 | 58 |
| 3 | 45 | 9.327136 | 10.672864 | 9.337159 | 10.662841 | 10.010023 | 9.989977 | 15 | 57 |
| 4 | 16 | 9.327281 | 10.672719 | 9.337311 | 10.662689 | 10.010030 | 9.989970 | 44 | 56 |
| 5 | 15 | 9.327426 | 10.672574 | 9.337463 | 10.662537 | 10.010037 | 9.989963 | 45 | 55 |
| 6 | 30 | 9.327571 | 10.672429 | 9.337615 | 10.662385 | 10.010044 | 9.989956 | 30 | 54 |
| 7 | 45 | 9.327717 | 10.672283 | 9.337767 | 10.662233 | 10.010051 | 9.989949 | 15 | 53 |
| 8 | 17 | 9.327862 | 10.672138 | 9.337919 | 10.662081 | 10.010058 | 9.989942 | 43 | 52 |
| 9 | 15 | 9.328007 | 10.671993 | 9.338071 | 10.661929 | 10.010065 | 9.989935 | 45 | 51 |
| 10 | 30 | 9.328152 | 10.671848 | 9.338223 | 10.661777 | 10.010071 | 9.989929 | 30 | 50 |
| 11 | 45 | 9.328297 | 10.671703 | 9.338375 | 10.661626 | 10.010078 | 9.989922 | 15 | 49 |
| 12 | 18 | 9.328442 | 10.671558 | 9.338527 | 10.661473 | 10.010085 | 9.989915 | 42 | 48 |
| 13 | 15 | 9.328586 | 10.671414 | 9.338678 | 10.661322 | 10.010092 | 9.989908 | 45 | 47 |
| 14 | 30 | 9.328731 | 10.671269 | 9.338830 | 10.661170 | 10.010099 | 9.989901 | 30 | 46 |
| 15 | 45 | 9.328876 | 10.671124 | 9.338982 | 10.661018 | 10.010106 | 9.989894 | 15 | 45 |
| 16 | 19 | 9.329021 | 10.670979 | 9.339133 | 10.660867 | 10.010113 | 9.989887 | 41 | 44 |
| 17 | 15 | 9.329165 | 10.670835 | 9.339285 | 10.660715 | 10.010120 | 9.989880 | 45 | 43 |
| 18 | 30 | 9.329310 | 10.670690 | 9.339436 | 10.660564 | 10.010127 | 9.989873 | 30 | 42 |
| 19 | 45 | 9.329454 | 10.670546 | 9.339588 | 10.660412 | 10.010133 | 9.989867 | 15 | 41 |
| 20 | 20 | 9.329599 | 10.670401 | 9.339739 | 10.660261 | 10.010140 | 9.989860 | 40 | 40 |
| 21 | 15 | 9.329743 | 10.670257 | 9.339890 | 10.660110 | 10.010147 | 9.989853 | 45 | 39 |
| 22 | 30 | 9.329887 | 10.670113 | 9.340042 | 10.659958 | 10.010154 | 9.989846 | 30 | 38 |
| 23 | 45 | 9.330032 | 10.669968 | 9.340193 | 10.659807 | 10.010161 | 9.989839 | 15 | 37 |
| 24 | 21 | 9.330176 | 10.669824 | 9.340344 | 10.659656 | 10.010168 | 9.989832 | 39 | 36 |
| 25 | 15 | 9.330320 | 10.669680 | 9.340495 | 10.659505 | 10.010175 | 9.989825 | 45 | 35 |
| 26 | 30 | 9.330464 | 10.669536 | 9.340646 | 10.659354 | 10.010182 | 9.989818 | 30 | 34 |
| 27 | 45 | 9.330609 | 10.669391 | 9.340797 | 10.659203 | 10.010189 | 9.989811 | 15 | 33 |
| 28 | 22 | 9.330753 | 10.669247 | 9.340948 | 10.659052 | 10.010196 | 9.989804 | 38 | 32 |
| 29 | 15 | 9.330897 | 10.669103 | 9.341099 | 10.658901 | 10.010203 | 9.989797 | 45 | 31 |
| 30 | 30 | 9.331041 | 10.668959 | 9.341250 | 10.658750 | 10.010210 | 9.989790 | 30 | 30 |
| 31 | 45 | 9.331185 | 10.668815 | 9.341401 | 10.658599 | 10.010216 | 9.989784 | 15 | 29 |
| 32 | 23 | 9.331328 | 10.668672 | 9.341552 | 10.658448 | 10.010223 | 9.989777 | 37 | 28 |
| 33 | 15 | 9.331472 | 10.668528 | 9.341703 | 10.658297 | 10.010230 | 9.989770 | 45 | 27 |
| 34 | 30 | 9.331616 | 10.668384 | 9.341853 | 10.658147 | 10.010237 | 9.989763 | 30 | 26 |
| 35 | 45 | 9.331760 | 10.668240 | 9.342004 | 10.657996 | 10.010244 | 9.989756 | 15 | 25 |
| 36 | 24 | 9.331903 | 10.668097 | 9.342155 | 10.657845 | 10.010251 | 9.989749 | 36 | 24 |
| 37 | 15 | 9.332047 | 10.667953 | 9.342305 | 10.657695 | 10.010258 | 9.989742 | 45 | 23 |
| 38 | 30 | 9.332191 | 10.667809 | 9.342456 | 10.657544 | 10.010265 | 9.989735 | 30 | 22 |
| 39 | 45 | 9.332334 | 10.667666 | 9.342606 | 10.657394 | 10.010272 | 9.989728 | 15 | 21 |
| 40 | 25 | 9.332478 | 10.667522 | 9.342757 | 10.657243 | 10.010279 | 9.989721 | 35 | 20 |
| 41 | 15 | 9.332621 | 10.667379 | 9.342907 | 10.657093 | 10.010286 | 9.989714 | 45 | 19 |
| 42 | 30 | 9.332764 | 10.667236 | 9.343057 | 10.656943 | 10.010293 | 9.989707 | 30 | 18 |
| 43 | 45 | 9.332908 | 10.667092 | 9.343208 | 10.656792 | 10.010300 | 9.989700 | 15 | 17 |
| 44 | 26 | 9.333051 | 10.666949 | 9.343358 | 10.656642 | 10.010307 | 9.989693 | 34 | 16 |
| 45 | 15 | 9.333194 | 10.666806 | 9.343508 | 10.656492 | 10.010314 | 9.989686 | 45 | 15 |
| 46 | 30 | 9.333337 | 10.666663 | 9.343658 | 10.656342 | 10.010321 | 9.989679 | 30 | 14 |
| 47 | 45 | 9.333481 | 10.666519 | 9.343808 | 10.656192 | 10.010328 | 9.989672 | 15 | 13 |
| 48 | 27 | 9.333624 | 10.666376 | 9.343958 | 10.656042 | 10.010335 | 9.989665 | 33 | 12 |
| 49 | 15 | 9.333767 | 10.666233 | 9.344108 | 10.655892 | 10.010342 | 9.989658 | 45 | 11 |
| 50 | 30 | 9.333910 | 10.666090 | 9.344258 | 10.655742 | 10.010349 | 9.989651 | 30 | 10 |
| 51 | 45 | 9.334053 | 10.665947 | 9.344408 | 10.655592 | 10.010356 | 9.989644 | 15 | 9 |
| 52 | 28 | 9.334195 | 10.665805 | 9.344558 | 10.655442 | 10.010363 | 9.989637 | 32 | 8 |
| 53 | 15 | 9.334338 | 10.665662 | 9.344708 | 10.655292 | 10.010370 | 9.989630 | 45 | 7 |
| 54 | 30 | 9.334481 | 10.665519 | 9.344858 | 10.655142 | 10.010377 | 9.989623 | 30 | 6 |
| 55 | 45 | 9.334624 | 10.665376 | 9.345007 | 10.654993 | 10.010384 | 9.989616 | 15 | 5 |
| 56 | 29 | 9.334766 | 10.665234 | 9.345157 | 10.654843 | 10.010391 | 9.989609 | 31 | 4 |
| 57 | 15 | 9.334909 | 10.665091 | 9.345307 | 10.654693 | 10.010398 | 9.989602 | 45 | 3 |
| 58 | 30 | 9.335052 | 10.664948 | 9.345456 | 10.654544 | 10.010405 | 9.989595 | 30 | 2 |
| 59 | 45 | 9.335194 | 10.664806 | 9.345606 | 10.654394 | 10.010412 | 9.989588 | 15 | 1 |
| 60 | 30 | 9.335337 | 10.664663 | 9.345755 | 10.654245 | 10.010419 | 9.989581 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 10m. | | | LOG. SINES, &c. | | | | 77 deg. | | |

| 0h 50m. | | | LOG. SINES, &c. (t.) | | | | 12 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.335337 | 10.664663 | 9.345755 | 10.654245 | 10.010419 | 9.989581 | 30 | 60 |
| 1 | 15 | 9.335479 | 10.664521 | 9.345905 | 10.654095 | 10.010426 | 9.989574 | 45 | 59 |
| 2 | 30 | 9.335622 | 10.664378 | 9.346054 | 10.653946 | 10.010433 | 9.989567 | 30 | 58 |
| 3 | 45 | 9.335764 | 10.664236 | 9.346203 | 10.653797 | 10.010440 | 9.989560 | 15 | 57 |
| 4 | 31 | 9.335906 | 10.664094 | 9.346353 | 10.653647 | 10.010447 | 9.989553 | 29 | 56 |
| 5 | 15 | 9.336048 | 10.663952 | 9.346502 | 10.653498 | 10.010454 | 9.989546 | 45 | 55 |
| 6 | 30 | 9.336191 | 10.663809 | 9.346651 | 10.653349 | 10.010461 | 9.989539 | 30 | 54 |
| 7 | 45 | 9.336333 | 10.663667 | 9.346800 | 10.653200 | 10.010468 | 9.989532 | 15 | 53 |
| 8 | 32 | 9.336475 | 10.663525 | 9.346949 | 10.653051 | 10.010475 | 9.989525 | 28 | 52 |
| 9 | 15 | 9.336617 | 10.663383 | 9.347098 | 10.652902 | 10.010482 | 9.989518 | 45 | 51 |
| 10 | 30 | 9.336759 | 10.663241 | 9.347247 | 10.652753 | 10.010489 | 9.989511 | 30 | 50 |
| 11 | 45 | 9.336901 | 10.663099 | 9.347396 | 10.652604 | 10.010496 | 9.989504 | 15 | 49 |
| 12 | 33 | 9.337043 | 10.662957 | 9.347545 | 10.652455 | 10.010503 | 9.989497 | 27 | 48 |
| 13 | 15 | 9.337185 | 10.662815 | 9.347694 | 10.652306 | 10.010510 | 9.989490 | 45 | 47 |
| 14 | 30 | 9.337326 | 10.662674 | 9.347843 | 10.652157 | 10.010517 | 9.989483 | 30 | 46 |
| 15 | 45 | 9.337468 | 10.662532 | 9.347992 | 10.652008 | 10.010524 | 9.989476 | 15 | 45 |
| 16 | 34 | 9.337610 | 10.662390 | 9.348141 | 10.651859 | 10.010531 | 9.989469 | 26 | 44 |
| 17 | 15 | 9.337751 | 10.662249 | 9.348289 | 10.651711 | 10.010538 | 9.989462 | 45 | 43 |
| 18 | 30 | 9.337893 | 10.662107 | 9.348438 | 10.651562 | 10.010545 | 9.989455 | 30 | 42 |
| 19 | 45 | 9.338035 | 10.661965 | 9.348587 | 10.651413 | 10.010552 | 9.989448 | 15 | 41 |
| 20 | 35 | 9.338176 | 10.661824 | 9.348735 | 10.651265 | 10.010559 | 9.989441 | 25 | 40 |
| 21 | 15 | 9.338318 | 10.661682 | 9.348884 | 10.651116 | 10.010566 | 9.989434 | 45 | 39 |
| 22 | 30 | 9.338459 | 10.661541 | 9.349032 | 10.650968 | 10.010573 | 9.989427 | 30 | 38 |
| 23 | 45 | 9.338600 | 10.661400 | 9.349181 | 10.650819 | 10.010580 | 9.989420 | 15 | 37 |
| 24 | 36 | 9.338742 | 10.661258 | 9.349329 | 10.650671 | 10.010587 | 9.989413 | 24 | 36 |
| 25 | 15 | 9.338883 | 10.661117 | 9.349477 | 10.650523 | 10.010594 | 9.989406 | 45 | 35 |
| 26 | 30 | 9.339024 | 10.660976 | 9.349626 | 10.650374 | 10.010601 | 9.989399 | 30 | 34 |
| 27 | 45 | 9.339165 | 10.660835 | 9.349774 | 10.650226 | 10.010608 | 9.989392 | 15 | 33 |
| 28 | 37 | 9.339306 | 10.660694 | 9.349922 | 10.650078 | 10.010616 | 9.989384 | 23 | 32 |
| 29 | 15 | 9.339448 | 10.660552 | 9.350070 | 10.649930 | 10.010623 | 9.989377 | 45 | 31 |
| 30 | 30 | 9.339589 | 10.660411 | 9.350218 | 10.649782 | 10.010630 | 9.989370 | 30 | 30 |
| 31 | 45 | 9.339730 | 10.660270 | 9.350366 | 10.649634 | 10.010637 | 9.989363 | 15 | 29 |
| 32 | 38 | 9.339871 | 10.660129 | 9.350514 | 10.649486 | 10.010644 | 9.989356 | 22 | 28 |
| 33 | 15 | 9.340011 | 10.659989 | 9.350662 | 10.649338 | 10.010651 | 9.989349 | 45 | 27 |
| 34 | 30 | 9.340152 | 10.659848 | 9.350810 | 10.649190 | 10.010658 | 9.989342 | 30 | 26 |
| 35 | 45 | 9.340293 | 10.659707 | 9.350958 | 10.649042 | 10.010665 | 9.989335 | 15 | 25 |
| 36 | 39 | 9.340434 | 10.659566 | 9.351106 | 10.648894 | 10.010672 | 9.989328 | 21 | 24 |
| 37 | 15 | 9.340574 | 10.659426 | 9.351254 | 10.648746 | 10.010679 | 9.989321 | 45 | 23 |
| 38 | 30 | 9.340715 | 10.659285 | 9.351401 | 10.648599 | 10.010686 | 9.989314 | 30 | 22 |
| 39 | 45 | 9.340856 | 10.659144 | 9.351549 | 10.648451 | 10.010693 | 9.989307 | 15 | 21 |
| 40 | 40 | 9.340996 | 10.659004 | 9.351697 | 10.648303 | 10.010701 | 9.989299 | 20 | 20 |
| 41 | 15 | 9.341137 | 10.658863 | 9.351844 | 10.648156 | 10.010708 | 9.989292 | 45 | 19 |
| 42 | 30 | 9.341277 | 10.658723 | 9.351992 | 10.648008 | 10.010715 | 9.989285 | 30 | 18 |
| 43 | 45 | 9.341418 | 10.658582 | 9.352139 | 10.647861 | 10.010722 | 9.989278 | 15 | 17 |
| 44 | 41 | 9.341558 | 10.658442 | 9.352287 | 10.647713 | 10.010729 | 9.989271 | 19 | 16 |
| 45 | 15 | 9.341698 | 10.658302 | 9.352434 | 10.647566 | 10.010736 | 9.989264 | 45 | 15 |
| 46 | 30 | 9.341839 | 10.658161 | 9.352582 | 10.647418 | 10.010743 | 9.989257 | 30 | 14 |
| 47 | 45 | 9.341979 | 10.658021 | 9.352729 | 10.647271 | 10.010750 | 9.989250 | 15 | 13 |
| 48 | 42 | 9.342119 | 10.657881 | 9.352876 | 10.647124 | 10.010757 | 9.989243 | 18 | 12 |
| 49 | 15 | 9.342259 | 10.657741 | 9.353024 | 10.646976 | 10.010765 | 9.989235 | 45 | 11 |
| 50 | 30 | 9.342399 | 10.657601 | 9.353171 | 10.646829 | 10.010772 | 9.989228 | 30 | 10 |
| 51 | 45 | 9.342539 | 10.657461 | 9.353318 | 10.646682 | 10.010779 | 9.989221 | 15 | 9 |
| 52 | 43 | 9.342679 | 10.657321 | 9.353465 | 10.646535 | 10.010786 | 9.989214 | 17 | 8 |
| 53 | 15 | 9.342819 | 10.657181 | 9.353612 | 10.646388 | 10.010793 | 9.989207 | 45 | 7 |
| 54 | 30 | 9.342959 | 10.657041 | 9.353759 | 10.646241 | 10.010800 | 9.989200 | 30 | 6 |
| 55 | 45 | 9.343099 | 10.656901 | 9.353906 | 10.646094 | 10.010807 | 9.989193 | 15 | 5 |
| 56 | 44 | 9.343239 | 10.656761 | 9.354053 | 10.645947 | 10.010814 | 9.989186 | 16 | 4 |
| 57 | 15 | 9.343378 | 10.656622 | 9.354200 | 10.645800 | 10.010822 | 9.989178 | 45 | 3 |
| 58 | 30 | 9.343518 | 10.656482 | 9.354347 | 10.645653 | 10.010829 | 9.989171 | 30 | 2 |
| 59 | 45 | 9.343658 | 10.656342 | 9.354493 | 10.645507 | 10.010836 | 9.989164 | 15 | 1 |
| 60 | 45 | 9.343797 | 10.656203 | 9.354640 | 10.645360 | 10.010843 | 9.989157 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 9m. | | | LOG. SINES, &c. | | | | 77 deg. | | |

| | 0h 51m. | LOG. SINES, &c. (t.) | | | | | 12 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
| 0 | 45 | 9.343797 | 10.656203 | 9.354640 | 10.645360 | 10.010843 | 9.989157 | 15 | 60 |
| 1 | 15 | 9.343937 | 10.656063 | 9.354787 | 10.645213 | 10.010850 | 9.989150 | 45 | 59 |
| 2 | 30 | 9.344076 | 10.655924 | 9.354934 | 10.645066 | 10.010857 | 9.989143 | 30 | 58 |
| 3 | 45 | 9.344216 | 10.655784 | 9.355080 | 10.644920 | 10.010864 | 9.989136 | 15 | 57 |
| 4 | 46 | 9.344355 | 10.655645 | 9.355227 | 10.644773 | 10.010872 | 9.989128 | 14 | 56 |
| 5 | 15 | 9.344495 | 10.655505 | 9.355373 | 10.644627 | 10.010879 | 9.989121 | 45 | 55 |
| 6 | 30 | 9.344634 | 10.655366 | 9.355520 | 10.644480 | 10.010886 | 9.989114 | 30 | 54 |
| 7 | 45 | 9.344773 | 10.655227 | 9.355666 | 10.644334 | 10.010893 | 9.989107 | 15 | 53 |
| 8 | 47 | 9.344912 | 10.655088 | 9.355813 | 10.644187 | 10.010900 | 9.989100 | 13 | 52 |
| 9 | 15 | 9.345052 | 10.654948 | 9.355959 | 10.644041 | 10.010907 | 9.989093 | 45 | 51 |
| 10 | 30 | 9.345191 | 10.654809 | 9.356105 | 10.643895 | 10.010915 | 9.989085 | 30 | 50 |
| 11 | 45 | 9.345330 | 10.654670 | 9.356251 | 10.643749 | 10.010922 | 9.989078 | 15 | 49 |
| 12 | 48 | 9.345469 | 10.654531 | 9.356398 | 10.643602 | 10.010929 | 9.989071 | 12 | 48 |
| 13 | 15 | 9.345608 | 10.654392 | 9.356544 | 10.643456 | 10.010936 | 9.989064 | 45 | 47 |
| 14 | 30 | 9.345747 | 10.654253 | 9.356690 | 10.643310 | 10.010943 | 9.989057 | 30 | 46 |
| 15 | 45 | 9.345886 | 10.654114 | 9.356836 | 10.643164 | 10.010950 | 9.989050 | 15 | 45 |
| 16 | 49 | 9.346024 | 10.653976 | 9.356982 | 10.643018 | 10.010958 | 9.989042 | 11 | 44 |
| 17 | 15 | 9.346163 | 10.653837 | 9.357128 | 10.642872 | 10.010965 | 9.989035 | 45 | 43 |
| 18 | 30 | 9.346302 | 10.653698 | 9.357274 | 10.642726 | 10.010972 | 9.989028 | 30 | 42 |
| 19 | 45 | 9.346441 | 10.653559 | 9.357420 | 10.642580 | 10.010979 | 9.989021 | 15 | 41 |
| 20 | 50 | 9.346579 | 10.653421 | 9.357566 | 10.642434 | 10.010986 | 9.989014 | 10 | 40 |
| 21 | 15 | 9.346718 | 10.653282 | 9.357712 | 10.642288 | 10.010994 | 9.989006 | 45 | 39 |
| 22 | 30 | 9.346857 | 10.653143 | 9.357857 | 10.642143 | 10.011001 | 9.988999 | 30 | 38 |
| 23 | 45 | 9.346995 | 10.653005 | 9.358003 | 10.641997 | 10.011008 | 9.988992 | 15 | 37 |
| 24 | 51 | 9.347134 | 10.652866 | 9.358149 | 10.641851 | 10.011015 | 9.988985 | 9 | 36 |
| 25 | 15 | 9.347272 | 10.652728 | 9.358294 | 10.641706 | 10.011022 | 9.988978 | 45 | 35 |
| 26 | 30 | 9.347410 | 10.652590 | 9.358440 | 10.641560 | 10.011030 | 9.988970 | 30 | 34 |
| 27 | 45 | 9.347549 | 10.652451 | 9.358585 | 10.641415 | 10.011037 | 9.988963 | 15 | 33 |
| 28 | 52 | 9.347687 | 10.652313 | 9.358731 | 10.641269 | 10.011044 | 9.988956 | 8 | 32 |
| 29 | 15 | 9.347825 | 10.652175 | 9.358876 | 10.641124 | 10.011051 | 9.988949 | 45 | 31 |
| 30 | 30 | 9.347963 | 10.652037 | 9.359022 | 10.640978 | 10.011058 | 9.988942 | 30 | 30 |
| 31 | 45 | 9.348102 | 10.651898 | 9.359167 | 10.640833 | 10.011066 | 9.988934 | 15 | 29 |
| 32 | 53 | 9.348240 | 10.651760 | 9.359313 | 10.640687 | 10.011073 | 9.988927 | 7 | 28 |
| 33 | 15 | 9.348378 | 10.651622 | 9.359458 | 10.640542 | 10.011080 | 9.988920 | 45 | 27 |
| 34 | 30 | 9.348516 | 10.651484 | 9.359603 | 10.640397 | 10.011087 | 9.988913 | 30 | 26 |
| 35 | 45 | 9.348654 | 10.651346 | 9.359748 | 10.640252 | 10.011095 | 9.988905 | 15 | 25 |
| 36 | 54 | 9.348792 | 10.651208 | 9.359893 | 10.640107 | 10.011102 | 9.988898 | 6 | 24 |
| 37 | 15 | 9.348930 | 10.651070 | 9.360039 | 10.639961 | 10.011109 | 9.988891 | 45 | 23 |
| 38 | 30 | 9.349067 | 10.650933 | 9.360184 | 10.639816 | 10.011116 | 9.988884 | 30 | 22 |
| 39 | 45 | 9.349205 | 10.650795 | 9.360329 | 10.639671 | 10.011124 | 9.988876 | 15 | 21 |
| 40 | 55 | 9.349343 | 10.650657 | 9.360474 | 10.639526 | 10.011131 | 9.988869 | 5 | 20 |
| 41 | 15 | 9.349481 | 10.650519 | 9.360619 | 10.639381 | 10.011138 | 9.988862 | 45 | 19 |
| 42 | 30 | 9.349618 | 10.650382 | 9.360763 | 10.639237 | 10.011145 | 9.988855 | 30 | 18 |
| 43 | 45 | 9.349756 | 10.650244 | 9.360908 | 10.639092 | 10.011153 | 9.988847 | 15 | 17 |
| 44 | 56 | 9.349893 | 10.650107 | 9.361053 | 10.638947 | 10.011160 | 9.988840 | 4 | 16 |
| 45 | 15 | 9.350031 | 10.649969 | 9.361198 | 10.638802 | 10.011167 | 9.988833 | 45 | 15 |
| 46 | 30 | 9.350168 | 10.649832 | 9.361343 | 10.638657 | 10.011174 | 9.988826 | 30 | 14 |
| 47 | 45 | 9.350306 | 10.649694 | 9.361487 | 10.638513 | 10.011182 | 9.988818 | 15 | 13 |
| 48 | 57 | 9.350443 | 10.649557 | 9.361632 | 10.638368 | 10.011189 | 9.988811 | 3 | 12 |
| 49 | 15 | 9.350580 | 10.649420 | 9.361776 | 10.638224 | 10.011196 | 9.988804 | 45 | 11 |
| 50 | 30 | 9.350718 | 10.649282 | 9.361921 | 10.638079 | 10.011203 | 9.988797 | 30 | 10 |
| 51 | 45 | 9.350855 | 10.649145 | 9.362065 | 10.637935 | 10.011211 | 9.988789 | 15 | 9 |
| 52 | 58 | 9.350992 | 10.649008 | 9.362210 | 10.637790 | 10.011218 | 9.988782 | 2 | 8 |
| 53 | 15 | 9.351129 | 10.648871 | 9.362354 | 10.637646 | 10.011225 | 9.988775 | 45 | 7 |
| 54 | 30 | 9.351266 | 10.648734 | 9.362499 | 10.637501 | 10.011232 | 9.988768 | 30 | 6 |
| 55 | 45 | 9.351403 | 10.648597 | 9.362643 | 10.637357 | 10.011240 | 9.988760 | 15 | 5 |
| 56 | 59 | 9.351540 | 10.648460 | 9.362787 | 10.637213 | 10.011247 | 9.988753 | 1 | 4 |
| 57 | 15 | 9.351677 | 10.648323 | 9.362932 | 10.637068 | 10.011254 | 9.988746 | 45 | 3 |
| 58 | 30 | 9.351814 | 10.648186 | 9.363076 | 10.636924 | 10.011262 | 9.988738 | 30 | 2 |
| 59 | 45 | 9.351951 | 10.648049 | 9.363220 | 10.636780 | 10.011269 | 9.988731 | 15 | 1 |
| 60 | 60 | 9.352089 | 10.647912 | 9.363364 | 10.636636 | 10.011276 | 9.988724 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ | sec. |
| | 5h 8m. | LOG. SINES, &c. | | | | | 77 deg. | | |

| 0h 52m. | | LOG. SINES, &c. (t.) | | | | | 13 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| ′ | ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ | ′ | sec. |
| 0 | 0 | 9.352088 | 10.647912 | 9.363364 | 10.636636 | 10.011276 | 9.988724 | | 60 | 60 |
| 1 | 15 | 9.352225 | 10.647775 | 9.363508 | 10.636492 | 10.011283 | 9.988717 | 45 | | 59 |
| 2 | 30 | 9.352361 | 10.647639 | 9.363652 | 10.636348 | 10.011291 | 9.988709 | 30 | | 58 |
| 3 | 45 | 9.352498 | 10.647502 | 9.363796 | 10.636204 | 10.011298 | 9.988702 | 15 | | 57 |
| 4 | 1 | 9.352635 | 10.647365 | 9.363940 | 10.636060 | 10.011305 | 9.988695 | | 59 | 56 |
| 5 | 15 | 9.352771 | 10.647229 | 9.364084 | 10.635916 | 10.011313 | 9.988687 | 45 | | 55 |
| 6 | 30 | 9.352908 | 10.647092 | 9.364228 | 10.635772 | 10.011320 | 9.988680 | 30 | | 54 |
| 7 | 45 | 9.353044 | 10.646956 | 9.364372 | 10.635628 | 10.011327 | 9.988673 | 15 | | 53 |
| 8 | 2 | 9.353181 | 10.646819 | 9.364515 | 10.635485 | 10.011335 | 9.988665 | | 58 | 52 |
| 9 | 15 | 9.353317 | 10.646683 | 9.364659 | 10.635341 | 10.011342 | 9.988658 | 45 | | 51 |
| 10 | 30 | 9.353454 | 10.646546 | 9.364803 | 10.635197 | 10.011349 | 9.988651 | 30 | | 50 |
| 11 | 45 | 9.353590 | 10.646410 | 9.364946 | 10.635054 | 10.011356 | 9.988644 | 15 | | 49 |
| 12 | 3 | 9.353726 | 10.646274 | 9.365090 | 10.634910 | 10.011364 | 9.988636 | | 57 | 48 |
| 13 | 15 | 9.353863 | 10.646137 | 9.365234 | 10.634766 | 10.011371 | 9.988629 | 45 | | 47 |
| 14 | 30 | 9.353999 | 10.646001 | 9.365377 | 10.634623 | 10.011378 | 9.988622 | 30 | | 46 |
| 15 | 45 | 9.354135 | 10.645865 | 9.365521 | 10.634479 | 10.011386 | 9.988614 | 15 | | 45 |
| 16 | 4 | 9.354271 | 10.645729 | 9.365664 | 10.634336 | 10.011393 | 9.988607 | | 56 | 44 |
| 17 | 15 | 9.354407 | 10.645593 | 9.365807 | 10.634193 | 10.011400 | 9.988600 | 45 | | 43 |
| 18 | 30 | 9.354543 | 10.645457 | 9.365951 | 10.634049 | 10.011408 | 9.988592 | 30 | | 42 |
| 19 | 45 | 9.354679 | 10.645321 | 9.366094 | 10.633906 | 10.011415 | 9.988585 | 15 | | 41 |
| 20 | 5 | 9.354815 | 10.645185 | 9.366237 | 10.633763 | 10.011422 | 9.988578 | | 55 | 40 |
| 21 | 15 | 9.354951 | 10.645049 | 9.366381 | 10.633619 | 10.011430 | 9.988570 | 45 | | 39 |
| 22 | 30 | 9.355087 | 10.644913 | 9.366524 | 10.633476 | 10.011437 | 9.988563 | 30 | | 38 |
| 23 | 45 | 9.355222 | 10.644778 | 9.366667 | 10.633333 | 10.011444 | 9.988556 | 15 | | 37 |
| 24 | 6 | 9.355358 | 10.644642 | 9.366810 | 10.633190 | 10.011452 | 9.988548 | | 54 | 36 |
| 25 | 15 | 9.355494 | 10.644506 | 9.366953 | 10.633047 | 10.011459 | 9.988541 | 45 | | 35 |
| 26 | 30 | 9.355630 | 10.644370 | 9.367096 | 10.632904 | 10.011467 | 9.988533 | 30 | | 34 |
| 27 | 45 | 9.355765 | 10.644235 | 9.367239 | 10.632761 | 10.011474 | 9.988526 | 15 | | 33 |
| 28 | 7 | 9.355901 | 10.644099 | 9.367382 | 10.632618 | 10.011481 | 9.988519 | | 53 | 32 |
| 29 | 15 | 9.356036 | 10.643964 | 9.367525 | 10.632475 | 10.011489 | 9.988511 | 45 | | 31 |
| 30 | 30 | 9.356172 | 10.643828 | 9.367668 | 10.632332 | 10.011496 | 9.988504 | 30 | | 30 |
| 31 | 45 | 9.356307 | 10.643693 | 9.367810 | 10.632190 | 10.011503 | 9.988497 | 15 | | 29 |
| 32 | 8 | 9.356443 | 10.643557 | 9.367953 | 10.632047 | 10.011511 | 9.988489 | | 52 | 28 |
| 33 | 15 | 9.356578 | 10.643422 | 9.368096 | 10.631904 | 10.011518 | 9.988482 | 45 | | 27 |
| 34 | 30 | 9.356713 | 10.643287 | 9.368239 | 10.631761 | 10.011525 | 9.988475 | 30 | | 26 |
| 35 | 45 | 9.356848 | 10.643152 | 9.368381 | 10.631619 | 10.011533 | 9.988467 | 15 | | 25 |
| 36 | 9 | 9.356984 | 10.643016 | 9.368524 | 10.631476 | 10.011540 | 9.988460 | | 51 | 24 |
| 37 | 15 | 9.357119 | 10.642881 | 9.368666 | 10.631334 | 10.011548 | 9.988452 | 45 | | 23 |
| 38 | 30 | 9.357254 | 10.642746 | 9.368809 | 10.631191 | 10.011555 | 9.988445 | 30 | | 22 |
| 39 | 45 | 9.357389 | 10.642611 | 9.368951 | 10.631049 | 10.011562 | 9.988438 | 15 | | 21 |
| 40 | 10 | 9.357524 | 10.642476 | 9.369094 | 10.630906 | 10.011570 | 9.988430 | | 50 | 20 |
| 41 | 15 | 9.357659 | 10.642341 | 9.369236 | 10.630764 | 10.011577 | 9.988423 | 45 | | 19 |
| 42 | 30 | 9.357794 | 10.642206 | 9.369378 | 10.630622 | 10.011584 | 9.988416 | 30 | | 18 |
| 43 | 45 | 9.357929 | 10.642071 | 9.369521 | 10.630479 | 10.011592 | 9.988408 | 15 | | 17 |
| 44 | 11 | 9.358064 | 10.641936 | 9.369663 | 10.630337 | 10.011599 | 9.988401 | | 49 | 16 |
| 45 | 15 | 9.358198 | 10.641802 | 9.369805 | 10.630195 | 10.011607 | 9.988393 | 45 | | 15 |
| 46 | 30 | 9.358333 | 10.641667 | 9.369947 | 10.630053 | 10.011614 | 9.988386 | 30 | | 14 |
| 47 | 45 | 9.358468 | 10.641532 | 9.370089 | 10.629911 | 10.011621 | 9.988379 | 15 | | 13 |
| 48 | 12 | 9.358603 | 10.641397 | 9.370231 | 10.629769 | 10.011629 | 9.988371 | | 48 | 12 |
| 49 | 15 | 9.358737 | 10.641263 | 9.370374 | 10.629626 | 10.011636 | 9.988364 | 45 | | 11 |
| 50 | 30 | 9.358872 | 10.641128 | 9.370516 | 10.629484 | 10.011644 | 9.988356 | 30 | | 10 |
| 51 | 45 | 9.359006 | 10.640994 | 9.370657 | 10.629343 | 10.011651 | 9.988349 | 15 | | 9 |
| 52 | 13 | 9.359141 | 10.640859 | 9.370799 | 10.629201 | 10.011659 | 9.988341 | | 47 | 8 |
| 53 | 15 | 9.359275 | 10.640725 | 9.370941 | 10.629059 | 10.011666 | 9.988334 | 45 | | 7 |
| 54 | 30 | 9.359410 | 10.640590 | 9.371083 | 10.628917 | 10.011673 | 9.988327 | 30 | | 6 |
| 55 | 45 | 9.359544 | 10.640456 | 9.371225 | 10.628775 | 10.011681 | 9.988319 | 15 | | 5 |
| 56 | 14 | 9.359678 | 10.640322 | 9.371367 | 10.628633 | 10.011688 | 9.988312 | | 46 | 4 |
| 57 | 15 | 9.359813 | 10.640187 | 9.371508 | 10.628492 | 10.011696 | 9.988304 | 45 | | 3 |
| 58 | 30 | 9.359947 | 10.640053 | 9.371650 | 10.628350 | 10.011703 | 9.988297 | 30 | | 2 |
| 59 | 45 | 9.360081 | 10.639919 | 9.371792 | 10.628208 | 10.011711 | 9.988289 | 15 | | 1 |
| 60 | 15 | 9.360215 | 10.639785 | 9.371933 | 10.628067 | 10.011718 | 9.988282 | | 45 | 0 |
| sec. | ′ | ″ cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ | ′ | sec. |
| 5h 7m. | | | LOG. SINES, &c. | | | | 76 deg. | | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | ′ |
|---|---|---|---|---|---|---|---|---|---|
| | 0h 53m. | | LOG. SINES, &c. (t) | | | | | 13 deg. | |
| 0 | 15 | 9.360215 | 10.639785 | 9.371933 | 10.628067 | 10.011718 | 9.988282 | 4.) | 60 |
| 1 | 15 | 9.360349 | 10.639651 | 9.372075 | 10.627925 | 10.011725 | 9.988275 | 45 | 59 |
| 2 | 30 | 9.360483 | 10.639517 | 9.372216 | 10.627784 | 10.011733 | 9.988267 | 30 | 58 |
| 3 | 45 | 9.360617 | 10.639383 | 9.372358 | 10.627642 | 10.011740 | 9.988260 | 15 | 57 |
| 4 | 16 | 9.360751 | 10.639249 | 9.372499 | 10.627501 | 10.011748 | 9.988252 | 44 | 56 |
| 5 | 15 | 9.360885 | 10.639115 | 9.372641 | 10.627359 | 10.011755 | 9.988245 | 45 | 55 |
| 6 | 30 | 9.361019 | 10.638981 | 9.372782 | 10.627218 | 10.011763 | 9.988237 | 30 | 54 |
| 7 | 45 | 9.361153 | 10.638847 | 9.372923 | 10.627077 | 10.011770 | 9.988230 | 15 | 53 |
| 8 | 17 | 9.361287 | 10.638713 | 9.373064 | 10.626936 | 10.011778 | 9.988222 | 43 | 52 |
| 9 | 15 | 9.361421 | 10.638579 | 9.373206 | 10.626794 | 10.011785 | 9.988215 | 45 | 51 |
| 10 | 30 | 9.361554 | 10.638446 | 9.373347 | 10.626653 | 10.011792 | 9.988208 | 30 | 50 |
| 11 | 45 | 9.361688 | 10.638312 | 9.373488 | 10.626512 | 10.011800 | 9.988200 | 15 | 49 |
| 12 | 18 | 9.361822 | 10.638178 | 9.373629 | 10.626371 | 10.011807 | 9.988193 | 42 | 48 |
| 13 | 15 | 9.361955 | 10.638045 | 9.373770 | 10.626230 | 10.011815 | 9.988185 | 45 | 47 |
| 14 | 30 | 9.362089 | 10.637911 | 9.373911 | 10.626089 | 10.011822 | 9.988178 | 30 | 46 |
| 15 | 45 | 9.362222 | 10.637778 | 9.374052 | 10.625948 | 10.011830 | 9.988170 | 15 | 45 |
| 16 | 19 | 9.362356 | 10.637644 | 9.374193 | 10.625807 | 10.011837 | 9.988163 | 41 | 44 |
| 17 | 15 | 9.362489 | 10.637511 | 9.374334 | 10.625666 | 10.011845 | 9.988155 | 45 | 43 |
| 18 | 30 | 9.362623 | 10.637377 | 9.374475 | 10.625525 | 10 011852 | 9.988148 | 30 | 42 |
| 19 | 45 | 9.362756 | 10.637244 | 9.374616 | 10.625384 | 10.011860 | 9.988140 | 15 | 41 |
| 20 | 20 | 9.362889 | 10.637111 | 9.374756 | 10.625244 | 10.011867 | 9.988133 | 40 | 40 |
| 21 | 15 | 9.363022 | 10.636978 | 9.374897 | 10.625103 | 10.011875 | 9.988125 | 45 | 39 |
| 22 | 30 | 9.363156 | 10.636844 | 9.375038 | 10.624962 | 10.011882 | 9.988118 | 30 | 38 |
| 23 | 45 | 9.363289 | 10.636711 | 9.375178 | 10.624822 | 10.011890 | 9.988110 | 15 | 37 |
| 24 | 21 | 9.363422 | 10.636578 | 9.375319 | 10.624681 | 10.011897 | 9.988103 | 39 | 36 |
| 25 | 15 | 9.363555 | 10.636445 | 9.375459 | 10.624541 | 10.011905 | 9.988095 | 45 | 35 |
| 26 | 30 | 9.363688 | 10.636312 | 9.375600 | 10.624400 | 10.011912 | 9.988088 | 30 | 34 |
| 27 | 45 | 9.363821 | 10.636179 | 9.375740 | 10.624260 | 10.011920 | 9.988080 | 15 | 33 |
| 28 | 22 | 9.363954 | 10.636046 | 9.375881 | 10.624119 | 10.011927 | 9.988073 | 38 | 32 |
| 29 | 15 | 9.364087 | 10.635913 | 9.376021 | 10.623979 | 10.011935 | 9.988065 | 45 | 31 |
| 30 | 30 | 9.364220 | 10.635780 | 9.376162 | 10.623838 | 10.011942 | 9.988058 | 30 | 30 |
| 31 | 45 | 9.364352 | 10.635648 | 9.376302 | 10.623698 | 10.011950 | 9.988050 | 15 | 29 |
| 32 | 23 | 9.364485 | 10.635515 | 9.376442 | 10.623558 | 10.011957 | 9.988043 | 37 | 28 |
| 33 | 15 | 9.364618 | 10.635382 | 9.376583 | 10.623417 | 10.011965 | 9.988035 | 45 | 27 |
| 34 | 30 | 9.364751 | 10.635249 | 9.376723 | 10.623277 | 10.011972 | 9.988028 | 30 | 26 |
| 35 | 45 | 9.364883 | 10.635117 | 9.376863 | 10.623137 | 10.011980 | 9.988020 | 15 | 25 |
| 36 | 24 | 9.365016 | 10.634984 | 9.377003 | 10.622997 | 10.011987 | 9.988013 | 36 | 24 |
| 37 | 15 | 9.365148 | 10.634852 | 9.377143 | 10.622857 | 10.011995 | 9.988005 | 45 | 23 |
| 38 | 30 | 9.365281 | 10.634719 | 9.377283 | 10.622717 | 10.012002 | 9.987998 | 30 | 22 |
| 39 | 45 | 9.365413 | 10.634587 | 9.377423 | 10.622577 | 10.012010 | 9.987990 | 15 | 21 |
| 40 | 25 | 9.365546 | 10.634454 | 9.377563 | 10.622437 | 10.012017 | 9.987983 | 35 | 20 |
| 41 | 15 | 9.365678 | 10.634322 | 9.377703 | 10.622297 | 10.012025 | 9.987975 | 45 | 19 |
| 42 | 30 | 9.365810 | 10.634190 | 9.377843 | 10.622157 | 10.012032 | 9.987968 | 30 | 18 |
| 43 | 45 | 9.365943 | 10.634057 | 9.377983 | 10.622017 | 10.012040 | 9.987960 | 15 | 17 |
| 44 | 26 | 9.366075 | 10.633925 | 9.378122 | 10.621878 | 10.012048 | 9.987952 | 34 | 16 |
| 45 | 15 | 9.366207 | 10.633793 | 9.378262 | 10.621738 | 10.012055 | 9.987945 | 45 | 15 |
| 46 | 30 | 9.366339 | 10.633661 | 9.378402 | 10.621598 | 10.012063 | 9.987937 | 30 | 14 |
| 47 | 45 | 9.366471 | 10.633529 | 9.378542 | 10.621458 | 10.012070 | 9.987930 | 15 | 13 |
| 48 | 27 | 9.366604 | 10.633396 | 9.378681 | 10.621319 | 10.012078 | 9.987922 | 33 | 12 |
| 49 | 15 | 9.366736 | 10.633264 | 9.378821 | 10.621179 | 10.012085 | 9.987915 | 45 | 11 |
| 50 | 30 | 9.366868 | 10.633132 | 9.378960 | 10.621040 | 10.012093 | 9.987907 | 30 | 10 |
| 51 | 45 | 9.367000 | 10.633000 | 9.379100 | 10.620900 | 10.012100 | 9.987900 | 15 | 9 |
| 52 | 28 | 9.367131 | 10.632869 | 9.379239 | 10.620761 | 10.012108 | 9.987892 | 32 | 8 |
| 53 | 15 | 9.367263 | 10.632737 | 9.379379 | 10.620621 | 10.012116 | 9.987884 | 45 | 7 |
| 54 | 30 | 9.367395 | 10.632605 | 9.379518 | 10.620482 | 10.012123 | 9.987877 | 30 | 6 |
| 55 | 45 | 9.367527 | 10.632473 | 9.379658 | 10.620342 | 10.012131 | 9.987869 | 15 | 5 |
| 56 | 29 | 9.367659 | 10.632341 | 9.379797 | 10.620203 | 10.012138 | 9.987862 | 31 | 4 |
| 57 | 15 | 9.367790 | 10.632210 | 9.379936 | 10.620064 | 10.012146 | 9.987854 | 45 | 3 |
| 58 | 30 | 9.367922 | 10.632078 | 9.380075 | 10.619925 | 10.012153 | 9.987847 | 30 | 2 |
| 59 | 45 | 9.368054 | 10.631946 | 9.380215 | 10.619785 | 10.012161 | 9.987839 | 15 | 1 |
| 60 | 30 | 9.368185 | 10.631815 | 9.380354 | 10.619646 | 10.012169 | 9.987831 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine | ″ ′ | sec |
| | 5h 6m. | | LOG. SINES, &c. | | | | | 76 deg. | |

| 0ª 54ᵐ. | | | LOG. SINES, &c. (t.) | | | 13 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| ″ | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.368185 | 10.631815 | 9.380354 | 10.619646 | 10.012169 | 9.987831 | 30 | 60 |
| 1 | 15 | 9.368317 | 10.631683 | 9.380493 | 10.619507 | 10.012176 | 9.987824 | 45. | 59 |
| 2 | 30 | 9.368448 | 10.631552 | 9.380632 | 10.619368 | 10.012184 | 9.987816 | 30 | 58 |
| 3 | 45 | 9.368580 | 10.631420 | 9.380771 | 10.619229 | 10.012191 | 9.987809 | 15 | 57 |
| 4 | 31 | 9.368711 | 10.631289 | 9.380910 | 10.619090 | 10.012199 | 9.987801 | 29 | 56 |
| 5 | 15 | 9.368842 | 10.631158 | 9.381049 | 10.618951 | 10.012206 | 9.987794 | 45. | 55 |
| 6 | 30 | 9.368974 | 10.631026 | 9.381188 | 10.618812 | 10.012214 | 9.987786 | 30 | 54 |
| 7 | 45. | 9.369105 | 10.630895 | 9.381327 | 10.618673 | 10.012222 | 9.987778 | 15 | 53 |
| 8 | 32 | 9.369236 | 10.630764 | 9.381465 | 10.618535 | 10.012229 | 9.987771 | 28 | 52 |
| 9 | 15 | 9.369367 | 10.630633 | 9.381604 | 10.618396 | 10.012237 | 9.987763 | 45. | 51 |
| 10 | 30 | 9.369499 | 10.630501 | 9.381743 | 10.618257 | 10.012244 | 9.987756 | 30 | 50 |
| 11 | 45 | 9.369630 | 10.630370 | 9.381882 | 10.618118 | 10.012252 | 9.987748 | 15. | 49 |
| 12 | 33 | 9.369761 | 10.630239 | 9.382020 | 10.617980 | 10.012260 | 9.987740 | 27 | 48 |
| 13 | 15 | 9.369892 | 10.630108 | 9.382159 | 10.617841 | 10.012267 | 9.987733 | 45. | 47 |
| 14 | 30 | 9.370023 | 10.629977 | 9.382298 | 10.617702 | 10.012275 | 9.987725 | 30 | 46 |
| 15 | 45 | 9.370154 | 10.629846 | 9.382436 | 10.617564 | 10.012283 | 9.987717 | 15. | 45 |
| 16 | 34 | 9.370285 | 10.629715 | 9.382575 | 10.617425 | 10.012290 | 9.987710 | 26 | 44 |
| 17 | 15 | 9.370416 | 10.629584 | 9.382713 | 10.617287 | 10.012298 | 9.987702 | 45 | 43 |
| 18 | 30 | 9.370546 | 10.629454 | 9.382852 | 10.617148 | 10.012305 | 9.987695 | 30 | 42 |
| 19 | 45 | 9.370677 | 10.629323 | 9.382990 | 10.617010 | 10.012313 | 9.987687 | 15. | 41 |
| 20 | 35 | 9.370808 | 10.629192 | 9.383128 | 10.616872 | 10.012321 | 9.987679 | 25 | 40 |
| 21 | 15 | 9.370939 | 10.629061 | 9.383267 | 10.616733 | 10.012328 | 9.987672 | 45. | 39 |
| 22 | 30 | 9.371069 | 10.628931 | 9.383405 | 10.616595 | 10.012336 | 9.987664 | 30 | 38 |
| 23 | 45 | 9.371200 | 10.628800 | 9.383543 | 10.616457 | 10.012344 | 9.987656 | 15. | 37 |
| 24 | 36 | 9.371330 | 10.628670 | 9.383682 | 10.616318 | 10.012351 | 9.987649 | 24 | 36 |
| 25 | 15 | 9.371461 | 10.628539 | 9.383820 | 10.616180 | 10.012359 | 9.987641 | 45. | 35 |
| 26 | 30 | 9.371591 | 10.628409 | 9.383958 | 10.616042 | 10.012366 | 9.987634 | 30 | 34 |
| 27 | 45. | 9.371722 | 10.628278 | 9.384096 | 10.615904 | 10.012374 | 9.987626 | 15 | 33 |
| 28 | 37 | 9.371852 | 10.628148 | 9.384234 | 10.615766 | 10.012382 | 9.987618 | 23 | 32 |
| 29 | 15 | 9.371983 | 10.628017 | 9.384372 | 10.615628 | 10.012389 | 9.987611 | 45 | 31 |
| 30 | 30 | 9.372113 | 10.627887 | 9.384510 | 10.615490 | 10.012397 | 9.987603 | 30 | 30 |
| 31 | 45 | 9.372243 | 10.627757 | 9.384648 | 10.615352 | 10.012405 | 9.987595 | 15. | 29 |
| 32 | 38 | 9.372373 | 10.627627 | 9.384786 | 10.615214 | 10.012412 | 9.987588 | 22 | 28 |
| 33 | 15 | 9.372504 | 10.627496 | 9.384924 | 10.615076 | 10.012420 | 9.987580 | 45. | 27 |
| 34 | 30 | 9.372634 | 10.627366 | 9.385061 | 10.614939 | 10.012428 | 9.987572 | 30. | 26 |
| 35 | 45 | 9.372764 | 10.627236 | 9.385199 | 10.614801 | 10.012435 | 9.987565 | 15. | 25 |
| 36 | 39 | 9.372894 | 10.627106 | 9.385337 | 10.614663 | 10.012443 | 9.987557 | 21 | 24 |
| 37 | 15 | 9.373024 | 10.626976 | 9.385475 | 10.614525 | 10.012451 | 9.987549 | 45 | 23 |
| 38 | 30 | 9.373154 | 10.626846 | 9.385612 | 10.614388 | 10.012458 | 9.987542 | 30 | 22 |
| 39 | 45 | 9.373284 | 10.626716 | 9.385750 | 10.614250 | 10.012466 | 9.987534 | 15 | 21 |
| 40 | 40 | 9.373414 | 10.626586 | 9.385888 | 10.614112 | 10.012474 | 9.987526 | 20 | 20 |
| 41 | 15 | 9.373544 | 10.626456 | 9.386025 | 10.613975 | 10.012481 | 9.987519 | 45 | 19 |
| 42 | 30 | 9.373674 | 10.626326 | 9.386163 | 10.613837 | 10.012489 | 9.987511 | 30 | 18 |
| 43 | 45. | 9.373803 | 10.626197 | 9.386300 | 10.613700 | 10.012497 | 9.987503 | 15 | 17 |
| 44 | 41 | 9.373933 | 10.626067 | 9.386438 | 10.613562 | 10.012505 | 9.987495 | 19 | 16 |
| 45 | 15 | 9.374063 | 10.625937 | 9.386575 | 10.613425 | 10.012512 | 9.987488 | 45. | 15 |
| 46 | 30 | 9.374192 | 10.625808 | 9.386712 | 10.613288 | 10.012520 | 9.987480 | 30 | 14 |
| 47 | 45 | 9.374322 | 10.625678 | 9.386850 | 10.613150 | 10.012528 | 9.987472 | 15 | 13 |
| 48 | 42 | 9.374452 | 10.625548 | 9.386987 | 10.613013 | 10.012535 | 9.987465 | 18 | 12 |
| 49 | 15 | 9.374581 | 10.625419 | 9.387124 | 10.612876 | 10.012543 | 9.987457 | 45 | 11 |
| 50 | 30 | 9.374711 | 10.625289 | 9.387261 | 10.612739 | 10.012551 | 9.987449 | 30 | 10 |
| 51 | 45 | 9.374840 | 10.625160 | 9.387398 | 10.612602 | 10.012558 | 9.987442 | 15 | 9 |
| 52 | 43 | 9.374970 | 10.625030 | 9.387536 | 10.612464 | 10.012566 | 9.987434 | 17 | 8 |
| 53 | 15 | 9.375099 | 10.624901 | 9.387673 | 10.612327 | 10.012574 | 9.987426 | 45 | 7 |
| 54 | 30 | 9.375228 | 10.624772 | 9.387810 | 10.612190 | 10.012582 | 9.987418 | 30 | 6 |
| 55 | 45 | 9.375358 | 10.624642 | 9.387947 | 10.612053 | 10.012589 | 9.987411 | 15 | 5 |
| 56 | 44 | 9.375487 | 10.624513 | 9.388084 | 10.611916 | 10.012597 | 9.987403 | 16 | 4 |
| 57 | 15 | 9.375616 | 10.624384 | 9.388221 | 10.611779 | 10.012605 | 9.987395 | 45 | 3 |
| 58 | 30 | 9.375745 | 10.624255 | 9.388357 | 10.611643 | 10.012612 | 9.987388 | 30 | 2 |
| 59 | 45 | 9.375874 | 10.624126 | 9.388494 | 10.611506 | 10.012620 | 9.987380 | 15 | 1 |
| 60 | 45 | 9.376003 | 10.623997 | 9.388631 | 10.611369 | 10.012628 | 9.987372 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5ʰ 5ᵐ. | | | LOG. SINES, &c. | | | | | 76 deg | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $0^h\ 55^m$. | | LOG. SINES, &c. (t) | | | | | 13 deg. | |
| 0 | 45 | 9.376003 | 10.623997 | 9.388631 | 10.611369 | 10.012628 | 9.987372 | 15 | 60 |
| 1 | 15 | 9.376132 | 10.623868 | 9.388768 | 10.611232 | 10.012636 | 9.987364 | 45 | 59 |
| 2 | 30 | 9.376261 | 10.623739 | 9.388905 | 10.611095 | 10.012643 | 9.987357 | 30 | 58 |
| 3 | 45 | 9.376390 | 10.623610 | 9.389041 | 10.610959 | 10.012651 | 9.987349 | 15 | 57 |
| 4 | 46 | 9.376519 | 10.623481 | 9.389178 | 10.610822 | 10.012659 | 9.987341 | 14 | 56 |
| 5 | 15 | 9.376648 | 10.623352 | 9.389315 | 10.610685 | 10.012667 | 9.987333 | 45 | 55 |
| 6 | 30 | 9.376777 | 10.623223 | 9.389451 | 10.610549 | 10.012674 | 9.987326 | 30 | 54 |
| 7 | 45 | 9.376906 | 10.623094 | 9.389588 | 10.610412 | 10.012682 | 9.987318 | 15 | 53 |
| 8 | 47 | 9.377035 | 10.622965 | 9.389724 | 10.610276 | 10.012690 | 9.987310 | 13 | 52 |
| 9 | 15 | 9.377163 | 10.622837 | 9.389861 | 10.610139 | 10.012698 | 9.987302 | 45 | 51 |
| 10 | 30 | 9.377292 | 10.622708 | 9.389997 | 10.610003 | 10.012705 | 9.987295 | 30 | 50 |
| 11 | 45 | 9.377421 | 10.622579 | 9.390134 | 10.609866 | 10.012713 | 9.987287 | 15 | 49 |
| 12 | 48 | 9.377549 | 10.622451 | 9.390270 | 10.609730 | 10.012721 | 9.987279 | 12 | 48 |
| 13 | 15 | 9.377678 | 10.622322 | 9.390406 | 10.609594 | 10.012729 | 9.987271 | 45 | 47 |
| 14 | 30 | 9.377806 | 10.622194 | 9.390543 | 10.609457 | 10.012736 | 9.987264 | 30 | 46 |
| 15 | 45 | 9.377935 | 10.622065 | 9.390679 | 10.609321 | 10.012744 | 9.987256 | 15 | 45 |
| 16 | 49 | 9.378063 | 10.621937 | 9.390815 | 10.609185 | 10.012752 | 9.987248 | 11 | 44 |
| 17 | 15 | 9.378192 | 10.621808 | 9.390951 | 10.609049 | 10.012760 | 9.987240 | 45 | 43 |
| 18 | 30 | 9.378320 | 10.621680 | 9.391087 | 10.608913 | 10.012767 | 9.987233 | 30 | 42 |
| 19 | 45 | 9.378448 | 10.621552 | 9.391223 | 10.608777 | 10.012775 | 9.987225 | 15 | 41 |
| 20 | 50 | 9.378577 | 10.621423 | 9.391359 | 10.608641 | 10.012783 | 9.987217 | 10 | 40 |
| 21 | 15 | 9.378705 | 10.621295 | 9.391495 | 10.608505 | 10.012791 | 9.987209 | 45 | 39 |
| 22 | 30 | 9.378833 | 10.621167 | 9.391631 | 10.608369 | 10.012798 | 9.987202 | 30 | 38 |
| 23 | 45 | 9.378961 | 10.621039 | 9.391767 | 10.608233 | 10.012806 | 9.987194 | 15 | 37 |
| 24 | 51 | 9.379089 | 10.620911 | 9.391903 | 10.608097 | 10.012814 | 9.987186 | 9 | 36 |
| 25 | 15 | 9.379217 | 10.620783 | 9.392039 | 10.607961 | 10.012822 | 9.987178 | 45 | 35 |
| 26 | 30 | 9.379345 | 10.620655 | 9.392175 | 10.607825 | 10.012830 | 9.987170 | 30 | 34 |
| 27 | 45 | 9.379473 | 10.620527 | 9.392311 | 10.607689 | 10.012837 | 9.987163 | 15 | 33 |
| 28 | 52 | 9.379601 | 10.620399 | 9.392447 | 10.607553 | 10.012845 | 9.987155 | 8 | 32 |
| 29 | 15 | 9.379729 | 10.620271 | 9.392582 | 10.607418 | 10.012853 | 9.987147 | 45 | 31 |
| 30 | 30 | 9.379857 | 10.620143 | 9.392718 | 10.607282 | 10.012861 | 9.987139 | 30 | 30 |
| 31 | 45 | 9.379985 | 10.620015 | 9.392854 | 10.607146 | 10.012869 | 9.987131 | 15 | 29 |
| 32 | 53 | 9.380113 | 10.619887 | 9.392989 | 10.607011 | 10.012876 | 9.987124 | 7 | 28 |
| 33 | 15 | 9.380241 | 10.619759 | 9.393125 | 10.606875 | 10.012884 | 9.987116 | 45 | 27 |
| 34 | 30 | 9.380368 | 10.619632 | 9.393260 | 10.606740 | 10.012892 | 9.987108 | 30 | 26 |
| 35 | 45 | 9.380496 | 10.619504 | 9.393396 | 10.606604 | 10.012900 | 9.987100 | 15 | 25 |
| 36 | 54 | 9.380624 | 10.619376 | 9.393531 | 10.606469 | 10.012908 | 9.987092 | 6 | 24 |
| 37 | 15 | 9.380751 | 10.619249 | 9.393667 | 10.606333 | 10.012915 | 9.987085 | 45 | 23 |
| 38 | 30 | 9.380879 | 10.619121 | 9.393802 | 10.606198 | 10.012923 | 9.987077 | 30 | 22 |
| 39 | 45 | 9.381006 | 10.618994 | 9.393937 | 10.606063 | 10.012931 | 9.987069 | 15 | 21 |
| 40 | 55 | 9.381134 | 10.618866 | 9.394073 | 10.605927 | 10.012939 | 9.987061 | 5 | 20 |
| 41 | 15 | 9.381261 | 10.618739 | 9.394208 | 10.605792 | 10.012947 | 9.987053 | 45 | 19 |
| 42 | 30 | 9.381389 | 10.618611 | 9.394343 | 10.605657 | 10.012955 | 9.987045 | 30 | 18 |
| 43 | 45 | 9.381516 | 10.618484 | 9.394478 | 10.605522 | 10.012962 | 9.987038 | 15 | 17 |
| 44 | 56 | 9.381643 | 10.618357 | 9.394614 | 10.605386 | 10.012970 | 9.987030 | 4 | 16 |
| 45 | 15 | 9.381771 | 10.618229 | 9.394749 | 10.605251 | 10.012978 | 9.987022 | 45 | 15 |
| 46 | 30 | 9.381898 | 10.618102 | 9.394884 | 10.605116 | 10.012986 | 9.987014 | 30 | 14 |
| 47 | 45 | 9.382025 | 10.617975 | 9.395019 | 10.604981 | 10.012994 | 9.987006 | 15 | 13 |
| 48 | 57 | 9.382152 | 10.617848 | 9.395154 | 10.604846 | 10.013002 | 9.986998 | 3 | 12 |
| 49 | 15 | 9.382279 | 10.617721 | 9.395289 | 10.604711 | 10.013009 | 9.986991 | 45 | 11 |
| 50 | 30 | 9.382406 | 10.617594 | 9.395424 | 10.604576 | 10.013017 | 9.986983 | 30 | 10 |
| 51 | 45 | 9.382533 | 10.617467 | 9.395559 | 10.604441 | 10.013025 | 9.986975 | 15 | 9 |
| 52 | 58 | 9.382660 | 10.617340 | 9.395693 | 10.604307 | 10.013033 | 9.986967 | 2 | 8 |
| 53 | 15 | 9.382787 | 10.617213 | 9.395828 | 10.604172 | 10.013041 | 9.986959 | 45 | 7 |
| 54 | 30 | 9.382914 | 10.617086 | 9.395963 | 10.604037 | 10.013049 | 9.986951 | 30 | 6 |
| 55 | 45 | 9.383041 | 10.616959 | 9.396098 | 10.603902 | 10.013057 | 9.986943 | 15 | 5 |
| 56 | 59 | 9.383168 | 10.616832 | 9.396233 | 10.603767 | 10.013064 | 9.986936 | 1 | 4 |
| 57 | 15 | 9.383295 | 10.616705 | 9.396367 | 10.603633 | 10.013072 | 9.986928 | 45 | 3 |
| 58 | 30 | 9.383422 | 10.616578 | 9.396502 | 10.603498 | 10.013080 | 9.986920 | 30 | 2 |
| 59 | 45 | 9.383548 | 10.616452 | 9.396636 | 10.603364 | 10.013088 | 9.986912 | 15 | 1 |
| 60 | 60 | 9.383675 | 10.616325 | 9.396771 | 10.603229 | 10.013096 | 9.986904 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ | sec. |
| | $5^h\ 4^m$. | | | LOG. SINES, &c. | | | | 76 deg. | |

| sec. | 0h 56m. | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | LOG. SINES, &c. (t.) | | | | | | | 14 deg. | |
| 0 | 0 | 9.383675 | 10.616325 | 9.396771 | 10.603229 | 10.013096 | 9.986904 | 60 | 60 |
| 1 | 15 | 9.383802 | 10.616198 | 9.396906 | 10.603094 | 10.013104 | 9.986896 | 45 | 59 |
| 2 | 30 | 9.383928 | 10.616072 | 9.397040 | 10.602960 | 10.013112 | 9.986888 | 30 | 58 |
| 3 | 45 | 9.384055 | 10.615945 | 9.397174 | 10.602826 | 10.013120 | 9.986880 | 15 | 57 |
| 4 | 1 | 9.384181 | 10.615819 | 9.397309 | 10.602691 | 10.013127 | 9.986873 | 59 | 56 |
| 5 | 15 | 9.384308 | 10.615692 | 9.397443 | 10.602557 | 10.013135 | 9.986865 | 45 | 55 |
| 6 | 30 | 9.384434 | 10.615566 | 9.397578 | 10.602422 | 10.013143 | 9.986857 | 30 | 54 |
| 7 | 45 | 9.384561 | 10.615439 | 9.397712 | 10.602288 | 10.013151 | 9.986849 | 15 | 53 |
| 8 | 2 | 9.384687 | 10.615313 | 9.397846 | 10.602154 | 10.013159 | 9.986841 | 58 | 52 |
| 9 | 15 | 9.384814 | 10.615186 | 9.397980 | 10.602020 | 10.013167 | 9.986833 | 45 | 51 |
| 10 | 30 | 9.384940 | 10.615060 | 9.398115 | 10.601885 | 10.013175 | 9.986825 | 30 | 50 |
| 11 | 45 | 9.385066 | 10.614934 | 9.398249 | 10.601751 | 10.013183 | 9.986817 | 15 | 49 |
| 12 | 3 | 9.385192 | 10.614808 | 9.398383 | 10.601617 | 10.013191 | 9.986809 | 57 | 48 |
| 13 | 15 | 9.385319 | 10.614681 | 9.398517 | 10.601483 | 10.013199 | 9.986801 | 45 | 47 |
| 14 | 30 | 9.385445 | 10.614555 | 9.398651 | 10.601349 | 10.013206 | 9.986794 | 30 | 46 |
| 15 | 45 | 9.385571 | 10.614429 | 9.398785 | 10.601215 | 10.013214 | 9.986786 | 15 | 45 |
| 16 | 4 | 9.385697 | 10.614303 | 9.398919 | 10.601081 | 10.013222 | 9.986778 | 56 | 44 |
| 17 | 15 | 9.385823 | 10.614177 | 9.399053 | 10.600947 | 10.013230 | 9.986770 | 45 | 43 |
| 18 | 30 | 9.385949 | 10.614051 | 9.399187 | 10.600813 | 10.013238 | 9.986762 | 30 | 42 |
| 19 | 45 | 9.386075 | 10.613925 | 9.399321 | 10.600679 | 10.013246 | 9.986754 | 15 | 41 |
| 20 | 5 | 9.386201 | 10.613799 | 9.399455 | 10.600545 | 10.013254 | 9.986746 | 55 | 40 |
| 21 | 15 | 9.386327 | 10.613673 | 9.399588 | 10.600412 | 10.013262 | 9.986738 | 45 | 39 |
| 22 | 30 | 9.386452 | 10.613548 | 9.399722 | 10.600278 | 10.013270 | 9.986730 | 30 | 38 |
| 23 | 45 | 9.386578 | 10.613422 | 9.399856 | 10.600144 | 10.013278 | 9.986722 | 15 | 37 |
| 24 | 6 | 9.386704 | 10.613296 | 9.399990 | 10.600010 | 10.013286 | 9.986714 | 54 | 36 |
| 25 | 15 | 9.386830 | 10.613170 | 9.400123 | 10.599877 | 10.013294 | 9.986706 | 45 | 35 |
| 26 | 30 | 9.386955 | 10.613045 | 9.400257 | 10.599743 | 10.013301 | 9.986699 | 30 | 34 |
| 27 | 45 | 9.387081 | 10.612919 | 9.400390 | 10.599610 | 10.013309 | 9.986691 | 15 | 33 |
| 28 | 7 | 9.387207 | 10.612793 | 9.400524 | 10.599476 | 10.013317 | 9.986683 | 53 | 32 |
| 29 | 15 | 9.387332 | 10.612668 | 9.400657 | 10.599343 | 10.013325 | 9.986675 | 45 | 31 |
| 30 | 30 | 9.387458 | 10.612542 | 9.400791 | 10.599209 | 10.013333 | 9.986667 | 30 | 30 |
| 31 | 45 | 9.387583 | 10.612417 | 9.400924 | 10.599076 | 10.013341 | 9.986659 | 15 | 29 |
| 32 | 8 | 9.387709 | 10.612291 | 9.401058 | 10.598942 | 10.013349 | 9.986651 | 52 | 28 |
| 33 | 15 | 9.387834 | 10.612166 | 9.401191 | 10.598809 | 10.013357 | 9.986643 | 45 | 27 |
| 34 | 30 | 9.387959 | 10.612041 | 9.401324 | 10.598676 | 10.013365 | 9.986635 | 30 | 26 |
| 35 | 45 | 9.388085 | 10.611915 | 9.401458 | 10.598542 | 10.013373 | 9.986627 | 15 | 25 |
| 36 | 9 | 9.388210 | 10.611790 | 9.401591 | 10.598409 | 10.013381 | 9.986619 | 51 | 24 |
| 37 | 15 | 9.388335 | 10.611665 | 9.401724 | 10.598276 | 10.013389 | 9.986611 | 45 | 23 |
| 38 | 30 | 9.388461 | 10.611539 | 9.401857 | 10.598143 | 10.013397 | 9.986603 | 30 | 22 |
| 39 | 45 | 9.388586 | 10.611414 | 9.401991 | 10.598009 | 10.013405 | 9.986595 | 15 | 21 |
| 40 | 10 | 9.388711 | 10.611289 | 9.402124 | 10.597876 | 10.013413 | 9.986587 | 50 | 20 |
| 41 | 15 | 9.388836 | 10.611164 | 9.402257 | 10.597743 | 10.013421 | 9.986579 | 45 | 19 |
| 42 | 30 | 9.388961 | 10.611039 | 9.402390 | 10.597610 | 10.013429 | 9.986571 | 30 | 18 |
| 43 | 45 | 9.389086 | 10.610914 | 9.402523 | 10.597477 | 10.013437 | 9.986563 | 15 | 17 |
| 44 | 11 | 9.389211 | 10.610789 | 9.402656 | 10.597344 | 10.013445 | 9.986555 | 49 | 16 |
| 45 | 15 | 9.389336 | 10.610664 | 9.402789 | 10.597211 | 10.013453 | 9.986547 | 45 | 15 |
| 46 | 30 | 9.389461 | 10.610539 | 9.402922 | 10.597078 | 10.013461 | 9.986539 | 30 | 14 |
| 47 | 45 | 9.389586 | 10.610414 | 9.403054 | 10.596946 | 10.013469 | 9.986531 | 15 | 13 |
| 48 | 12 | 9.389711 | 10.610289 | 9.403187 | 10.596813 | 10.013477 | 9.986523 | 48 | 12 |
| 49 | 15 | 9.389835 | 10.610165 | 9.403320 | 10.596680 | 10.013485 | 9.986515 | 45 | 11 |
| 50 | 30 | 9.389960 | 10.610040 | 9.403453 | 10.596547 | 10.013493 | 9.986507 | 30 | 10 |
| 51 | 45 | 9.390085 | 10.609915 | 9.403585 | 10.596415 | 10.013501 | 9.986499 | 15 | 9 |
| 52 | 13 | 9.390210 | 10.609790 | 9.403718 | 10.596282 | 10.013509 | 9.986491 | 47 | 8 |
| 53 | 15 | 9.390334 | 10.609666 | 9.403851 | 10.596149 | 10.013517 | 9.986483 | 45 | 7 |
| 54 | 30 | 9.390459 | 10.609541 | 9.403983 | 10.596017 | 10.013525 | 9.986475 | 30 | 6 |
| 55 | 45 | 9.390583 | 10.609417 | 9.404116 | 10.595884 | 10.013533 | 9.986467 | 15 | 5 |
| 56 | 14 | 9.390708 | 10.609292 | 9.404249 | 10.595751 | 10.013541 | 9.986459 | 46 | 4 |
| 57 | 15 | 9.390832 | 10.609168 | 9.404381 | 10.595619 | 10.013549 | 9.986451 | 45 | 3 |
| 58 | 30 | 9.390957 | 10.609043 | 9.404514 | 10.595486 | 10.013557 | 9.986443 | 30 | 2 |
| 59 | 45 | 9.391081 | 10.608919 | 9.404646 | 10.595354 | 10.013565 | 9.986435 | 15 | 1 |
| 60 | 15 | 9.391206 | 10.608794 | 9.404778 | 10.595222 | 10.013573 | 9.986427 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 5h 3m. | | LOG. SINES, &c. | | | | | 75 deg. | |

| 0h 57m. | | LOG. SINES, &c. (t.) | | | | | 14 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | ″ |
| 0 | 15 | 9.391206 | 10.608794 | 9.404778 | 10.595222 | 10.013573 | 9.986427 | 45 | 60 |
| 1 | 15 | 9.391330 | 10.608670 | 9.404911 | 10.595089 | 10.013581 | 9.986419 | 45 | 59 |
| 2 | 30 | 9.391454 | 10.608546 | 9.405043 | 10.594957 | 10.013589 | 9.986411 | 30 | 58 |
| 3 | 45 | 9.391579 | 10.608421 | 9.405175 | 10.594825 | 10.013597 | 9.986403 | 15 | 57 |
| 4 | 16 | 9.391703 | 10.608297 | 9.405308 | 10.594692 | 10.013605 | 9.986395 | 44 | 56 |
| 5 | 15 | 9.391827 | 10.608173 | 9.405440 | 10.594560 | 10.013613 | 9.986387 | 45 | 55 |
| 6 | 30 | 9.391951 | 10.608049 | 9.405572 | 10.594428 | 10.013621 | 9.986379 | 30 | 54 |
| 7 | 45 | 9.392075 | 10.607925 | 9.405704 | 10.594296 | 10.013629 | 9.986371 | 15 | 53 |
| 8 | 17 | 9.392199 | 10.607801 | 9.405836 | 10.594164 | 10.013637 | 9.986363 | 43 | 52 |
| 9 | 15 | 9.392323 | 10.607677 | 9.405968 | 10.594032 | 10.013645 | 9.986355 | 45 | 51 |
| 10 | 30 | 9.392447 | 10.607553 | 9.406100 | 10.593900 | 10.013653 | 9.986347 | 30 | 50 |
| 11 | 45 | 9.392571 | 10.607429 | 9.406232 | 10.593768 | 10.013661 | 9.986339 | 15 | 49 |
| 12 | 18 | 9.392695 | 10.607305 | 9.406864 | 10.593636 | 10.013669 | 9.986331 | 42 | 48 |
| 13 | 15 | 9.392819 | 10.607181 | 9.406496 | 10.593504 | 10.013677 | 9.986323 | 45 | 47 |
| 14 | 30 | 9.392943 | 10.607057 | 9.406628 | 10.593372 | 10.013685 | 9.986315 | 30 | 46 |
| 15 | 45 | 9.393067 | 10.606933 | 9.406760 | 10.593240 | 10.013693 | 9.986307 | 15 | 45 |
| 16 | 19 | 9.393190 | 10.606810 | 9.406892 | 10.593108 | 10.013701 | 9.986299 | 41 | 44 |
| 17 | 15 | 9.393314 | 10.606686 | 9.407024 | 10.592976 | 10.013710 | 9.986290 | 45 | 43 |
| 18 | 30 | 9.393438 | 10.606562 | 9.407155 | 10.592845 | 10.013718 | 9.986282 | 30 | 42 |
| 19 | 45 | 9.393562 | 10.606438 | 9.407287 | 10.592713 | 10.013726 | 9.986274 | 15 | 41 |
| 20 | 20 | 9.393685 | 10.606315 | 9.407419 | 10.592581 | 10.013734 | 9.986266 | 40 | 40 |
| 21 | 15 | 9.393809 | 10.606191 | 9.407551 | 10.592449 | 10.013742 | 9.986258 | 45 | 39 |
| 22 | 30 | 9.393932 | 10.606068 | 9.407682 | 10.592318 | 10.013750 | 9.986250 | 30 | 38 |
| 23 | 45 | 9.394056 | 10.605944 | 9.407814 | 10.592186 | 10.013758 | 9.986242 | 15 | 37 |
| 24 | 21 | 9.394179 | 10.605821 | 9.407945 | 10.592055 | 10.013766 | 9.986234 | 39 | 36 |
| 25 | 15 | 9.394303 | 10.605697 | 9.408077 | 10.591923 | 10.013774 | 9.986226 | 45 | 35 |
| 26 | 30 | 9.394426 | 10.605574 | 9.408208 | 10.591792 | 10.013782 | 9.986218 | 30 | 34 |
| 27 | 45 | 9.394550 | 10.605450 | 9.408340 | 10.591660 | 10.013790 | 9.986210 | 15 | 33 |
| 28 | 22 | 9.394673 | 10.605327 | 9.408471 | 10.591529 | 10.013798 | 9.986202 | 38 | 32 |
| 29 | 15 | 9.394796 | 10.605204 | 9.408602 | 10.591398 | 10.013806 | 9.986194 | 45 | 31 |
| 30 | 30 | 9.394919 | 10.605081 | 9.408734 | 10.591266 | 10.013815 | 9.986185 | 30 | 30 |
| 31 | 45 | 9.395043 | 10.604957 | 9.408865 | 10.591135 | 10.013823 | 9.986177 | 15 | 29 |
| 32 | 23 | 9.395166 | 10.604834 | 9.408996 | 10.591004 | 10.013831 | 9.986169 | 37 | 28 |
| 33 | 15 | 9.395289 | 10.604711 | 9.409128 | 10.590872 | 10.013839 | 9.986161 | 45 | 27 |
| 34 | 30 | 9.395412 | 10.604588 | 9.409259 | 10.590741 | 10.013847 | 9.986153 | 30 | 26 |
| 35 | 45 | 9.395535 | 10.604465 | 9.409390 | 10.590610 | 10.013855 | 9.986145 | 15 | 25 |
| 36 | 24 | 9.395658 | 10.604342 | 9.409521 | 10.590479 | 10.013863 | 9.986137 | 36 | 24 |
| 37 | 15 | 9.395781 | 10.604219 | 9.409652 | 10.590348 | 10.013871 | 9.986129 | 45 | 23 |
| 38 | 30 | 9.395904 | 10.604096 | 9.409783 | 10.590217 | 10.013879 | 9.986121 | 30 | 22 |
| 39 | 45 | 9.396027 | 10.603973 | 9.409914 | 10.590086 | 10.013887 | 9.986113 | 15 | 21 |
| 40 | 25 | 9.396150 | 10.603850 | 9.410045 | 10.589955 | 10.013896 | 9.986104 | 35 | 20 |
| 41 | 15 | 9.396273 | 10.603727 | 9.410176 | 10.589824 | 10.013904 | 9.986096 | 45 | 19 |
| 42 | 30 | 9.396395 | 10.603505 | 9.410307 | 10.589693 | 10.013912 | 9.986088 | 30 | 18 |
| 43 | 45 | 9.396518 | 10.603482 | 9.410438 | 10.589562 | 10.013920 | 9.986080 | 15 | 17 |
| 44 | 26 | 9.396641 | 10.603359 | 9.410569 | 10.589431 | 10.013928 | 9.986072 | 34 | 16 |
| 45 | 15 | 9.396764 | 10.603236 | 9.410700 | 10.589300 | 10.013936 | 9.986064 | 45 | 15 |
| 46 | 30 | 9.396886 | 10.603114 | 9.410831 | 10.589169 | 10.013944 | 9.986056 | 30 | 14 |
| 47 | 45 | 9.397009 | 10.602991 | 9.410961 | 10.589039 | 10.013952 | 9.986048 | 15 | 13 |
| 48 | 27 | 9.397131 | 10.602869 | 9.411092 | 10.588908 | 10.013961 | 9.986039 | 33 | 12 |
| 49 | 15 | 9.397254 | 10.602746 | 9.411223 | 10.588777 | 10.013969 | 9.986031 | 45 | 11 |
| 50 | 30 | 9.397377 | 10.602623 | 9.411353 | 10.588647 | 10.013977 | 9.986023 | 30 | 10 |
| 51 | 45 | 9.397499 | 10.602501 | 9.411484 | 10.588516 | 10.013985 | 9.986015 | 15 | 9 |
| 52 | 28 | 9.397621 | 10.602379 | 9.411615 | 10.588385 | 10.013993 | 9.986007 | 32 | 8 |
| 53 | 15 | 9.397744 | 10.602256 | 9.411745 | 10.588255 | 10.014001 | 9.985999 | 45 | 7 |
| 54 | 30 | 9.397866 | 10.602134 | 9.411876 | 10.588124 | 10.014009 | 9.985991 | 30 | 6 |
| 55 | 45 | 9.397989 | 10.602011 | 9.412006 | 10.587994 | 10.014018 | 9.985982 | 15 | 5 |
| 56 | 29 | 9.398111 | 10.601889 | 9.412137 | 10.587863 | 10.014026 | 9.985974 | 31 | 4 |
| 57 | 15 | 9.398233 | 10.601767 | 9.412267 | 10.587733 | 10.014034 | 9.985966 | 45 | 3 |
| 58 | 30 | 9.398355 | 10.601645 | 9.412397 | 10.587603 | 10.014042 | 9.985958 | 30 | 2 |
| 59 | 45 | 9.398477 | 10.601523 | 9.412528 | 10.587472 | 10.014050 | 9.985950 | 15 | 1 |
| 60 | 30 | 9.398600 | 10.601400 | 9.412658 | 10.587342 | 10.014058 | 9.985942 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | ″ |
| 5h 2m. | | LOG. SINES, &c. | | | | | 75 deg. | | |

| 0h 58m. | | | LOG. SINES, &c. (t.) | | | | 14 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.398600 | 10.601400 | 9.412658 | 10.587342 | 10.014058 | 9.985942 | 30 | 60 |
| 1 | 15 | 9.398722 | 10.601278 | 9.412788 | 10.587212 | 10.014067 | 9.985933 | 45 | 59 |
| 2 | 30 | 9.398844 | 10.601156 | 9.412919 | 10.587081 | 10.014075 | 9.985925 | 30 | 58 |
| 3 | 45 | 9.398966 | 10.601034 | 9.413049 | 10.586951 | 10.014083 | 9.985917 | 15 | 57 |
| 4 | 31 | 9.399088 | 10.600912 | 9.413179 | 10.586821 | 10.014091 | 9.985909 | 29 | 56 |
| 5 | 15 | 9.399210 | 10.600790 | 9.413309 | 10.586691 | 10.014099 | 9.985901 | 45 | 55 |
| 6 | 30 | 9.399332 | 10.600668 | 9.413439 | 10.586561 | 10.014108 | 9.985892 | 30 | 54 |
| 7 | 45 | 9.399454 | 10.600546 | 9.413569 | 10.586431 | 10.014116 | 9.985884 | 15 | 53 |
| 8 | 32 | 9.399575 | 10.600425 | 9.413699 | 10.586301 | 10.014124 | 9.985876 | 28 | 52 |
| 9 | 15 | 9.399697 | 10.600303 | 9.413829 | 10.586171 | 10.014132 | 9.985868 | 45 | 51 |
| 10 | 30 | 9.399819 | 10.600181 | 9.413959 | 10.586041 | 10.014140 | 9.985860 | 30 | 50 |
| 11 | 45 | 9.399941 | 10.600059 | 9.414089 | 10.585911 | 10.014148 | 9.985852 | 15 | 49 |
| 12 | 33 | 9.400062 | 10.599938 | 9.414219 | 10.585781 | 10.014157 | 9.985843 | 27 | 48 |
| 13 | 15 | 9.400184 | 10.599816 | 9.414349 | 10.585651 | 10.014165 | 9.985835 | 45 | 47 |
| 14 | 30 | 9.400306 | 10.599694 | 9.414479 | 10.585521 | 10.014173 | 9.985827 | 30 | 46 |
| 15 | 45 | 9.400427 | 10.599573 | 9.414609 | 10.585391 | 10.014181 | 9.985819 | 15 | 45 |
| 16 | 34 | 9.400549 | 10.599451 | 9.414738 | 10.585262 | 10.014189 | 9.985811 | 26 | 44 |
| 17 | 15 | 9.400670 | 10.599330 | 9.414868 | 10.585132 | 10.014198 | 9.985802 | 45 | 43 |
| 18 | 30 | 9.400792 | 10.599208 | 9.414998 | 10.585002 | 10.014206 | 9.985794 | 30 | 42 |
| 19 | 45 | 9.400913 | 10.599087 | 9.415127 | 10.584873 | 10.014214 | 9.985786 | 15 | 41 |
| 20 | 35 | 9.401035 | 10.598965 | 9.415257 | 10.584743 | 10.014222 | 9.985778 | 25 | 40 |
| 21 | 15 | 9.401156 | 10.598844 | 9.415387 | 10.584613 | 10.014231 | 9.985769 | 45 | 39 |
| 22 | 30 | 9.401277 | 10.598723 | 9.415516 | 10.584484 | 10.014239 | 9.985761 | 30 | 38 |
| 23 | 45 | 9.401399 | 10.598601 | 9.415646 | 10.584354 | 10.014247 | 9.985753 | 15 | 37 |
| 24 | 36 | 9.401520 | 10.598480 | 9.415775 | 10.584225 | 10.014255 | 9.985745 | 24 | 36 |
| 25 | 15 | 9.401641 | 10.598359 | 9.415905 | 10.584095 | 10.014263 | 9.985737 | 45 | 35 |
| 26 | 30 | 9.401762 | 10.598238 | 9.416034 | 10.583966 | 10.014272 | 9.985728 | 30 | 34 |
| 27 | 45 | 9.401884 | 10.598116 | 9.416163 | 10.583837 | 10.014280 | 9.985720 | 15 | 33 |
| 28 | 37 | 9.402005 | 10.597995 | 9.416293 | 10.583707 | 10.014288 | 9.985712 | 23 | 32 |
| 29 | 15 | 9.402126 | 10.597874 | 9.416422 | 10.583578 | 10.014296 | 9.985704 | 45 | 31 |
| 30 | 30 | 9.402247 | 10.597753 | 9.416551 | 10.583449 | 10.014305 | 9.985695 | 30 | 30 |
| 31 | 45 | 9.402368 | 10.597632 | 9.416681 | 10.583319 | 10.014313 | 9.985687 | 15 | 29 |
| 32 | 38 | 9.402489 | 10.597511 | 9.416810 | 10.583190 | 10.014321 | 9.985679 | 22 | 28 |
| 33 | 15 | 9.402610 | 10.597390 | 9.416939 | 10.583061 | 10.014329 | 9.985671 | 45 | 27 |
| 34 | 30 | 9.402731 | 10.597269 | 9.417068 | 10.582932 | 10.014338 | 9.985662 | 30 | 26 |
| 35 | 45 | 9.402852 | 10.597148 | 9.417197 | 10.582803 | 10.014346 | 9.985654 | 15 | 25 |
| 36 | 39 | 9.402972 | 10.597028 | 9.417326 | 10.582674 | 10.014354 | 9.985646 | 21 | 24 |
| 37 | 15 | 9.403093 | 10.596907 | 9.417455 | 10.582545 | 10.014362 | 9.985638 | 45 | 23 |
| 38 | 30 | 9.403214 | 10.596786 | 9.417585 | 10.582415 | 10.014371 | 9.985629 | 30 | 22 |
| 39 | 45 | 9.403335 | 10.596665 | 9.417713 | 10.582287 | 10.014379 | 9.985621 | 15 | 21 |
| 40 | 40 | 9.403455 | 10.596545 | 9.417842 | 10.582158 | 10.014387 | 9.985613 | 20 | 20 |
| 41 | 15 | 9.403576 | 10.596424 | 9.417971 | 10.582029 | 10.014395 | 9.985605 | 45 | 19 |
| 42 | 30 | 9.403697 | 10.596303 | 9.418100 | 10.581900 | 10.014404 | 9.985596 | 30 | 18 |
| 43 | 45 | 9.403817 | 10.596183 | 9.418229 | 10.581771 | 10.014412 | 9.985588 | 15 | 17 |
| 44 | 41 | 9.403938 | 10.596062 | 9.418358 | 10.581642 | 10.014420 | 9.985580 | 19 | 16 |
| 45 | 15 | 9.404058 | 10.595942 | 9.418487 | 10.581513 | 10.014428 | 9.985572 | 45 | 15 |
| 46 | 30 | 9.404179 | 10.595821 | 9.418615 | 10.581385 | 10.014437 | 9.985563 | 30 | 14 |
| 47 | 45 | 9.404299 | 10.595701 | 9.418744 | 10.581256 | 10.014445 | 9.985555 | 15 | 13 |
| 48 | 42 | 9.404420 | 10.595580 | 9.418873 | 10.581127 | 10.014453 | 9.985547 | 18 | 12 |
| 49 | 15 | 9.404540 | 10.595460 | 9.419002 | 10.580998 | 10.014462 | 9.985538 | 45 | 11 |
| 50 | 30 | 9.404660 | 10.595340 | 9.419130 | 10.580870 | 10.014470 | 9.985530 | 30 | 10 |
| 51 | 45 | 9.404781 | 10.595219 | 9.419259 | 10.580741 | 10.014478 | 9.985522 | 15 | 9 |
| 52 | 43 | 9.404901 | 10.595099 | 9.419387 | 10.580613 | 10.014487 | 9.985513 | 17 | 8 |
| 53 | 15 | 9.405021 | 10.594979 | 9.419516 | 10.580484 | 10.014495 | 9.985505 | 45 | 7 |
| 54 | 30 | 9.405141 | 10.594859 | 9.419644 | 10.580356 | 10.014503 | 9.985497 | 30 | 6 |
| 55 | 45 | 9.405261 | 10.594739 | 9.419773 | 10.580227 | 10.014511 | 9.985489 | 15 | 5 |
| 56 | 44 | 9.405382 | 10.594618 | 9.419901 | 10.580099 | 10.014520 | 9.985480 | 16 | 4 |
| 57 | 15 | 9.405502 | 10.594498 | 9.420030 | 10.579970 | 10.014528 | 9.985472 | 45 | 3 |
| 58 | 30 | 9.405622 | 10.594378 | 9.420158 | 10.579842 | 10.014536 | 9.985464 | 30 | 2 |
| 59 | 45 | 9.405742 | 10.594258 | 9.420286 | 10.579714 | 10.014545 | 9.985455 | 15 | 1 |
| 60 | 45 | 9.405862 | 10.594138 | 9.420415 | 10.579585 | 10.014553 | 9.985447 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 1m. | | | LOG. SINES, &c. | | | | 75 deg. | | |

| 0h 59m. | | | LOG. SINES, &c. (t.) | | | | 14 deg | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.405862 | 10.594138 | 9.420415 | 10.579585 | 10.014553 | 9.985447 | 15 | 60 |
| 1 | 15 | 9.405982 | 10.594018 | 9.420543 | 10.579457 | 10.014561 | 9.985439 | 45 | 59 |
| 2 | 30 | 9.406102 | 10.593898 | 9.420671 | 10.579329 | 10.014570 | 9.985430 | 30 | 58 |
| 3 | 45 | 9.406221 | 10.593779 | 9.420799 | 10.579201 | 10.014578 | 9.985422 | 15 | 57 |
| 4 | 46 | 9.406341 | 10.593659 | 9.420927 | 10.579073 | 10.014586 | 9.985414 | 14 | 56 |
| 5 | 15 | 9.406461 | 10.593539 | 9.421056 | 10.578944 | 10.014595 | 9.985405 | 45 | 55 |
| 6 | 30 | 9.406581 | 10.593419 | 9.421184 | 10.578816 | 10.014603 | 9.985397 | 30 | 54 |
| 7 | 45 | 9.406701 | 10.593299 | 9.421312 | 10.578688 | 10.014611 | 9.985389 | 15 | 53 |
| 8 | 47 | 9.406820 | 10.593180 | 9.421440 | 10.578560 | 10.014620 | 9.985380 | 13 | 52 |
| 9 | 15 | 9.406940 | 10.593060 | 9.421568 | 10.578432 | 10.014628 | 9.985372 | 45 | 51 |
| 10 | 30 | 9.407060 | 10.592940 | 9.421696 | 10.578304 | 10.014636 | 9.985364 | 30 | 50 |
| 11 | 45 | 9.407179 | 10.592821 | 9.421824 | 10.578176 | 10.014645 | 9.985355 | 15 | 49 |
| 12 | 48 | 9.407299 | 10.592701 | 9.421951 | 10.578049 | 10.014653 | 9.985347 | 12 | 48 |
| 13 | 15 | 9.407418 | 10.592582 | 9.422079 | 10.577921 | 10.014661 | 9.985339 | 45 | 47 |
| 14 | 30 | 9.407538 | 10.592462 | 9.422207 | 10.577793 | 10.014670 | 9.985330 | 30 | 46 |
| 15 | 45 | 9.407657 | 10.592343 | 9.422335 | 10.577665 | 10.014678 | 9.985322 | 15 | 45 |
| 16 | 49 | 9.407777 | 10.592223 | 9.422463 | 10.577537 | 10.014686 | 9.985314 | 11 | 44 |
| 17 | 15 | 9.407896 | 10.592104 | 9.422590 | 10.577410 | 10.014695 | 9.985305 | 45 | 43 |
| 18 | 30 | 9.408015 | 10.591985 | 9.422718 | 10.577282 | 10.014703 | 9.985297 | 30 | 42 |
| 19 | 45 | 9.408135 | 10.591865 | 9.422846 | 10.577154 | 10.014711 | 9.985289 | 15 | 41 |
| 20 | 50 | 9.408254 | 10.591746 | 9.422973 | 10.577027 | 10.014720 | 9.985280 | 10 | 40 |
| 21 | 15 | 9.408373 | 10.591627 | 9.423101 | 10.576899 | 10.014728 | 9.985272 | 45 | 39 |
| 22 | 30 | 9.408492 | 10.591508 | 9.423229 | 10.576771 | 10.014736 | 9.985264 | 30 | 38 |
| 23 | 45 | 9.408611 | 10.591389 | 9.423356 | 10.576644 | 10.014745 | 9.985255 | 15 | 37 |
| 24 | 51 | 9.408731 | 10.591269 | 9.423484 | 10.576516 | 10.014753 | 9.985247 | 9 | 36 |
| 25 | 15 | 9.408850 | 10.591150 | 9.423611 | 10.576389 | 10.014762 | 9.985238 | 45 | 35 |
| 26 | 30 | 9.408969 | 10.591031 | 9.423739 | 10.576261 | 10.014770 | 9.985230 | 30 | 34 |
| 27 | 45 | 9.409088 | 10.590912 | 9.423866 | 10.576134 | 10.014778 | 9.985222 | 15 | 33 |
| 28 | 52 | 9.409207 | 10.590793 | 9.423993 | 10.576007 | 10.014787 | 9.985213 | 8 | 32 |
| 29 | 15 | 9.409326 | 10.590674 | 9.424121 | 10.575879 | 10.014795 | 9.985205 | 45 | 31 |
| 30 | 30 | 9.409445 | 10.590555 | 9.424248 | 10.575752 | 10.014804 | 9.985196 | 30 | 30 |
| 31 | 45 | 9.409563 | 10.590437 | 9.424375 | 10.575625 | 10.014812 | 9.985188 | 15 | 29 |
| 32 | 53 | 9.409682 | 10.590318 | 9.424503 | 10.575497 | 10.014820 | 9.985180 | 7 | 28 |
| 33 | 15 | 9.409801 | 10.590199 | 9.424630 | 10.575370 | 10.014829 | 9.985171 | 45 | 27 |
| 34 | 30 | 9.409920 | 10.590080 | 9.424757 | 10.575243 | 10.014837 | 9.985163 | 30 | 26 |
| 35 | 45 | 9.410039 | 10.589961 | 9.424884 | 10.575116 | 10.014845 | 9.985155 | 15 | 25 |
| 36 | 54 | 9.410157 | 10.589843 | 9.425011 | 10.574989 | 10.014854 | 9.985146 | 6 | 24 |
| 37 | 15 | 9.410276 | 10.589724 | 9.425138 | 10.574862 | 10.014862 | 9.985138 | 45 | 23 |
| 38 | 30 | 9.410395 | 10.589605 | 9.425265 | 10.574735 | 10.014871 | 9.985129 | 30 | 22 |
| 39 | 45 | 9.410513 | 10.589487 | 9.425392 | 10.574608 | 10.014879 | 9.985121 | 15 | 21 |
| 40 | 55 | 9.410632 | 10.589368 | 9.425519 | 10.574481 | 10.014888 | 9.985112 | 5 | 20 |
| 41 | 15 | 9.410750 | 10.589250 | 9.425646 | 10.574354 | 10.014896 | 9.985104 | 45 | 19 |
| 42 | 30 | 9.410869 | 10.589131 | 9.425773 | 10.574227 | 10.014904 | 9.985096 | 30 | 18 |
| 43 | 45 | 9.410987 | 10.589013 | 9.425900 | 10.574100 | 10.014913 | 9.985087 | 15 | 17 |
| 44 | 56 | 9.411106 | 10.588894 | 9.426027 | 10.573973 | 10.014921 | 9.985079 | 4 | 16 |
| 45 | 15 | 9.411224 | 10.588776 | 9.426154 | 10.573846 | 10.014930 | 9.985070 | 45 | 15 |
| 46 | 30 | 9.411343 | 10.588657 | 9.426281 | 10.573719 | 10.014938 | 9.985062 | 30 | 14 |
| 47 | 45 | 9.411461 | 10.588539 | 9.426407 | 10.573593 | 10.014946 | 9.985054 | 15 | 13 |
| 48 | 57 | 9.411579 | 10.588421 | 9.426534 | 10.573466 | 10.014955 | 9.985045 | 3 | 12 |
| 49 | 15 | 9.411698 | 10.588302 | 9.426661 | 10.573339 | 10.014963 | 9.985037 | 45 | 11 |
| 50 | 30 | 9.411816 | 10.588184 | 9.426787 | 10.573213 | 10.014972 | 9.985028 | 30 | 10 |
| 51 | 45 | 9.411934 | 10.588066 | 9.426914 | 10.573086 | 10.014980 | 9.985020 | 15 | 9 |
| 52 | 58 | 9.412052 | 10.587948 | 9.427041 | 10.572959 | 10.014989 | 9.985011 | 2 | 8 |
| 53 | 15 | 9.412170 | 10.587830 | 9.427167 | 10.572833 | 10.014997 | 9.985003 | 45 | 7 |
| 54 | 30 | 9.412288 | 10.587712 | 9.427294 | 10.572706 | 10.015006 | 9.984994 | 30 | 6 |
| 55 | 45 | 9.412406 | 10.587594 | 9.427420 | 10.572580 | 10.015014 | 9.984986 | 15 | 5 |
| 56 | 59 | 9.412524 | 10.587476 | 9.427547 | 10.572453 | 10.015022 | 9.984978 | 1 | 4 |
| 57 | 15 | 9.412642 | 10.587358 | 9.427673 | 10.572327 | 10.015031 | 9.984969 | 45 | 3 |
| 58 | 30 | 9.412760 | 10.587240 | 9.427800 | 10.572200 | 10.015039 | 9.984961 | 30 | 2 |
| 59 | 45 | 9.412878 | 10.587122 | 9.427926 | 10.572074 | 10.015048 | 9.984952 | 15 | 1 |
| 60 | 60 | 9.412996 | 10.587004 | 9.428052 | 10.571948 | 10.015056 | 9.984944 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 5h 0m. | | | LOG. SINES, &c. | | | | 75 deg. | | |

| 1h 0m. | | LOG. SINES, &c. (t.) | | | | 15 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ | sec. |
| 0 | 0 | 9.412996 | 10.587004 | 9.428052 | 10.571948 | 10.015056 | 9.984944 | 60 | 60 |
| 1 | 15 | 9.413114 | 10.586886 | 9.428179 | 10.571821 | 10.015065 | 9.984935 | 45 | 59 |
| 2 | 30 | 9.413232 | 10.586768 | 9.428305 | 10.571695 | 10.015073 | 9.984927 | 30 | 58 |
| 3 | 45 | 9.413350 | 10.586650 | 9.428431 | 10.571569 | 10.015082 | 9.984918 | 15 | 57 |
| 4 | 1 | 9.413467 | 10.586533 | 9.428557 | 10.571443 | 10.015090 | 9.984910 | 59 | 56 |
| 5 | 15 | 9.413585 | 10.586415 | 9.428684 | 10.571316 | 10.015099 | 9.984901 | 45 | 55 |
| 6 | 30 | 9.413703 | 10.586297 | 9.428810 | 10.571190 | 10.015107 | 9.984893 | 30 | 54 |
| 7 | 45 | 9.413821 | 10.586179 | 9.428936 | 10.571064 | 10.015116 | 9.984884 | 15 | 53 |
| 8 | 2 | 9.413938 | 10.586062 | 9.429062 | 10.570938 | 10.015124 | 9.984876 | 58 | 52 |
| 9 | 15 | 9.414056 | 10.585944 | 9.429188 | 10.570812 | 10.015133 | 9.984867 | 45 | 51 |
| 10 | 30 | 9.414173 | 10.585827 | 9.429314 | 10.570686 | 10.015141 | 9.984859 | 30 | 50 |
| 11 | 45 | 9.414291 | 10.585709 | 9.429440 | 10.570560 | 10.015150 | 9.984850 | 15 | 49 |
| 12 | 3 | 9.414408 | 10.585592 | 9.429566 | 10.570434 | 10.015158 | 9.984842 | 57 | 48 |
| 13 | 15 | 9.414526 | 10.585474 | 9.429692 | 10.570308 | 10.015166 | 9.984834 | 45 | 47 |
| 14 | 30 | 9.414643 | 10.585357 | 9.429818 | 10.570182 | 10.015175 | 9.984825 | 30 | 46 |
| 15 | 45 | 9.414760 | 10.585240 | 9.429944 | 10.570056 | 10.015183 | 9.984817 | 15 | 45 |
| 16 | 4 | 9.414878 | 10.585122 | 9.430070 | 10.569930 | 10.015192 | 9.984808 | 56 | 44 |
| 17 | 15 | 9.414995 | 10.585005 | 9.430195 | 10.569805 | 10.015200 | 9.984800 | 45 | 43 |
| 18 | 30 | 9.415112 | 10.584888 | 9.430321 | 10.569679 | 10.015209 | 9.984791 | 30 | 42 |
| 19 | 45 | 9.415230 | 10.584770 | 9.430447 | 10.569553 | 10.015218 | 9.984782 | 15 | 41 |
| 20 | 5 | 9.415347 | 10.584653 | 9.430573 | 10.569427 | 10.015226 | 9.984774 | 55 | 40 |
| 21 | 15 | 9.415464 | 10.584536 | 9.430698 | 10.569302 | 10.015235 | 9.984765 | 45 | 39 |
| 22 | 30 | 9.415581 | 10.584419 | 9.430824 | 10.569176 | 10.015243 | 9.984757 | 30 | 38 |
| 23 | 45 | 9.415698 | 10.584302 | 9.430950 | 10.569050 | 10.015252 | 9.984748 | 15 | 37 |
| 24 | 6 | 9.415815 | 10.584185 | 9.431075 | 10.568925 | 10.015260 | 9.984740 | 54 | 36 |
| 25 | 15 | 9.415932 | 10.584068 | 9.431201 | 10.568799 | 10.015269 | 9.984731 | 45 | 35 |
| 26 | 30 | 9.416049 | 10.583951 | 9.431326 | 10.568674 | 10.015277 | 9.984723 | 30 | 34 |
| 27 | 45 | 9.416166 | 10.583834 | 9.431452 | 10.568548 | 10.015286 | 9.984714 | 15 | 33 |
| 28 | 7 | 9.416283 | 10.583717 | 9.431577 | 10.568423 | 10.015294 | 9.984706 | 53 | 32 |
| 29 | 15 | 9.416400 | 10.583600 | 9.431703 | 10.568297 | 10.015303 | 9.984697 | 45 | 31 |
| 30 | 30 | 9.416517 | 10.583483 | 9.431828 | 10.568172 | 10.015311 | 9.984689 | 30 | 30 |
| 31 | 45 | 9.416634 | 10.583366 | 9.431953 | 10.568047 | 10.015320 | 9.984680 | 15 | 29 |
| 32 | 8 | 9.416751 | 10.583249 | 9.432079 | 10.567921 | 10.015328 | 9.984672 | 52 | 28 |
| 33 | 15 | 9.416867 | 10.583133 | 9.432204 | 10.567796 | 10.015337 | 9.984663 | 45 | 27 |
| 34 | 30 | 9.416984 | 10.583016 | 9.432329 | 10.567671 | 10.015345 | 9.984655 | 30 | 26 |
| 35 | 45 | 9.417101 | 10.582899 | 9.432455 | 10.567545 | 10.015354 | 9.984646 | 15 | 25 |
| 36 | 9 | 9.417217 | 10.582783 | 9.432580 | 10.567420 | 10.015363 | 9.984637 | 51 | 24 |
| 37 | 15 | 9.417334 | 10.582666 | 9.432705 | 10.567295 | 10.015371 | 9.984629 | 45 | 23 |
| 38 | 30 | 9.417451 | 10.582549 | 9.432830 | 10.567170 | 10.015380 | 9.984620 | 30 | 22 |
| 39 | 45 | 9.417567 | 10.582433 | 9.432955 | 10.567045 | 10.015388 | 9.984612 | 15 | 21 |
| 40 | 10 | 9.417684 | 10.582316 | 9.433080 | 10.566920 | 10.015397 | 9.984603 | 50 | 20 |
| 41 | 15 | 9.417800 | 10.582200 | 9.433205 | 10.566795 | 10.015405 | 9.984595 | 45 | 19 |
| 42 | 30 | 9.417917 | 10.582083 | 9.433330 | 10.566670 | 10.015414 | 9.984586 | 30 | 18 |
| 43 | 45 | 9.418033 | 10.581967 | 9.433455 | 10.566545 | 10.015422 | 9.984578 | 15 | 17 |
| 44 | 11 | 9.418149 | 10.581851 | 9.433580 | 10.566420 | 10.015431 | 9.984569 | 49 | 16 |
| 45 | 15 | 9.418266 | 10.581734 | 9.433705 | 10.566295 | 10.015440 | 9.984560 | 45 | 15 |
| 46 | 30 | 9.418382 | 10.581618 | 9.433830 | 10.566170 | 10.015448 | 9.984552 | 30 | 14 |
| 47 | 45 | 9.418498 | 10.581502 | 9.433955 | 10.566045 | 10.015457 | 9.984543 | 15 | 13 |
| 48 | 12 | 9.418615 | 10.581385 | 9.434080 | 10.565920 | 10.015465 | 9.984535 | 48 | 12 |
| 49 | 15 | 9.418731 | 10.581269 | 9.434205 | 10.565795 | 10.015474 | 9.984526 | 45 | 11 |
| 50 | 30 | 9.418847 | 10.581153 | 9.434330 | 10.565670 | 10.015482 | 9.984518 | 30 | 10 |
| 51 | 45 | 9.418963 | 10.581037 | 9.434454 | 10.565546 | 10.015491 | 9.984509 | 15 | 9 |
| 52 | 13 | 9.419079 | 10.580921 | 9.434579 | 10.565421 | 10.015500 | 9.984500 | 47 | 8 |
| 53 | 15 | 9.419196 | 10.580804 | 9.434704 | 10.565296 | 10.015508 | 9.984492 | 45 | 7 |
| 54 | 30 | 9.419312 | 10.580688 | 9.434828 | 10.565172 | 10.015517 | 9.984483 | 30 | 6 |
| 55 | 45 | 9.419428 | 10.580572 | 9.434953 | 10.565047 | 10.015525 | 9.984475 | 15 | 5 |
| 56 | 14 | 9.419544 | 10.580456 | 9.435078 | 10.564922 | 10.015534 | 9.984466 | 46 | 4 |
| 57 | 15 | 9.419660 | 10.580340 | 9.435202 | 10.564798 | 10.015543 | 9.984457 | 45 | 3 |
| 58 | 30 | 9.419775 | 10.580225 | 9.435327 | 10.564673 | 10.015551 | 9.984449 | 30 | 2 |
| 59 | 45 | 9.419891 | 10.580109 | 9.435451 | 10.564549 | 10.015560 | 9.984440 | 15 | 1 |
| 60 | 15 | 9.420007 | 10.579993 | 9.435576 | 10.564424 | 10.015568 | 9.984432 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 59m. | | | LOG. SINES, &c. | | | | 74 deg. | | |

| 1h 1m. | | LOG. SINES, &c. (t) | | | | | 15 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.420007 | 10.579993 | 9.435576 | 10.564424 | 10.015568 | 9.984432 | 45 | 60 |
| 1 | 15 | 9.420123 | 10.579877 | 9.435700 | 10.564300 | 10.015577 | 9.984423 | 45 | 59 |
| 2 | 30 | 9.420239 | 10.579761 | 9.435824 | 10.564176 | 10.015586 | 9.984414 | 30 | 58 |
| 3 | 45 | 9.420355 | 10.579645 | 9.435949 | 10.564051 | 10.015594 | 9.984406 | 15 | 57 |
| 4 | 16 | 9.420470 | 10.579530 | 9.436073 | 10.563927 | 10.015603 | 9.984397 | 44 | 56 |
| 5 | 15 | 9.420586 | 10.579414 | 9.436198 | 10.563802 | 10.015612 | 9.984388 | 45 | 55 |
| 6 | 30 | 9.420702 | 10.579298 | 9.436322 | 10.563678 | 10.015620 | 9.984380 | 30 | 54 |
| 7 | 45 | 9.420817 | 10.579183 | 9.436446 | 10.563554 | 10.015629 | 9.984371 | 15 | 53 |
| 8 | 17 | 9.420933 | 10.579067 | 9.436570 | 10.563430 | 10.015637 | 9.984363 | 43 | 52 |
| 9 | 15 | 9.421048 | 10.578952 | 9.436695 | 10.563305 | 10.015646 | 9.984354 | 45 | 51 |
| 10 | 30 | 9.421164 | 10.578836 | 9.436819 | 10.563181 | 10.015655 | 9.984345 | 30 | 50 |
| 11 | 45 | 9.421280 | 10.578720 | 9.436943 | 10.563057 | 10.015663 | 9.984337 | 15 | 49 |
| 12 | 18 | 9.421395 | 10.578605 | 9.437067 | 10.562933 | 10.015672 | 9.984328 | 42 | 48 |
| 13 | 15 | 9.421510 | 10.578490 | 9.437191 | 10.562809 | 10.015681 | 9.984319 | 45 | 47 |
| 14 | 30 | 9.421626 | 10.578374 | 9.437315 | 10.562685 | 10.015689 | 9.984311 | 30 | 46 |
| 15 | 45 | 9.421741 | 10.578259 | 9.437439 | 10.562561 | 10.015698 | 9.984302 | 15 | 45 |
| 16 | 19 | 9.421857 | 10.578143 | 9.437563 | 10.562437 | 10.015707 | 9.984293 | 41 | 44 |
| 17 | 15 | 9.421972 | 10.578028 | 9.437687 | 10.562313 | 10.015715 | 9.984285 | 45 | 43 |
| 18 | 30 | 9.422087 | 10.577913 | 9.437811 | 10.562189 | 10.015724 | 9.984276 | 30 | 42 |
| 19 | 45 | 9.422202 | 10.577798 | 9.437935 | 10.562065 | 10.015733 | 9.984267 | 15 | 41 |
| 20 | 20 | 9.422318 | 10.577682 | 9.438059 | 10.561941 | 10.015741 | 9.984259 | 40 | 40 |
| 21 | 15 | 9.422433 | 10.577567 | 9.438182 | 10.561818 | 10.015750 | 9.984250 | 45 | 39 |
| 22 | 30 | 9.422548 | 10.577452 | 9.438306 | 10.561694 | 10.015758 | 9.984242 | 30 | 38 |
| 23 | 45 | 9.422663 | 10.577337 | 9.438430 | 10.561570 | 10.015767 | 9.984233 | 15 | 37 |
| 24 | 21 | 9.422778 | 10.577222 | 9.438554 | 10.561446 | 10.015776 | 9.984224 | 39 | 36 |
| 25 | 15 | 9.422893 | 10.577107 | 9.438677 | 10.561323 | 10.015784 | 9.984216 | 45 | 35 |
| 26 | 30 | 9.423008 | 10.576992 | 9.438801 | 10.561199 | 10.015793 | 9.984207 | 30 | 34 |
| 27 | 45 | 9.423123 | 10.576877 | 9.438925 | 10.561075 | 10.015802 | 9.984198 | 15 | 33 |
| 28 | 22 | 9.423238 | 10.576762 | 9.439048 | 10.560952 | 10.015811 | 9.984189 | 38 | 32 |
| 29 | 15 | 9.423353 | 10.576647 | 9.439172 | 10.560828 | 10.015819 | 9.984181 | 45 | 31 |
| 30 | 30 | 9.423468 | 10.576532 | 9.439296 | 10.560704 | 10.015828 | 9.984172 | 30 | 30 |
| 31 | 45 | 9.423583 | 10.576417 | 9.439419 | 10.560581 | 10.015837 | 9.984163 | 15 | 29 |
| 32 | 23 | 9.423697 | 10.576303 | 9.439543 | 10.560457 | 10.015845 | 9.984155 | 37 | 28 |
| 33 | 15 | 9.423812 | 10.576188 | 9.439666 | 10.560334 | 10.015854 | 9.984146 | 45 | 27 |
| 34 | 30 | 9.423927 | 10.576073 | 9.439789 | 10.560211 | 10.015863 | 9.984137 | 30 | 26 |
| 35 | 45 | 9.424042 | 10.575958 | 9.439913 | 10.560087 | 10.015871 | 9.984129 | 15 | 25 |
| 36 | 24 | 9.424156 | 10.575844 | 9.440036 | 10.559964 | 10.015880 | 9.984120 | 36 | 24 |
| 37 | 15 | 9.424271 | 10.575729 | 9.440160 | 10.559840 | 10.015889 | 9.984111 | 45 | 23 |
| 38 | 30 | 9.424386 | 10.575614 | 9.440283 | 10.559717 | 10.015897 | 9.984103 | 30 | 22 |
| 39 | 45 | 9.424500 | 10.575500 | 9.440406 | 10.559594 | 10.015906 | 9.984094 | 15 | 21 |
| 40 | 25 | 9.424615 | 10.575385 | 9.440529 | 10.559471 | 10.015915 | 9.984085 | 35 | 20 |
| 41 | 15 | 9.424729 | 10.575271 | 9.440653 | 10.559347 | 10.015924 | 9.984076 | 45 | 19 |
| 42 | 30 | 9.424844 | 10.575156 | 9.440776 | 10.559224 | 10.015932 | 9.984068 | 30 | 18 |
| 43 | 45 | 9.424958 | 10.575042 | 9.440899 | 10.559101 | 10.015941 | 9.984059 | 15 | 17 |
| 44 | 26 | 9.425073 | 10.574927 | 9.441022 | 10.558978 | 10.015950 | 9.984050 | 34 | 16 |
| 45 | 15 | 9.425187 | 10.574813 | 9.441145 | 10.558855 | 10.015958 | 9.984042 | 45 | 15 |
| 46 | 30 | 9.425301 | 10.574699 | 9.441268 | 10.558732 | 10.015967 | 9.984033 | 30 | 14 |
| 47 | 45 | 9.425416 | 10.574584 | 9.441391 | 10.558609 | 10.015976 | 9.984024 | 15 | 13 |
| 48 | 27 | 9.425530 | 10.574470 | 9.441514 | 10.558486 | 10.015985 | 9.984015 | 33 | 12 |
| 49 | 15 | 9.425644 | 10.574356 | 9.441637 | 10.558363 | 10.015993 | 9.984007 | 45 | 11 |
| 50 | 30 | 9.425758 | 10.574242 | 9.441760 | 10.558240 | 10.016002 | 9.983998 | 30 | 10 |
| 51 | 45 | 9.425873 | 10.574127 | 9.441883 | 10.558117 | 10.016011 | 9.983989 | 15 | 9 |
| 52 | 28 | 9.425987 | 10.574013 | 9.442006 | 10.557994 | 10.016020 | 9.983980 | 32 | 8 |
| 53 | 15 | 9.426101 | 10.573899 | 9.442129 | 10.557871 | 10.016028 | 9.983972 | 45 | 7 |
| 54 | 30 | 9.426215 | 10.573785 | 9.442252 | 10.557748 | 10.016037 | 9.983963 | 30 | 6 |
| 55 | 45 | 9.426329 | 10.573671 | 9.442375 | 10.557625 | 10.016046 | 9.983954 | 15 | 5 |
| 56 | 29 | 9.426443 | 10.573557 | 9.442497 | 10.557503 | 10.016055 | 9.983945 | 31 | 4 |
| 57 | 15 | 9.426557 | 10.573443 | 9.442620 | 10.557380 | 10.016063 | 9.983937 | 45 | 3 |
| 58 | 30 | 9.426671 | 10.573329 | 9.442743 | 10.557257 | 10.016072 | 9.983928 | 30 | 2 |
| 59 | 45 | 9.426785 | 10.573215 | 9.442866 | 10.557134 | 10.016081 | 9.983919 | 15 | 1 |
| 60 | 30 | 9.426899 | 10.573101 | 9.442988 | 10.557012 | 10.016090 | 9.983910 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 4h 55m. | LOG. SINES, &c. | 74 deg. |
|---|---|---|

| 1h 2m. | | LOG. SINES, &c. (t.) | | | | | 15 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.426899 | 10.573101 | 9.442988 | 10.557012 | 10.016090 | 9.983910 | 30 | 60 |
| 1 | 15 | 9.427013 | 10.572987 | 9.443111 | 10.556889 | 10.016098 | 9.983902 | 45 | 59 |
| 2 | 30 | 9.427126 | 10.572874 | 9.443233 | 10.556767 | 10.016107 | 9.983893 | 30 | 58 |
| 3 | 45 | 9.427240 | 10.572760 | 9.443356 | 10.556644 | 10.016116 | 9.983884 | 15 | 57 |
| 4 | 31 | 9.427354 | 10.572646 | 9.443479 | 10.556521 | 10.016125 | 9.983875 | 29 | 56 |
| 5 | 15 | 9.427468 | 10.572532 | 9.443601 | 10.556399 | 10.016133 | 9.983867 | 45 | 55 |
| 6 | 30 | 9.427581 | 10.572419 | 9.443724 | 10.556276 | 10.016142 | 9.983858 | 30 | 54 |
| 7 | 45 | 9.427695 | 10.572305 | 9.443846 | 10.556154 | 10.016151 | 9.983849 | 15 | 53 |
| 8 | 32 | 9.427809 | 10.572191 | 9.443968 | 10.556032 | 10.016160 | 9.983840 | 28 | 52 |
| 9 | 15 | 9.427922 | 10.572078 | 9.444091 | 10.555909 | 10.016168 | 9.983832 | 45 | 51 |
| 10 | 30 | 9.428036 | 10.571964 | 9.444213 | 10.555787 | 10.016177 | 9.983823 | 30 | 50 |
| 11 | 45 | 9.428150 | 10.571850 | 9.444336 | 10.555664 | 10.016186 | 9.983814 | 15 | 49 |
| 12 | 33 | 9.428263 | 10.571737 | 9.444458 | 10.555542 | 10.016195 | 9.983805 | 27 | 48 |
| 13 | 15 | 9.428377 | 10.571623 | 9.444580 | 10.555420 | 10.016204 | 9.983796 | 45 | 47 |
| 14 | 30 | 9.428490 | 10.571510 | 9.444702 | 10.555298 | 10.016212 | 9.983788 | 30 | 46 |
| 15 | 45 | 9.428603 | 10.571397 | 9.444825 | 10.555175 | 10.016221 | 9.983779 | 15 | 45 |
| 16 | 34 | 9.428717 | 10.571283 | 9.444947 | 10.555053 | 10.016230 | 9.983770 | 26 | 44 |
| 17 | 15 | 9.428830 | 10.571170 | 9.445069 | 10.554931 | 10.016239 | 9.983761 | 45 | 43 |
| 18 | 30 | 9.428943 | 10.571057 | 9.445191 | 10.554809 | 10.016248 | 9.983752 | 30 | 42 |
| 19 | 45 | 9.429057 | 10.570943 | 9.445313 | 10.554687 | 10.016256 | 9.983744 | 15 | 41 |
| 20 | 35 | 9.429170 | 10.570830 | 9.445435 | 10.554565 | 10.016265 | 9.983735 | 25 | 40 |
| 21 | 15 | 9.429283 | 10.570717 | 9.445557 | 10.554443 | 10.016274 | 9.983726 | 45 | 39 |
| 22 | 30 | 9.429396 | 10.570604 | 9.445679 | 10.554321 | 10.016283 | 9.983717 | 30 | 38 |
| 23 | 45 | 9.429510 | 10.570490 | 9.445801 | 10.554199 | 10.016292 | 9.983708 | 15 | 37 |
| 24 | 36 | 9.429623 | 10.570377 | 9.445923 | 10.554077 | 10.016300 | 9.983700 | 24 | 36 |
| 25 | 15 | 9.429736 | 10.570264 | 9.446045 | 10.553955 | 10.016309 | 9.983691 | 45 | 35 |
| 26 | 30 | 9.429849 | 10.570151 | 9.446167 | 10.553833 | 10.016318 | 9.983682 | 30 | 34 |
| 27 | 45 | 9.429962 | 10.570038 | 9.446289 | 10.553711 | 10.016327 | 9.983673 | 15 | 33 |
| 28 | 37 | 9.430075 | 10.569925 | 9.446411 | 10.553589 | 10.016336 | 9.983664 | 23 | 32 |
| 29 | 15 | 9.430188 | 10.569812 | 9.446532 | 10.553468 | 10.016345 | 9.983655 | 45 | 31 |
| 30 | 30 | 9.430301 | 10.569699 | 9.446654 | 10.553346 | 10.016353 | 9.983647 | 30 | 30 |
| 31 | 45 | 9.430414 | 10.569586 | 9.446776 | 10.553224 | 10.016362 | 9.983638 | 15 | 29 |
| 32 | 38 | 9.430527 | 10.569473 | 9.446898 | 10.553102 | 10.016371 | 9.983629 | 22 | 28 |
| 33 | 15 | 9.430640 | 10.569360 | 9.447019 | 10.552981 | 10.016380 | 9.983620 | 45 | 27 |
| 34 | 30 | 9.430752 | 10.569248 | 9.447141 | 10.552859 | 10.016389 | 9.983611 | 30 | 26 |
| 35 | 45 | 9.430865 | 10.569135 | 9.447263 | 10.552737 | 10.016398 | 9.983602 | 15 | 25 |
| 36 | 39 | 9.430978 | 10.569022 | 9.447384 | 10.552616 | 10.016406 | 9.983594 | 21 | 24 |
| 37 | 15 | 9.431091 | 10.568909 | 9.447506 | 10.552494 | 10.016415 | 9.983585 | 45 | 23 |
| 38 | 30 | 9.431203 | 10.568797 | 9.447627 | 10.552373 | 10.016424 | 9.983576 | 30 | 22 |
| 39 | 45 | 9.431316 | 10.568684 | 9.447749 | 10.552251 | 10.016433 | 9.983567 | 15 | 21 |
| 40 | 40 | 9.431429 | 10.568571 | 9.447870 | 10.552130 | 10.016442 | 9.983558 | 20 | 20 |
| 41 | 15 | 9.431541 | 10.568459 | 9.447992 | 10.552008 | 10.016451 | 9.983549 | 45 | 19 |
| 42 | 30 | 9.431654 | 10.568346 | 9.448113 | 10.551887 | 10.016460 | 9.983540 | 30 | 18 |
| 43 | 45 | 9.431766 | 10.568234 | 9.448235 | 10.551765 | 10.016468 | 9.983532 | 15 | 17 |
| 44 | 41 | 9.431879 | 10.568121 | 9.448356 | 10.551644 | 10.016477 | 9.983523 | 19 | 16 |
| 45 | 15 | 9.431991 | 10.568009 | 9.448477 | 10.551523 | 10.016486 | 9.983514 | 45 | 15 |
| 46 | 30 | 9.432104 | 10.567896 | 9.448599 | 10.551401 | 10.016495 | 9.983505 | 30 | 14 |
| 47 | 45 | 9.432216 | 10.567784 | 9.448720 | 10.551280 | 10.016504 | 9.983496 | 15 | 13 |
| 48 | 42 | 9.432328 | 10.567672 | 9.448841 | 10.551159 | 10.016513 | 9.983487 | 18 | 12 |
| 49 | 15 | 9.432441 | 10.567559 | 9.448962 | 10.551038 | 10.016522 | 9.983478 | 45 | 11 |
| 50 | 30 | 9.432553 | 10.567447 | 9.449084 | 10.550916 | 10.016531 | 9.983469 | 30 | 10 |
| 51 | 45 | 9.432665 | 10.567335 | 9.449205 | 10.550795 | 10.016539 | 9.983461 | 15 | 9 |
| 52 | 43 | 9.432778 | 10.567222 | 9.449326 | 10.550674 | 10.016548 | 9.983452 | 17 | 8 |
| 53 | 15 | 9.432890 | 10.567110 | 9.449447 | 10.550553 | 10.016557 | 9.983443 | 45 | 7 |
| 54 | 30 | 9.433002 | 10.566998 | 9.449568 | 10.550432 | 10.016566 | 9.983434 | 30 | 6 |
| 55 | 45 | 9.433114 | 10.566886 | 9.449689 | 10.550311 | 10.016575 | 9.983425 | 15 | 5 |
| 56 | 44 | 9.433226 | 10.566774 | 9.449810 | 10.550190 | 10.016584 | 9.983416 | 16 | 4 |
| 57 | 15 | 9.433338 | 10.566662 | 9.449931 | 10.550069 | 10.016593 | 9.983407 | 45 | 3 |
| 58 | 30 | 9.433450 | 10.566550 | 9.450052 | 10.549948 | 10.016602 | 9.983398 | 30 | 2 |
| 59 | 45 | 9.433563 | 10.566437 | 9.450173 | 10.549827 | 10.016611 | 9.983389 | 15 | 1 |
| 60 | 45 | 9.433675 | 10.566325 | 9.450294 | 10.549706 | 10.016620 | 9.983380 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 57m. | | | | LOG. SINES, &c. | | | 74 deg | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 1ª 3ᵐ. | LOG. SINES, &c. (t) | | | | | | 15 deg. | |
| 0 | 45 | 9.433675 | 10.566325 | 9.450294 | 10.549706 | 10.016620 | 9.983380 | 15 | 60 |
| 1 | 15 | 9.433786 | 10.566214 | 9.450415 | 10.549585 | 10.016628 | 9.983372 | 45 | 59 |
| 2 | 30 | 9.433898 | 10.566102 | 9.450536 | 10.549464 | 10.016637 | 9.983363 | 30 | 58 |
| 3 | 45 | 9.434010 | 10.565990 | 9.450657 | 10.549343 | 10.016646 | 9.983354 | 15 | 57 |
| 4 | 46 | 9.434122 | 10.565878 | 9.450777 | 10.549223 | 10.016655 | 9.983345 | 14 | 56 |
| 5 | 15 | 9.434234 | 10.565766 | 9.450898 | 10.549102 | 10.016664 | 9.983336 | 45 | 55 |
| 6 | 30 | 9.434346 | 10.565654 | 9.451019 | 10.548981 | 10.016673 | 9.983327 | 30 | 54 |
| 7 | 45 | 9.434458 | 10.565542 | 9.451140 | 10.548860 | 10.016682 | 9.983318 | 15 | 53 |
| 8 | 47 | 9.434569 | 10.565431 | 9.451260 | 10.548740 | 10.016691 | 9.983309 | 13 | 52 |
| 9 | 15 | 9.434681 | 10.565319 | 9.451381 | 10.548619 | 10.016700 | 9.983300 | 45 | 51 |
| 10 | 30 | 9.434793 | 10.565207 | 9.451501 | 10.548499 | 10.016709 | 9.983291 | 30 | 50 |
| 11 | 45 | 9.434904 | 10.565096 | 9.451622 | 10.548378 | 10.016718 | 9.983282 | 15 | 49 |
| 12 | 48 | 9.435016 | 10.564984 | 9.451743 | 10.548257 | 10.016727 | 9.983273 | 12 | 48 |
| 13 | 15 | 9.435128 | 10.564872 | 9.451863 | 10.548137 | 10.016736 | 9.983264 | 45 | 47 |
| 14 | 30 | 9.435239 | 10.564761 | 9.451984 | 10.548016 | 10.016744 | 9.983256 | 30 | 46 |
| 15 | 45 | 9.435351 | 10.564649 | 9.452104 | 10.547896 | 10.016753 | 9.983247 | 15 | 45 |
| 16 | 49 | 9.435462 | 10.564538 | 9.452225 | 10.547775 | 10.016762 | 9.983238 | 11 | 44 |
| 17 | 15 | 9.435574 | 10.564426 | 9.452345 | 10.547655 | 10.016771 | 9.983229 | 45 | 43 |
| 18 | 30 | 9.435685 | 10.564315 | 9.452465 | 10.547535 | 10.016780 | 9.983220 | 30 | 42 |
| 19 | 45 | 9.435797 | 10.564203 | 9.452586 | 10.547414 | 10.016789 | 9.983211 | 15 | 41 |
| 20 | 50 | 9.435908 | 10.564092 | 9.452706 | 10.547294 | 10.016798 | 9.983202 | 10 | 40 |
| 21 | 15 | 9.436019 | 10.563981 | 9.452826 | 10.547174 | 10.016807 | 9.983193 | 45 | 39 |
| 22 | 30 | 9.436131 | 10.563869 | 9.452947 | 10.547053 | 10.016816 | 9.983184 | 30 | 38 |
| 23 | 45 | 9.436242 | 10.563758 | 9.453067 | 10.546933 | 10.016825 | 9.983175 | 15 | 37 |
| 24 | 51 | 9.436353 | 10.563647 | 9.453187 | 10.546813 | 10.016834 | 9.983166 | 9 | 36 |
| 25 | 15 | 9.436464 | 10.563536 | 9.453307 | 10.546693 | 10.016843 | 9.983157 | 45 | 35 |
| 26 | 30 | 9.436576 | 10.563424 | 9.453428 | 10.546572 | 10.016852 | 9.983148 | 30 | 34 |
| 27 | 45 | 9.436687 | 10.563313 | 9.453548 | 10.546452 | 10.016861 | 9.983139 | 15 | 33 |
| 28 | 52 | 9.436798 | 10.563202 | 9.453668 | 10.546332 | 10.016870 | 9.983130 | 8 | 32 |
| 29 | 15 | 9.436909 | 10.563091 | 9.453788 | 10.546212 | 10.016879 | 9.983121 | 45 | 31 |
| 30 | 30 | 9.437020 | 10.562980 | 9.453908 | 10.546092 | 10.016888 | 9.983112 | 30 | 30 |
| 31 | 45 | 9.437131 | 10.562869 | 9.454028 | 10.545972 | 10.016897 | 9.983103 | 15 | 29 |
| 32 | 53 | 9.437242 | 10.562758 | 9.454148 | 10.545852 | 10.016906 | 9.983094 | 7 | 28 |
| 33 | 15 | 9.437353 | 10.562647 | 9.454268 | 10.545732 | 10.016915 | 9.983085 | 45 | 27 |
| 34 | 30 | 9.437464 | 10.562536 | 9.454388 | 10.545612 | 10.016924 | 9.983076 | 30 | 26 |
| 35 | 45 | 9.437575 | 10.562425 | 9.454508 | 10.545492 | 10.016933 | 9.983067 | 15 | 25 |
| 36 | 54 | 9.437686 | 10.562314 | 9.454628 | 10.545372 | 10.016942 | 9.983058 | 6 | 24 |
| 37 | 15 | 9.437797 | 10.562203 | 9.454747 | 10.545253 | 10.016951 | 9.983049 | 45 | 23 |
| 38 | 30 | 9.437908 | 10.562092 | 9.454867 | 10.545133 | 10.016960 | 9.983040 | 30 | 22 |
| 39 | 45 | 9.438018 | 10.561982 | 9.454987 | 10.545013 | 10.016969 | 9.983031 | 15 | 21 |
| 40 | 55 | 9.438129 | 10.561871 | 9.455107 | 10.544893 | 10.016978 | 9.983022 | 5 | 20 |
| 41 | 15 | 9.438240 | 10.561760 | 9.455227 | 10.544773 | 10.016987 | 9.983013 | 45 | 19 |
| 42 | 30 | 9.438351 | 10.561649 | 9.455346 | 10.544654 | 10.016996 | 9.983004 | 30 | 18 |
| 43 | 45 | 9.438461 | 10.561539 | 9.455466 | 10.544534 | 10.017005 | 9.982995 | 15 | 17 |
| 44 | 56 | 9.438572 | 10.561428 | 9.455586 | 10.544414 | 10.017014 | 9.982986 | 4 | 16 |
| 45 | 15 | 9.438682 | 10.561318 | 9.455705 | 10.544295 | 10.017023 | 9.982977 | 45 | 15 |
| 46 | 30 | 9.438793 | 10.561207 | 9.455825 | 10.544175 | 10.017032 | 9.982968 | 30 | 14 |
| 47 | 45 | 9.438904 | 10.561096 | 9.455944 | 10.544056 | 10.017041 | 9.982959 | 15 | 13 |
| 48 | 57 | 9.439014 | 10.560986 | 9.456064 | 10.543936 | 10.017050 | 9.982950 | 3 | 12 |
| 49 | 15 | 9.439125 | 10.560875 | 9.456184 | 10.543816 | 10.017059 | 9.982941 | 45 | 11 |
| 50 | 30 | 9.439235 | 10.560765 | 9.456303 | 10.543697 | 10.017068 | 9.982932 | 30 | 10 |
| 51 | 45 | 9.439346 | 10.560654 | 9.456422 | 10.543578 | 10.017077 | 9.982923 | 15 | 9 |
| 52 | 58 | 9.439456 | 10.560544 | 9.456542 | 10.543458 | 10.017086 | 9.982914 | 2 | 8 |
| 53 | 15 | 9.439566 | 10.560434 | 9.456661 | 10.543339 | 10.017095 | 9.982905 | 45 | 7 |
| 54 | 30 | 9.439677 | 10.560323 | 9.456781 | 10.543219 | 10.017104 | 9.982896 | 30 | 6 |
| 55 | 45 | 9.439787 | 10.560213 | 9.456900 | 10.543100 | 10.017113 | 9.982887 | 15 | 5 |
| 56 | 59 | 9.439897 | 10.560103 | 9.457019 | 10.542981 | 10.017122 | 9.982878 | 1 | 4 |
| 57 | 15 | 9.440007 | 10.559993 | 9.457139 | 10.542861 | 10.017131 | 9.982869 | 45 | 3 |
| 58 | 30 | 9.440118 | 10.559882 | 9.457258 | 10.542742 | 10.017140 | 9.982860 | 30 | 2 |
| 59 | 45 | 9.440228 | 10.559772 | 9.457377 | 10.542623 | 10.017149 | 9.982851 | 15 | 1 |
| 60 | 60 | 9.440338 | 10.559662 | 9.457496 | 10.542504 | 10.017158 | 9.982842 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4ʰ 56ᵐ. | LOG. SINES, &c. | | | | | | 74 deg. | |

| sec. | 1h 4m. ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | LOG. SINES, &c. (t.) | | | | | | | 16 deg. | |
| 0 | 0 | 9.440338 | 10.559662 | 9.457496 | 10.542504 | 10.017158 | 9.982842 | 60 | 60 |
| 1 | 15 | 9.440448 | 10.559552 | 9.457616 | 10.542384 | 10.017167 | 9.982833 | 45 | 59 |
| 2 | 30 | 9.440558 | 10.559442 | 9.457735 | 10.542265 | 10.017177 | 9.982823 | 30 | 58 |
| 3 | 45 | 9.440668 | 10.559332 | 9.457854 | 10.542146 | 10.017186 | 9.982814 | 15 | 57 |
| 4 | 1 | 9.440778 | 10.559222 | 9.457973 | 10.542027 | 10.017195 | 9.982805 | 59 | 56 |
| 5 | 15 | 9.440888 | 10.559112 | 9.458092 | 10.541908 | 10.017204 | 9.982796 | 45 | 55 |
| 6 | 30 | 9.440998 | 10.559002 | 9.458211 | 10.541789 | 10.017213 | 9.982787 | 30 | 54 |
| 7 | 45 | 9.441108 | 10.558892 | 9.458330 | 10.541670 | 10.017222 | 9.982778 | 15 | 53 |
| 8 | 2 | 9.441218 | 10.558782 | 9.458449 | 10.541551 | 10.017231 | 9.982769 | 58 | 52 |
| 9 | 15 | 9.441328 | 10.558672 | 9.458568 | 10.541432 | 10.017240 | 9.982760 | 45 | 51 |
| 10 | 30 | 9.441438 | 10.558562 | 9.458687 | 10.541313 | 10.017249 | 9.982751 | 30 | 50 |
| 11 | 45 | 9.441548 | 10.558452 | 9.458806 | 10.541194 | 10.017258 | 9.982742 | 15 | 49 |
| 12 | 3 | 9.441658 | 10.558342 | 9.458925 | 10.541075 | 10.017267 | 9.982733 | 57 | 48 |
| 13 | 15 | 9.441767 | 10.558233 | 9.459044 | 10.540956 | 10.017276 | 9.982724 | 45 | 47 |
| 14 | 30 | 9.441877 | 10.558123 | 9.459162 | 10.540838 | 10.017285 | 9.982715 | 30 | 46 |
| 15 | 45 | 9.441987 | 10.558013 | 9.459281 | 10.540719 | 10.017295 | 9.982705 | 15 | 45 |
| 16 | 4 | 9.442096 | 10.557904 | 9.459400 | 10.540600 | 10.017304 | 9.982696 | 56 | 44 |
| 17 | 15 | 9.442206 | 10.557794 | 9.459519 | 10.540481 | 10.017313 | 9.982687 | 45 | 43 |
| 18 | 30 | 9.442316 | 10.557684 | 9.459637 | 10.540363 | 10.017322 | 9.982678 | 30 | 42 |
| 19 | 45 | 9.442425 | 10.557575 | 9.459756 | 10.540244 | 10.017331 | 9.982669 | 15 | 41 |
| 20 | 5 | 9.442535 | 10.557465 | 9.459875 | 10.540125 | 10.017340 | 9.982660 | 55 | 40 |
| 21 | 15 | 9.442644 | 10.557356 | 9.459993 | 10.540007 | 10.017349 | 9.982651 | 45 | 39 |
| 22 | 30 | 9.442754 | 10.557246 | 9.460112 | 10.539888 | 10.017358 | 9.982642 | 30 | 38 |
| 23 | 45 | 9.442863 | 10.557137 | 9.460231 | 10.539769 | 10.017367 | 9.982633 | 15 | 37 |
| 24 | 6 | 9.442973 | 10.557027 | 9.460349 | 10.539651 | 10.017376 | 9.982624 | 54 | 36 |
| 25 | 15 | 9.443082 | 10.556918 | 9.460468 | 10.539532 | 10.017386 | 9.982614 | 45 | 35 |
| 26 | 30 | 9.443192 | 10.556808 | 9.460586 | 10.539414 | 10.017395 | 9.982605 | 30 | 34 |
| 27 | 45 | 9.443301 | 10.556699 | 9.460705 | 10.539295 | 10.017404 | 9.982596 | 15 | 33 |
| 28 | 7 | 9.443410 | 10.556590 | 9.460823 | 10.539177 | 10.017413 | 9.982587 | 53 | 32 |
| 29 | 15 | 9.443520 | 10.556480 | 9.460942 | 10.539058 | 10.017422 | 9.982578 | 45 | 31 |
| 30 | 30 | 9.443629 | 10.556371 | 9.461060 | 10.538940 | 10.017431 | 9.982569 | 30 | 30 |
| 31 | 45 | 9.443738 | 10.556262 | 9.461178 | 10.538822 | 10.017440 | 9.982560 | 15 | 29 |
| 32 | 8 | 9.443847 | 10.556153 | 9.461297 | 10.538703 | 10.017449 | 9.982551 | 52 | 28 |
| 33 | 15 | 9.443956 | 10.556044 | 9.461415 | 10.538585 | 10.017459 | 9.982541 | 45 | 27 |
| 34 | 30 | 9.444065 | 10.555935 | 9.461533 | 10.538467 | 10.017468 | 9.982532 | 30 | 26 |
| 35 | 45 | 9.444175 | 10.555825 | 9.461651 | 10.538349 | 10.017477 | 9.982523 | 15 | 25 |
| 36 | 9 | 9.444284 | 10.555716 | 9.461770 | 10.538230 | 10.017486 | 9.982514 | 51 | 24 |
| 37 | 15 | 9.444393 | 10.555607 | 9.461888 | 10.538112 | 10.017495 | 9.982505 | 45 | 23 |
| 38 | 30 | 9.444502 | 10.555498 | 9.462006 | 10.537994 | 10.017504 | 9.982496 | 30 | 22 |
| 39 | 45 | 9.444611 | 10.555389 | 9.462124 | 10.537876 | 10.017513 | 9.982487 | 15 | 21 |
| 40 | 10 | 9.444720 | 10.555280 | 9.462242 | 10.537758 | 10.017523 | 9.982477 | 50 | 20 |
| 41 | 15 | 9.444829 | 10.555171 | 9.462360 | 10.537640 | 10.017532 | 9.982468 | 45 | 19 |
| 42 | 30 | 9.444938 | 10.555062 | 9.462478 | 10.537522 | 10.017541 | 9.982459 | 30 | 18 |
| 43 | 45 | 9.445046 | 10.554954 | 9.462596 | 10.537404 | 10.017550 | 9.982450 | 15 | 17 |
| 44 | 11 | 9.445155 | 10.554845 | 9.462714 | 10.537286 | 10.017559 | 9.982441 | 49 | 16 |
| 45 | 15 | 9.445264 | 10.554736 | 9.462832 | 10.537168 | 10.017568 | 9.982432 | 45 | 15 |
| 46 | 30 | 9.445373 | 10.554627 | 9.462950 | 10.537050 | 10.017578 | 9.982422 | 30 | 14 |
| 47 | 45 | 9.445482 | 10.554518 | 9.463068 | 10.536932 | 10.017587 | 9.982413 | 15 | 13 |
| 48 | 12 | 9.445590 | 10.554410 | 9.463186 | 10.536814 | 10.017596 | 9.982404 | 48 | 12 |
| 49 | 15 | 9.445699 | 10.554301 | 9.463304 | 10.536696 | 10.017605 | 9.982395 | 45 | 11 |
| 50 | 30 | 9.445808 | 10.554192 | 9.463422 | 10.536578 | 10.017614 | 9.982386 | 30 | 10 |
| 51 | 45 | 9.445916 | 10.554084 | 9.463540 | 10.536460 | 10.017624 | 9.982376 | 15 | 9 |
| 52 | 13 | 9.446025 | 10.553975 | 9.463658 | 10.536342 | 10.017633 | 9.982367 | 47 | 8 |
| 53 | 15 | 9.446133 | 10.553867 | 9.463775 | 10.536225 | 10.017642 | 9.982358 | 45 | 7 |
| 54 | 30 | 9.446242 | 10.553758 | 9.463893 | 10.536107 | 10.017651 | 9.982349 | 30 | 6 |
| 55 | 45 | 9.446351 | 10.553649 | 9.464011 | 10.535989 | 10.017660 | 9.982340 | 15 | 5 |
| 56 | 14 | 9.446459 | 10.553541 | 9.464128 | 10.535872 | 10.017669 | 9.982331 | 46 | 4 |
| 57 | 15 | 9.446567 | 10.553433 | 9.464246 | 10.535754 | 10.017679 | 9.982321 | 45 | 3 |
| 58 | 30 | 9.446676 | 10.553324 | 9.464364 | 10.535636 | 10.017688 | 9.982312 | 30 | 2 |
| 59 | 45 | 9.446784 | 10.553216 | 9.464481 | 10.535519 | 10.017697 | 9.982303 | 15 | 1 |
| 60 | 15 | 9.446893 | 10.553107 | 9.464599 | 10.535401 | 10.017706 | 9.982294 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 55m. | | LOG. SINES, &c. | | | | | 73 deg. | |

| 1h 5m. | | LOG. SINES, &c. (t.) | | | | | 16 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec |
| 0 | 15 | 9.446893 | 10.553107 | 9.464599 | 10.535401 | 10.017706 | 9.982294 | 45 | 60 |
| 1 | 15 | 9.447001 | 10.552999 | 9.464716 | 10.535284 | 10.017715 | 9.982285 | 45 | 59 |
| 2 | 30 | 9.447109 | 10.552891 | 9.464834 | 10.535166 | 10.017725 | 9.982275 | 30 | 58 |
| 3 | 45 | 9.447218 | 10.552782 | 9.464951 | 10.535049 | 10.017734 | 9.982266 | 15 | 57 |
| 4 | 16 | 9.447326 | 10.552674 | 9.465069 | 10.534931 | 10.017743 | 9.982257 | 44 | 56 |
| 5 | 15 | 9.447434 | 10.552566 | 9.465186 | 10.534814 | 10.017752 | 9.982248 | 45 | 55 |
| 6 | 30 | 9.447542 | 10.552458 | 9.465304 | 10.534696 | 10.017762 | 9.982238 | 30 | 54 |
| 7 | 45 | 9.447650 | 10.552350 | 9.465421 | 10.534579 | 10.017771 | 9.982229 | 15 | 53 |
| 8 | 17 | 9.447759 | 10.552241 | 9.465539 | 10.534461 | 10.017780 | 9.982220 | 43 | 52 |
| 9 | 15 | 9.447867 | 10.552133 | 9.465656 | 10.534344 | 10.017789 | 9.982211 | 45 | 51 |
| 10 | 30 | 9.447975 | 10.552025 | 9.465773 | 10.534227 | 10.017798 | 9.982202 | 30 | 50 |
| 11 | 45 | 9.448083 | 10.551917 | 9.465890 | 10.534110 | 10.017808 | 9.982192 | 15 | 49 |
| 12 | 18 | 9.448191 | 10.551809 | 9.466008 | 10.533992 | 10.017817 | 9.982183 | 42 | 48 |
| 13 | 15 | 9.448299 | 10.551701 | 9.466125 | 10.533875 | 10.017826 | 9.982174 | 45 | 47 |
| 14 | 30 | 9.448407 | 10.551593 | 9.466242 | 10.533758 | 10.017835 | 9.982165 | 30 | 46 |
| 15 | 45 | 9.448515 | 10.551485 | 9.466359 | 10.533641 | 10.017845 | 9.982155 | 15 | 45 |
| 16 | 19 | 9.448623 | 10.551377 | 9.466476 | 10.533524 | 10.017854 | 9.982146 | 41 | 44 |
| 17 | 15 | 9.448731 | 10.551269 | 9.466594 | 10.533406 | 10.017863 | 9.982137 | 45 | 43 |
| 18 | 30 | 9.448838 | 10.551162 | 9.466711 | 10.533289 | 10.017872 | 9.982128 | 30 | 42 |
| 19 | 45 | 9.448946 | 10.551054 | 9.466828 | 10.533172 | 10.017882 | 9.982118 | 15 | 41 |
| 20 | 20 | 9.449054 | 10.550946 | 9.466945 | 10.533055 | 10.017891 | 9.982109 | 40 | 40 |
| 21 | 15 | 9.449162 | 10.550838 | 9.467062 | 10.532938 | 10.017900 | 9.982100 | 45 | 39 |
| 22 | 30 | 9.449269 | 10.550731 | 9.467179 | 10.532821 | 10.017909 | 9.982091 | 30 | 38 |
| 23 | 45 | 9.449377 | 10.550623 | 9.467296 | 10.532704 | 10.017919 | 9.982081 | 15 | 37 |
| 24 | 21 | 9.449485 | 10.550515 | 9.467413 | 10.532587 | 10.017928 | 9.982072 | 39 | 36 |
| 25 | 15 | 9.449592 | 10.550408 | 9.467530 | 10.532470 | 10.017937 | 9.982063 | 45 | 35 |
| 26 | 30 | 9.449700 | 10.550300 | 9.467646 | 10.532354 | 10.017946 | 9.982054 | 30 | 34 |
| 27 | 45 | 9.449808 | 10.550192 | 9.467763 | 10.532237 | 10.017956 | 9.982044 | 15 | 33 |
| 28 | 22 | 9.449915 | 10.550085 | 9.467880 | 10.532120 | 10.017965 | 9.982035 | 38 | 32 |
| 29 | 15 | 9.450023 | 10.549977 | 9.467997 | 10.532003 | 10.017974 | 9.982026 | 45 | 31 |
| 30 | 30 | 9.450130 | 10.549870 | 9.468114 | 10.531886 | 10.017984 | 9.982016 | 30 | 30 |
| 31 | 45 | 9.450238 | 10.549762 | 9.468230 | 10.531770 | 10.017993 | 9.982007 | 15 | 29 |
| 32 | 23 | 9.450345 | 10.549655 | 9.468347 | 10.531653 | 10.018002 | 9.981998 | 37 | 28 |
| 33 | 15 | 9.450453 | 10.549547 | 9.468464 | 10.531536 | 10.018011 | 9.981989 | 45 | 27 |
| 34 | 30 | 9.450560 | 10.549440 | 9.468581 | 10.531419 | 10.018021 | 9.981979 | 30 | 26 |
| 35 | 45 | 9.450667 | 10.549333 | 9.468697 | 10.531303 | 10.018030 | 9.981970 | 15 | 25 |
| 36 | 24 | 9.450775 | 10.549225 | 9.468814 | 10.531186 | 10.018039 | 9.981961 | 36 | 24 |
| 37 | 15 | 9.450882 | 10.549118 | 9.468930 | 10.531070 | 10.018049 | 9.981951 | 45 | 23 |
| 38 | 30 | 9.450989 | 10.549011 | 9.469047 | 10.530953 | 10.018058 | 9.981942 | 30 | 22 |
| 39 | 45 | 9.451096 | 10.548904 | 9.469164 | 10.530836 | 10.018067 | 9.981933 | 15 | 21 |
| 40 | 25 | 9.451204 | 10.548796 | 9.469280 | 10.530720 | 10.018076 | 9.981924 | 35 | 20 |
| 41 | 15 | 9.451311 | 10.548689 | 9.469397 | 10.530603 | 10.018086 | 9.981914 | 45 | 19 |
| 42 | 30 | 9.451418 | 10.548582 | 9.469513 | 10.530487 | 10.018095 | 9.981905 | 30 | 18 |
| 43 | 45 | 9.451525 | 10.548475 | 9.469629 | 10.530371 | 10.018104 | 9.981896 | 15 | 17 |
| 44 | 26 | 9.451632 | 10.548368 | 9.469746 | 10.530254 | 10.018114 | 9.981886 | 34 | 16 |
| 45 | 15 | 9.451739 | 10.548261 | 9.469862 | 10.530138 | 10.018123 | 9.981877 | 45 | 15 |
| 46 | 30 | 9.451846 | 10.548154 | 9.469979 | 10.530021 | 10.018132 | 9.981868 | 30 | 14 |
| 47 | 45 | 9.451953 | 10.548047 | 9.470095 | 10.529905 | 10.018142 | 9.981858 | 15 | 13 |
| 48 | 27 | 9.452060 | 10.547940 | 9.470211 | 10.529789 | 10.018151 | 9.981849 | 33 | 12 |
| 49 | 15 | 9.452167 | 10.547833 | 9.470327 | 10.529673 | 10.018160 | 9.981840 | 45 | 11 |
| 50 | 30 | 9.452274 | 10.547726 | 9.470444 | 10.529556 | 10.018170 | 9.981830 | 30 | 10 |
| 51 | 45 | 9.452381 | 10.547619 | 9.470560 | 10.529440 | 10.018179 | 9.981821 | 15 | 9 |
| 52 | 28 | 9.452488 | 10.547512 | 9.470676 | 10.529324 | 10.018188 | 9.981812 | 32 | 8 |
| 53 | 15 | 9.452595 | 10.547405 | 9.470792 | 10.529208 | 10.018198 | 9.981802 | 45 | 7 |
| 54 | 30 | 9.452702 | 10.547298 | 9.470908 | 10.529092 | 10.018207 | 9.981793 | 30 | 6 |
| 55 | 45 | 9.452808 | 10.547192 | 9.471025 | 10.528975 | 10.018216 | 9.981784 | 15 | 5 |
| 56 | 29 | 9.452915 | 10.547085 | 9.471141 | 10.528859 | 10.018226 | 9.981774 | 31 | 4 |
| 57 | 15 | 9.453022 | 10.546978 | 9.471257 | 10.528743 | 10.018235 | 9.981765 | 45 | 3 |
| 58 | 30 | 9.453128 | 10.546872 | 9.471373 | 10.528627 | 10.018244 | 9.981756 | 30 | 2 |
| 59 | 45 | 9.453235 | 10.546765 | 9.471489 | 10.528511 | 10.018254 | 9.981746 | 15 | 1 |
| 60 | 30 | 9.453342 | 10.546658 | 9.471605 | 10.528395 | 10.018263 | 9.981737 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ | sec. |
| 4h 54m. | | | LOG. SINES, &c. | | | | 73 deg. | | |

| 1h 6m. | | LOG. SINES, &c. (t.) | | | | | 16 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.453342 | 10.546658 | 9.471605 | 10.528395 | 10.018263 | 9.981737 | 30 | 60 |
| 1 | 15 | 9.453448 | 10.546552 | 9.471721 | 10.528279 | 10.018272 | 9.981728 | 45 | 59 |
| 2 | 30 | 9.453555 | 10.546445 | 9.471837 | 10.528163 | 10.018282 | 9.981718 | 30 | 58 |
| 3 | 45 | 9.453661 | 10.546339 | 9.471953 | 10.528047 | 10.018291 | 9.981709 | 15 | 57 |
| 4 | 31 | 9.453768 | 10.546232 | 9.472068 | 10.527932 | 10.018301 | 9.981699 | 29 | 56 |
| 5 | 15 | 9.453875 | 10.546125 | 9.472184 | 10.527816 | 10.018310 | 9.981690 | 45 | 55 |
| 6 | 30 | 9.453981 | 10.546019 | 9.472300 | 10.527700 | 10.018319 | 9.981681 | 30 | 54 |
| 7 | 45 | 9.454087 | 10.545913 | 9.472416 | 10.527584 | 10.018329 | 9.981671 | 15 | 53 |
| 8 | 32 | 9.454194 | 10.545806 | 9.472532 | 10.527468 | 10.018338 | 9.981662 | 28 | 52 |
| 9 | 15 | 9.454300 | 10.545700 | 9.472648 | 10.527352 | 10.018347 | 9.981653 | 45 | 51 |
| 10 | 30 | 9.454407 | 10.545593 | 9.472763 | 10.527237 | 10.018357 | 9.981643 | 30 | 50 |
| 11 | 45 | 9.454513 | 10.545487 | 9.472879 | 10.527121 | 10.018366 | 9.981634 | 15 | 49 |
| 12 | 33 | 9.454619 | 10.545381 | 9.472995 | 10.527005 | 10.018376 | 9.981624 | 27 | 48 |
| 13 | 15 | 9.454725 | 10.545275 | 9.473110 | 10.526890 | 10.018385 | 9.981615 | 45 | 47 |
| 14 | 30 | 9.454832 | 10.545168 | 9.473226 | 10.526774 | 10.018394 | 9.981606 | 30 | 46 |
| 15 | 45 | 9.454938 | 10.545062 | 9.473342 | 10.526658 | 10.018404 | 9.981596 | 15 | 45 |
| 16 | 34 | 9.455044 | 10.544956 | 9.473457 | 10.526543 | 10.018413 | 9.981587 | 26 | 44 |
| 17 | 15 | 9.455150 | 10.544850 | 9.473573 | 10.526427 | 10.018422 | 9.981578 | 45 | 43 |
| 18 | 30 | 9.455256 | 10.544744 | 9.473688 | 10.526312 | 10.018432 | 9.981568 | 30 | 42 |
| 19 | 45 | 9.455362 | 10.544638 | 9.473804 | 10.526196 | 10.018441 | 9.981559 | 15 | 41 |
| 20 | 35 | 9.455469 | 10.544531 | 9.473919 | 10.526081 | 10.018451 | 9.981549 | 25 | 40 |
| 21 | 15 | 9.455575 | 10.544425 | 9.474035 | 10.525965 | 10.018460 | 9.981540 | 45 | 39 |
| 22 | 30 | 9.455681 | 10.544319 | 9.474150 | 10.525850 | 10.018470 | 9.981530 | 30 | 38 |
| 23 | 45 | 9.455787 | 10.544213 | 9.474265 | 10.525735 | 10.018479 | 9.981521 | 15 | 37 |
| 24 | 36 | 9.455893 | 10.544107 | 9.474381 | 10.525619 | 10.018488 | 9.981512 | 24 | 36 |
| 25 | 15 | 9.455998 | 10.544002 | 9.474496 | 10.525504 | 10.018498 | 9.981502 | 45 | 35 |
| 26 | 30 | 9.456104 | 10.543896 | 9.474611 | 10.525389 | 10.018507 | 9.981493 | 30 | 34 |
| 27 | 45 | 9.456210 | 10.543790 | 9.474727 | 10.525273 | 10.018517 | 9.981483 | 15 | 33 |
| 28 | 37 | 9.456316 | 10.543684 | 9.474842 | 10.525158 | 10.018526 | 9.981474 | 23 | 32 |
| 29 | 15 | 9.456422 | 10.543578 | 9.474957 | 10.525043 | 10.018535 | 9.981465 | 45 | 31 |
| 30 | 30 | 9.456528 | 10.543472 | 9.475072 | 10.524928 | 10.018545 | 9.981455 | 30 | 30 |
| 31 | 45 | 9.456633 | 10.543367 | 9.475188 | 10.524812 | 10.018554 | 9.981446 | 15 | 29 |
| 32 | 38 | 9.456739 | 10.543261 | 9.475303 | 10.524697 | 10.018564 | 9.981436 | 22 | 28 |
| 33 | 15 | 9.456845 | 10.543155 | 9.475418 | 10.524582 | 10.018573 | 9.981427 | 45 | 27 |
| 34 | 30 | 9.456951 | 10.543049 | 9.475533 | 10.524467 | 10.018583 | 9.981417 | 30 | 26 |
| 35 | 45 | 9.457056 | 10.542944 | 9.475648 | 10.524352 | 10.018592 | 9.981408 | 15 | 25 |
| 36 | 39 | 9.457162 | 10.542838 | 9.475763 | 10.524237 | 10.018601 | 9.981399 | 21 | 24 |
| 37 | 15 | 9.457267 | 10.542733 | 9.475878 | 10.524122 | 10.018611 | 9.981389 | 45 | 23 |
| 38 | 30 | 9.457373 | 10.542627 | 9.475993 | 10.524007 | 10.018620 | 9.981380 | 30 | 22 |
| 39 | 45 | 9.457478 | 10.542522 | 9.476108 | 10.523892 | 10.018630 | 9.981370 | 15 | 21 |
| 40 | 40 | 9.457584 | 10.542416 | 9.476223 | 10.523777 | 10.018639 | 9.981361 | 20 | 20 |
| 41 | 15 | 9.457689 | 10.542311 | 9.476338 | 10.523662 | 10.018649 | 9.981351 | 45 | 19 |
| 42 | 30 | 9.457795 | 10.542205 | 9.476453 | 10.523547 | 10.018658 | 9.981342 | 30 | 18 |
| 43 | 45 | 9.457900 | 10.542100 | 9.476568 | 10.523432 | 10.018668 | 9.981332 | 15 | 17 |
| 44 | 41 | 9.458006 | 10.541994 | 9.476683 | 10.523317 | 10.018677 | 9.981323 | 19 | 16 |
| 45 | 15 | 9.458111 | 10.541889 | 9.476798 | 10.523202 | 10.018687 | 9.981313 | 45 | 15 |
| 46 | 30 | 9.458216 | 10.541784 | 9.476912 | 10.523088 | 10.018696 | 9.981304 | 30 | 14 |
| 47 | 45 | 9.458322 | 10.541678 | 9.477027 | 10.522973 | 10.018706 | 9.981294 | 15 | 13 |
| 48 | 42 | 9.458427 | 10.541573 | 9.477142 | 10.522858 | 10.018715 | 9.981285 | 18 | 12 |
| 49 | 15 | 9.458532 | 10.541468 | 9.477257 | 10.522743 | 10.018724 | 9.981276 | 45 | 11 |
| 50 | 30 | 9.458638 | 10.541362 | 9.477371 | 10.522629 | 10.018734 | 9.981266 | 30 | 10 |
| 51 | 45 | 9.458743 | 10.541257 | 9.477486 | 10.522514 | 10.018743 | 9.981257 | 15 | 9 |
| 52 | 43 | 9.458848 | 10.541152 | 9.477601 | 10.522399 | 10.018753 | 9.981247 | 17 | 8 |
| 53 | 15 | 9.458953 | 10.541047 | 9.477715 | 10.522285 | 10.018762 | 9.981238 | 45 | 7 |
| 54 | 30 | 9.459058 | 10.540942 | 9.477830 | 10.522170 | 10.018772 | 9.981228 | 30 | 6 |
| 55 | 45 | 9.459163 | 10.540837 | 9.477945 | 10.522055 | 10.018781 | 9.981219 | 15 | 5 |
| 56 | 44 | 9.459268 | 10.540732 | 9.478059 | 10.521941 | 10.018791 | 9.981209 | 16 | 4 |
| 57 | 15 | 9.459373 | 10.540627 | 9.478174 | 10.521826 | 10.018800 | 9.981200 | 45 | 3 |
| 58 | 30 | 9.459478 | 10.540522 | 9.478288 | 10.521712 | 10.018810 | 9.981190 | 30 | 2 |
| 59 | 45 | 9.459583 | 10.540417 | 9.478403 | 10.521597 | 10.018819 | 9.981181 | 15 | 1 |
| 60 | 45 | 9.459688 | 10.540312 | 9.478517 | 10.521483 | 10.018829 | 9.981171 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 53m. | | | LOG. SINES, &c. | | | | 73 deg. | | |

| 1h 7m. | | LOG. SINES, &c. (t) | | | | | 16 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec |
| 0 | 45 | 9.459688 | 10.540312 | 9.478517 | 10.521483 | 10.018829 | 9.981171 | 15 | 60 |
| 1 | 15 | 9.459793 | 10.540207 | 9.478632 | 10.521368 | 10.018838 | 9.981162 | 45 | 59 |
| 2 | 30 | 9.459898 | 10.540102 | 9.478746 | 10.521254 | 10.018848 | 9.981152 | 30 | 58 |
| 3 | 45 | 9.460003 | 10.539997 | 9.478860 | 10.521140 | 10.018857 | 9.981143 | 15 | 57 |
| 4 | 46 | 9.460108 | 10.539892 | 9.478975 | 10.521025 | 10.018867 | 9.981133 | 14 | 56 |
| 5 | 15 | 9.460213 | 10.539787 | 9.479089 | 10.520911 | 10.018876 | 9.981124 | 45 | 55 |
| 6 | 30 | 9.460317 | 10.539683 | 9.479203 | 10.520797 | 10.018886 | 9.981114 | 30 | 54 |
| 7 | 45 | 9.460422 | 10.539578 | 9.479318 | 10.520682 | 10.018896 | 9.981104 | 15 | 53 |
| 8 | 47 | 9.460527 | 10.539473 | 9.479432 | 10.520568 | 10.018905 | 9.981095 | 13 | 52 |
| 9 | 15 | 9.460632 | 10.539368 | 9.479546 | 10.520454 | 10.018915 | 9.981085 | 45 | 51 |
| 10 | 30 | 9.460736 | 10.539264 | 9.479660 | 10.520340 | 10.018924 | 9.981076 | 30 | 50 |
| 11 | 45 | 9.460841 | 10.539159 | 9.479775 | 10.520225 | 10.018934 | 9.981066 | 15 | 49 |
| 12 | 48 | 9.460946 | 10.539054 | 9.479889 | 10.520111 | 10.018943 | 9.981057 | 12 | 48 |
| 13 | 15 | 9.461050 | 10.538950 | 9.480003 | 10.519997 | 10.018953 | 9.981047 | 45 | 47 |
| 14 | 30 | 9.461155 | 10.538845 | 9.480117 | 10.519883 | 10.018962 | 9.981038 | 30 | 46 |
| 15 | 45 | 9.461259 | 10.538741 | 9.480231 | 10.519769 | 10.018972 | 9.981028 | 15 | 45 |
| 16 | 49 | 9.461364 | 10.538636 | 9.480345 | 10.519655 | 10.018981 | 9.981019 | 11 | 44 |
| 17 | 15 | 9.461468 | 10.538532 | 9.480459 | 10.519541 | 10.018991 | 9.981009 | 45 | 43 |
| 18 | 30 | 9.461573 | 10.538427 | 9.480573 | 10.519427 | 10.019000 | 9.981000 | 30 | 42 |
| 19 | 45 | 9.461677 | 10.538323 | 9.480687 | 10.519313 | 10.019010 | 9.980990 | 15 | 41 |
| 20 | 50 | 9.461782 | 10.538218 | 9.480801 | 10.519199 | 10.019020 | 9.980980 | 10 | 40 |
| 21 | 15 | 9.461886 | 10.538114 | 9.480915 | 10.519085 | 10.019029 | 9.980971 | 45 | 39 |
| 22 | 30 | 9.461990 | 10.538010 | 9.481029 | 10.518971 | 10.019039 | 9.980961 | 30 | 38 |
| 23 | 45 | 9.462095 | 10.537905 | 9.481143 | 10.518857 | 10.019048 | 9.980952 | 15 | 37 |
| 24 | 51 | 9.462199 | 10.537801 | 9.481257 | 10.518743 | 10.019058 | 9.980942 | 9 | 36 |
| 25 | 15 | 9.462303 | 10.537697 | 9.481370 | 10.518630 | 10.019067 | 9.980933 | 45 | 35 |
| 26 | 30 | 9.462407 | 10.537593 | 9.481484 | 10.518516 | 10.019077 | 9.980923 | 30 | 34 |
| 27 | 45 | 9.462512 | 10.537488 | 9.481598 | 10.518402 | 10.019086 | 9.980914 | 15 | 33 |
| 28 | 52 | 9.462616 | 10.537384 | 9.481712 | 10.518288 | 10.019096 | 9.980904 | 8 | 32 |
| 29 | 15 | 9.462720 | 10.537280 | 9.481825 | 10.518175 | 10.019106 | 9.980894 | 45 | 31 |
| 30 | 30 | 9.462824 | 10.537176 | 9.481939 | 10.518061 | 10.019115 | 9.980885 | 30 | 30 |
| 31 | 45 | 9.462928 | 10.537072 | 9.482053 | 10.517947 | 10.019125 | 9.980875 | 15 | 29 |
| 32 | 53 | 9.463032 | 10.536968 | 9.482167 | 10.517833 | 10.019134 | 9.980866 | 7 | 28 |
| 33 | 15 | 9.463136 | 10.536864 | 9.482280 | 10.517720 | 10.019144 | 9.980856 | 45 | 27 |
| 34 | 30 | 9.463240 | 10.536760 | 9.482394 | 10.517606 | 10.019154 | 9.980846 | 30 | 26 |
| 35 | 45 | 9.463344 | 10.536656 | 9.482507 | 10.517493 | 10.019163 | 9.980837 | 15 | 25 |
| 36 | 54 | 9.463448 | 10.536552 | 9.482621 | 10.517379 | 10.019173 | 9.980827 | 6 | 24 |
| 37 | 15 | 9.463552 | 10.536448 | 9.482734 | 10.517266 | 10.019182 | 9.980818 | 45 | 23 |
| 38 | 30 | 9.463656 | 10.536344 | 9.482848 | 10.517152 | 10.019192 | 9.980808 | 30 | 22 |
| 39 | 45 | 9.463760 | 10.536240 | 9.482961 | 10.517039 | 10.019202 | 9.980798 | 15 | 21 |
| 40 | 55 | 9.463864 | 10.536136 | 9.483075 | 10.516925 | 10.019211 | 9.980789 | 5 | 20 |
| 41 | 15 | 9.463968 | 10.536032 | 9.483188 | 10.516812 | 10.019221 | 9.980779 | 45 | 19 |
| 42 | 30 | 9.464071 | 10.535929 | 9.483302 | 10.516698 | 10.019230 | 9.980770 | 30 | 18 |
| 43 | 45 | 9.464175 | 10.535825 | 9.483415 | 10.516585 | 10.019240 | 9.980760 | 15 | 17 |
| 44 | 56 | 9.464279 | 10.535721 | 9.483529 | 10.516471 | 10.019250 | 9.980750 | 4 | 16 |
| 45 | 15 | 9.464383 | 10.535617 | 9.483642 | 10.516358 | 10.019259 | 9.980741 | 45 | 15 |
| 46 | 30 | 9.464486 | 10.535514 | 9.483755 | 10.516245 | 10.019269 | 9.980731 | 30 | 14 |
| 47 | 45 | 9.464590 | 10.535410 | 9.483868 | 10.516132 | 10.019278 | 9.980722 | 15 | 13 |
| 48 | 57 | 9.464694 | 10.535306 | 9.483982 | 10.516018 | 10.019288 | 9.980712 | 3 | 12 |
| 49 | 15 | 9.464797 | 10.535203 | 9.484095 | 10.515905 | 10.019298 | 9.980702 | 45 | 11 |
| 50 | 30 | 9.464901 | 10.535099 | 9.484208 | 10.515792 | 10.019307 | 9.980693 | 30 | 10 |
| 51 | 45 | 9.465004 | 10.534996 | 9.484321 | 10.515679 | 10.019317 | 9.980683 | 15 | 9 |
| 52 | 58 | 9.465108 | 10.534892 | 9.484435 | 10.515565 | 10.019327 | 9.980673 | 2 | 8 |
| 53 | 15 | 9.465212 | 10.534788 | 9.484548 | 10.515452 | 10.019336 | 9.980664 | 45 | 7 |
| 54 | 30 | 9.465315 | 10.534685 | 9.484661 | 10.515339 | 10.019346 | 9.980654 | 30 | 6 |
| 55 | 45 | 9.465418 | 10.534582 | 9.484774 | 10.515226 | 10.019355 | 9.980645 | 15 | 5 |
| 56 | 59 | 9.465522 | 10.534478 | 9.484887 | 10.515113 | 10.019365 | 9.980635 | 1 | 4 |
| 57 | 15 | 9.465625 | 10.534375 | 9.485000 | 10.515000 | 10.019375 | 9.980625 | 45 | 3 |
| 58 | 30 | 9.465729 | 10.534271 | 9.485113 | 10.514887 | 10.019384 | 9.980616 | 30 | 2 |
| 59 | 45 | 9.465832 | 10.534168 | 9.485226 | 10.514774 | 10.019394 | 9.980606 | 15 | 1 |
| 60 | 60 | 9.465935 | 10.534065 | 9.485339 | 10.514661 | 10.019404 | 9.980596 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 52m. | | | | LOG. SINES, &c. | | | | 73 deg | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 1h 8m. | | LOG. SINES, &c. (t.) | | | | | 17 deg. | |
| 0 | 0 | 9.465935 | 10.534065 | 9.485339 | 10.514661 | 10.019404 | 9.980596 | 60 | 60 |
| 1 | 15 | 9.466039 | 10.533961 | 9.485452 | 10.514548 | 10.019413 | 9.980587 | 45 | 59 |
| 2 | 30 | 9.466142 | 10.533858 | 9.485565 | 10.514435 | 10.019423 | 9.980577 | 30 | 58 |
| 3 | 45 | 9.466245 | 10.533755 | 9.485678 | 10.514322 | 10.019433 | 9.980567 | 15 | 57 |
| 4 | 1 | 9.466348 | 10.533652 | 9.485791 | 10.514209 | 10.019442 | 9.980558 | 59 | 56 |
| 5 | 15 | 9.466451 | 10.533549 | 9.485903 | 10.514097 | 10.019452 | 9.980548 | 45 | 55 |
| 6 | 30 | 9.466555 | 10.533445 | 9.486016 | 10.513984 | 10.019462 | 9.980538 | 30 | 54 |
| 7 | 45 | 9.466658 | 10.533342 | 9.486129 | 10.513871 | 10.019471 | 9.980529 | 15 | 53 |
| 8 | 2 | 9.466761 | 10.533239 | 9.486242 | 10.513758 | 10.019481 | 9.980519 | 58 | 52 |
| 9 | 15 | 9.466864 | 10.533136 | 9.486355 | 10.513645 | 10.019491 | 9.980509 | 45 | 51 |
| 10 | 30 | 9.466967 | 10.533033 | 9.486467 | 10.513533 | 10.019500 | 9.980500 | 30 | 50 |
| 11 | 45 | 9.467070 | 10.532930 | 9.486580 | 10.513420 | 10.019510 | 9.980490 | 15 | 49 |
| 12 | 3 | 9.467173 | 10.532827 | 9.486693 | 10.513307 | 10.019520 | 9.980480 | 57 | 48 |
| 13 | 15 | 9.467276 | 10.532724 | 9.486805 | 10.513195 | 10.019529 | 9.980471 | 45 | 47 |
| 14 | 30 | 9.467379 | 10.532621 | 9.486918 | 10.513082 | 10.019539 | 9.980461 | 30 | 46 |
| 15 | 45 | 9.467482 | 10.532518 | 9.487031 | 10.512969 | 10.019549 | 9.980451 | 15 | 45 |
| 16 | 4 | 9.467585 | 10.532415 | 9.487143 | 10.512857 | 10.019559 | 9.980441 | 56 | 44 |
| 17 | 15 | 9.467688 | 10.532312 | 9.487256 | 10.512744 | 10.019568 | 9.980432 | 45 | 43 |
| 18 | 30 | 9.467790 | 10.532210 | 9.487368 | 10.512632 | 10.019578 | 9.980422 | 30 | 42 |
| 19 | 45 | 9.467893 | 10.532107 | 9.487481 | 10.512519 | 10.019588 | 9.980412 | 15 | 41 |
| 20 | 5 | 9.467996 | 10.532004 | 9.487593 | 10.512407 | 10.019597 | 9.980403 | 55 | 40 |
| 21 | 15 | 9.468099 | 10.531901 | 9.487706 | 10.512294 | 10.019607 | 9.980393 | 45 | 39 |
| 22 | 30 | 9.468201 | 10.531799 | 9.487818 | 10.512182 | 10.019617 | 9.980383 | 30 | 38 |
| 23 | 45 | 9.468304 | 10.531696 | 9.487931 | 10.512069 | 10.019626 | 9.980374 | 15 | 37 |
| 24 | 6 | 9.468407 | 10.531593 | 9.488043 | 10.511957 | 10.019636 | 9.980364 | 54 | 36 |
| 25 | 15 | 9.468509 | 10.531491 | 9.488155 | 10.511845 | 10.019646 | 9.980354 | 45 | 35 |
| 26 | 30 | 9.468612 | 10.531388 | 9.488268 | 10.511732 | 10.019656 | 9.980344 | 30 | 34 |
| 27 | 45 | 9.468715 | 10.531285 | 9.488380 | 10.511620 | 10.019665 | 9.980335 | 15 | 33 |
| 28 | 7 | 9.468817 | 10.531183 | 9.488492 | 10.511508 | 10.019675 | 9.980325 | 53 | 32 |
| 29 | 15 | 9.468920 | 10.531080 | 9.488605 | 10.511395 | 10.019685 | 9.980315 | 45 | 31 |
| 30 | 30 | 9.469022 | 10.530978 | 9.488717 | 10.511283 | 10.019695 | 9.980305 | 30 | 30 |
| 31 | 45 | 9.469125 | 10.530875 | 9.488829 | 10.511171 | 10.019704 | 9.980296 | 15 | 29 |
| 32 | 8 | 9.469227 | 10.530773 | 9.488941 | 10.511059 | 10.019714 | 9.980286 | 52 | 28 |
| 33 | 15 | 9.469330 | 10.530670 | 9.489053 | 10.510947 | 10.019724 | 9.980276 | 45 | 27 |
| 34 | 30 | 9.469432 | 10.530568 | 9.489166 | 10.510834 | 10.019733 | 9.980267 | 30 | 26 |
| 35 | 45 | 9.469535 | 10.530465 | 9.489278 | 10.510722 | 10.019743 | 9.980257 | 15 | 25 |
| 36 | 9 | 9.469637 | 10.530363 | 9.489390 | 10.510610 | 10.019753 | 9.980247 | 51 | 24 |
| 37 | 15 | 9.469739 | 10.530261 | 9.489502 | 10.510498 | 10.019763 | 9.980237 | 45 | 23 |
| 38 | 30 | 9.469842 | 10.530158 | 9.489614 | 10.510386 | 10.019772 | 9.980228 | 30 | 22 |
| 39 | 45 | 9.469944 | 10.530056 | 9.489726 | 10.510274 | 10.019782 | 9.980218 | 15 | 21 |
| 40 | 10 | 9.470046 | 10.529954 | 9.489838 | 10.510162 | 10.019792 | 9.980208 | 50 | 20 |
| 41 | 15 | 9.470148 | 10.529852 | 9.489950 | 10.510050 | 10.019802 | 9.980198 | 45 | 19 |
| 42 | 30 | 9.470250 | 10.529750 | 9.490062 | 10.509938 | 10.019811 | 9.980189 | 30 | 18 |
| 43 | 45 | 9.470353 | 10.529647 | 9.490174 | 10.509826 | 10.019821 | 9.980179 | 15 | 17 |
| 44 | 11 | 9.470455 | 10.529545 | 9.490286 | 10.509714 | 10.019831 | 9.980169 | 49 | 16 |
| 45 | 15 | 9.470557 | 10.529443 | 9.490398 | 10.509602 | 10.019841 | 9.980159 | 45 | 15 |
| 46 | 30 | 9.470659 | 10.529341 | 9.490510 | 10.509490 | 10.019851 | 9.980149 | 30 | 14 |
| 47 | 45 | 9.470761 | 10.529239 | 9.490621 | 10.509379 | 10.019860 | 9.980140 | 15 | 13 |
| 48 | 12 | 9.470863 | 10.529137 | 9.490733 | 10.509267 | 10.019870 | 9.980130 | 48 | 12 |
| 49 | 15 | 9.470965 | 10.529035 | 9.490845 | 10.509155 | 10.019880 | 9.980120 | 45 | 11 |
| 50 | 30 | 9.471067 | 10.528933 | 9.490957 | 10.509043 | 10.019890 | 9.980110 | 30 | 10 |
| 51 | 45 | 9.471169 | 10.528831 | 9.491068 | 10.508932 | 10.019899 | 9.980101 | 15 | 9 |
| 52 | 13 | 9.471271 | 10.528729 | 9.491180 | 10.508820 | 10.019909 | 9.980091 | 47 | 8 |
| 53 | 15 | 9.471373 | 10.528627 | 9.491292 | 10.508708 | 10.019919 | 9.980081 | 45 | 7 |
| 54 | 30 | 9.471475 | 10.528525 | 9.491404 | 10.508596 | 10.019929 | 9.980071 | 30 | 6 |
| 55 | 45 | 9.471577 | 10.528423 | 9.491515 | 10.508485 | 10.019939 | 9.980061 | 15 | 5 |
| 56 | 14 | 9.471678 | 10.528322 | 9.491627 | 10.508373 | 10.019948 | 9.980052 | 46 | 4 |
| 57 | 15 | 9.471780 | 10.528220 | 9.491738 | 10.508262 | 10.019958 | 9.980042 | 45 | 3 |
| 58 | 30 | 9.471882 | 10.528118 | 9.491850 | 10.508150 | 10.019968 | 9.980032 | 30 | 2 |
| 59 | 45 | 9.471984 | 10.528016 | 9.491962 | 10.508038 | 10.019978 | 9.980022 | 15 | 1 |
| 60 | 15 | 9.472086 | 10.527914 | 9.492073 | 10.507927 | 10.019988 | 9.980012 | 45 | 0 |
| sec | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 51m.. | | LOG. SINES, &c | | | | | 72 deg. | |

| 1h 9m. | | | LOG. SINES, &c. (t) | | | | 17 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.472086 | 10.527914 | 9.492073 | 10.507927 | 10.019988 | 9.980012 | 45 | 60 |
| 1 | 15 | 9.472187 | 10.527813 | 9.492185 | 10.507815 | 10.019997 | 9.980003 | 45 | 59 |
| 2 | 30 | 9.472289 | 10.527711 | 9.492296 | 10.507704 | 10.020007 | 9.979993 | 30 | 58 |
| 3 | 45 | 9.472391 | 10.527609 | 9.492408 | 10.507592 | 10.020017 | 9.979983 | 15 | 57 |
| 4 | 16 | 9.472492 | 10.527508 | 9.492519 | 10.507481 | 10.020027 | 9.979973 | 44 | 56 |
| 5 | 15 | 9.472594 | 10.527406 | 9.492630 | 10.507370 | 10.020037 | 9.979963 | 45 | 55 |
| 6 | 30 | 9.472695 | 10.527305 | 9.492742 | 10.507258 | 10.020046 | 9.979954 | 30 | 54 |
| 7 | 45 | 9.472797 | 10.527203 | 9.492853 | 10.507147 | 10.020056 | 9.979944 | 15 | 53 |
| 8 | 17 | 9.472898 | 10.527102 | 9.492965 | 10.507035 | 10.020066 | 9.979934 | 43 | 52 |
| 9 | 15 | 9.473000 | 10.527000 | 9.493076 | 10.506924 | 10.020076 | 9.979924 | 45 | 51 |
| 10 | 30 | 9.473101 | 10.526899 | 9.493187 | 10.506813 | 10.020086 | 9.979914 | 30 | 50 |
| 11 | 45 | 9.473203 | 10.526797 | 9.493298 | 10.506702 | 10.020096 | 9.979904 | 15 | 49 |
| 12 | 18 | 9.473304 | 10.526696 | 9.493410 | 10.506590 | 10.020105 | 9.979895 | 42 | 48 |
| 13 | 15 | 9.473406 | 10.526594 | 9.493521 | 10.506479 | 10.020115 | 9.979885 | 45 | 47 |
| 14 | 30 | 9.473507 | 10.526493 | 9.493632 | 10.506368 | 10.020125 | 9.979875 | 30 | 46 |
| 15 | 45 | 9.473608 | 10.526392 | 9.493743 | 10.506257 | 10.020135 | 9.979865 | 15 | 45 |
| 16 | 19 | 9.473710 | 10.526290 | 9.493854 | 10.506146 | 10.020145 | 9.979855 | 41 | 44 |
| 17 | 15 | 9.473811 | 10.526189 | 9.493966 | 10.506034 | 10.020155 | 9.979845 | 45 | 43 |
| 18 | 30 | 9.473912 | 10.526088 | 9.494077 | 10.505923 | 10.020165 | 9.979835 | 30 | 42 |
| 19 | 45 | 9.474013 | 10.525987 | 9.494188 | 10.505812 | 10.020174 | 9.979826 | 15 | 41 |
| 20 | 20 | 9.474115 | 10.525885 | 9.494299 | 10.505701 | 10.020184 | 9.979816 | 40 | 40 |
| 21 | 15 | 9.474216 | 10.525784 | 9.494410 | 10.505590 | 10.020194 | 9.979806 | 45 | 39 |
| 22 | 30 | 9.474317 | 10.525683 | 9.494521 | 10.505479 | 10.020204 | 9.979796 | 30 | 38 |
| 23 | 45 | 9.474418 | 10.525582 | 9.494632 | 10.505368 | 10.020214 | 9.979786 | 15 | 37 |
| 24 | 21 | 9.474519 | 10.525481 | 9.494743 | 10.505257 | 10.020224 | 9.979776 | 39 | 36 |
| 25 | 15 | 9.474620 | 10.525380 | 9.494854 | 10.505146 | 10.020234 | 9.979766 | 45 | 35 |
| 26 | 30 | 9.474721 | 10.525279 | 9.494965 | 10.505035 | 10.020243 | 9.979757 | 30 | 34 |
| 27 | 45 | 9.474822 | 10.525178 | 9.495076 | 10.504924 | 10.020253 | 9.979747 | 15 | 33 |
| 28 | 22 | 9.474923 | 10.525077 | 9.495186 | 10.504814 | 10.020263 | 9.979737 | 38 | 32 |
| 29 | 15 | 9.475024 | 10.524976 | 9.495297 | 10.504703 | 10.020273 | 9.979727 | 45 | 31 |
| 30 | 30 | 9.475125 | 10.524875 | 9.495408 | 10.504592 | 10.020283 | 9.979717 | 30 | 30 |
| 31 | 45 | 9.475226 | 10.524774 | 9.495519 | 10.504481 | 10.020293 | 9.979707 | 15 | 29 |
| 32 | 23 | 9.475327 | 10.524673 | 9.495630 | 10.504370 | 10.020303 | 9.979697 | 37 | 28 |
| 33 | 15 | 9.475428 | 10.524572 | 9.495740 | 10.504260 | 10.020313 | 9.979687 | 45 | 27 |
| 34 | 30 | 9.475529 | 10.524471 | 9.495851 | 10.504149 | 10.020322 | 9.979678 | 30 | 26 |
| 35 | 45 | 9.475630 | 10.524370 | 9.495962 | 10.504038 | 10.020332 | 9.979668 | 15 | 25 |
| 36 | 24 | 9.475730 | 10.524270 | 9.496073 | 10.503927 | 10.020342 | 9.979658 | 36 | 24 |
| 37 | 15 | 9.475831 | 10.524169 | 9.496183 | 10.503817 | 10.020352 | 9.979648 | 45 | 23 |
| 38 | 30 | 9.475932 | 10.524068 | 9.496294 | 10.503706 | 10.020362 | 9.979638 | 30 | 22 |
| 39 | 45 | 9.476033 | 10.523967 | 9.496405 | 10.503595 | 10.020372 | 9.979628 | 15 | 21 |
| 40 | 25 | 9.476133 | 10.523867 | 9.496515 | 10.503485 | 10.020382 | 9.979618 | 35 | 20 |
| 41 | 15 | 9.476234 | 10.523766 | 9.496626 | 10.503374 | 10.020392 | 9.979608 | 45 | 19 |
| 42 | 30 | 9.476335 | 10.523665 | 9.496736 | 10.503264 | 10.020402 | 9.979598 | 30 | 18 |
| 43 | 45 | 9.476435 | 10.523565 | 9.496847 | 10.503153 | 10.020412 | 9.979588 | 15 | 17 |
| 44 | 26 | 9.476536 | 10.523464 | 9.496957 | 10.503043 | 10.020422 | 9.979578 | 34 | 16 |
| 45 | 15 | 9.476636 | 10.523364 | 9.497068 | 10.502932 | 10.020431 | 9.979569 | 45 | 15 |
| 46 | 30 | 9.476737 | 10.523263 | 9.497178 | 10.502822 | 10.020441 | 9.979559 | 30 | 14 |
| 47 | 45 | 9.476837 | 10.523163 | 9.497289 | 10.502711 | 10.020451 | 9.979549 | 15 | 13 |
| 48 | 27 | 9.476938 | 10.523062 | 9.497399 | 10.502601 | 10.020461 | 9.979539 | 33 | 12 |
| 49 | 15 | 9.477038 | 10.522962 | 9.497509 | 10.502491 | 10.020471 | 9.979529 | 45 | 11 |
| 50 | 30 | 9.477139 | 10.522861 | 9.497620 | 10.502380 | 10.020481 | 9.979519 | 30 | 10 |
| 51 | 45 | 9.477239 | 10.522761 | 9.497730 | 10.502270 | 10.020491 | 9.979509 | 15 | 9 |
| 52 | 28 | 9.477340 | 10.522660 | 9.497841 | 10.502159 | 10.020501 | 9.979499 | 32 | 8 |
| 53 | 15 | 9.477440 | 10.522560 | 9.497951 | 10.502049 | 10.020511 | 9.979489 | 45 | 7 |
| 54 | 30 | 9.477540 | 10.522460 | 9.498061 | 10.501939 | 10.020521 | 9.979479 | 30 | 6 |
| 55 | 45 | 9.477641 | 10.522359 | 9.498171 | 10.501829 | 10.020531 | 9.979469 | 15 | 5 |
| 56 | 29 | 9.477741 | 10.522259 | 9.498282 | 10.501718 | 10.020541 | 9.979459 | 31 | 4 |
| 57 | 15 | 9.477841 | 10.522159 | 9.498392 | 10.501608 | 10.020551 | 9.979449 | 45 | 3 |
| 58 | 30 | 9.477941 | 10.522059 | 9.498502 | 10.501498 | 10.020561 | 9.979439 | 30 | 2 |
| 59 | 45 | 9.478042 | 10.521958 | 9.498612 | 10.501388 | 10.020571 | 9.979429 | 15 | 1 |
| 60 | 30 | 9.478142 | 10.521858 | 9.498722 | 10.501278 | 10.020581 | 9.979419 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 50m. | | | LOG. SINES, &c. | | | | 72 deg. | | |

| | 1h 10m. | | LOG. SINES, &c. (t.) | | | 17 deg | | | |
|---|---|---|---|---|---|---|---|---|---|
| ″ | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.478142 | 10.521858 | 9.498722 | 10.501278 | 10.020581 | 9.979419 | 30 | 60 |
| 1 | 15 | 9.478242 | 10.521758 | 9.498832 | 10.501168 | 10.020591 | 9.979409 | 45 | 59 |
| 2 | 30 | 9.478342 | 10.521658 | 9.498942 | 10.501058 | 10.020600 | 9.979400 | 30 | 58 |
| 3 | 45 | 9.478442 | 10.521558 | 9.499053 | 10.500947 | 10.020610 | 9.979390 | 15 | 57 |
| 4 | 31 | 9.478542 | 10.521458 | 9.499163 | 10.500837 | 10.020620 | 9.979380 | 29 | 56 |
| 5 | 15 | 9.478642 | 10.521358 | 9.499273 | 10.500727 | 10.020630 | 9.979370 | 45 | 55 |
| 6 | 30 | 9.478742 | 10.521258 | 9.499383 | 10.500617 | 10.020640 | 9.979360 | 30 | 54 |
| 7 | 45 | 9.478842 | 10.521158 | 9.499493 | 10.500507 | 10.020650 | 9.979350 | 15 | 53 |
| 8 | 32 | 9.478942 | 10.521058 | 9.499603 | 10.500397 | 10.020660 | 9.979340 | 28 | 52 |
| 9 | 15 | 9.479042 | 10.520958 | 9.499712 | 10.500288 | 10.020670 | 9.979330 | 45 | 51 |
| 10 | 30 | 9.479142 | 10.520858 | 9.499822 | 10.500178 | 10.020680 | 9.979320 | 30 | 50 |
| 11 | 45 | 9.479242 | 10.520758 | 9.499932 | 10.500068 | 10.020690 | 9.979310 | 15 | 49 |
| 12 | 33 | 9.479342 | 10.520658 | 9.500042 | 10.499958 | 10.020700 | 9.979300 | 27 | 48 |
| 13 | 15 | 9.479442 | 10.520558 | 9.500152 | 10.499848 | 10.020710 | 9.979290 | 45 | 47 |
| 14 | 30 | 9.479542 | 10.520458 | 9.500262 | 10.499738 | 10.020720 | 9.979280 | 30 | 46 |
| 15 | 45 | 9.479642 | 10.520358 | 9.500372 | 10.499628 | 10.020730 | 9.979270 | 15 | 45 |
| 16 | 34 | 9.479741 | 10.520259 | 9.500481 | 10.499519 | 10.020740 | 9.979260 | 26 | 44 |
| 17 | 15 | 9.479841 | 10.520159 | 9.500591 | 10.499409 | 10.020750 | 9.979250 | 45 | 43 |
| 18 | 30 | 9.479941 | 10.520059 | 9.500701 | 10.499299 | 10.020760 | 9.979240 | 30 | 42 |
| 19 | 45 | 9.480040 | 10.519960 | 9.500811 | 10.499189 | 10.020770 | 9.979230 | 15 | 41 |
| 20 | 35 | 9.480140 | 10.519860 | 9.500920 | 10.499080 | 10.020780 | 9.979220 | 25 | 40 |
| 21 | 15 | 9.480240 | 10.519760 | 9.501030 | 10.498970 | 10.020790 | 9.979210 | 45 | 39 |
| 22 | 30 | 9.480339 | 10.519661 | 9.501140 | 10.498860 | 10.020800 | 9.979200 | 30 | 38 |
| 23 | 45 | 9.480439 | 10.519561 | 9.501249 | 10.498751 | 10.020810 | 9.979190 | 15 | 37 |
| 24 | 36 | 9.480538 | 10.519462 | 9.501359 | 10.498641 | 10.020820 | 9.979180 | 24 | 36 |
| 25 | 15 | 9.480638 | 10.519362 | 9.501468 | 10.498532 | 10.020830 | 9.979170 | 45 | 35 |
| 26 | 30 | 9.480738 | 10.519262 | 9.501578 | 10.498422 | 10.020840 | 9.979160 | 30 | 34 |
| 27 | 45 | 9.480837 | 10.519163 | 9.501687 | 10.498313 | 10.020850 | 9.979150 | 15 | 33 |
| 28 | 37 | 9.480937 | 10.519063 | 9.501797 | 10.498203 | 10.020860 | 9.979140 | 23 | 32 |
| 29 | 15 | 9.481036 | 10.518964 | 9.501906 | 10.498094 | 10.020870 | 9.979130 | 45 | 31 |
| 30 | 30 | 9.481135 | 10.518865 | 9.502016 | 10.497984 | 10.020880 | 9.979120 | 30 | 30 |
| 31 | 45 | 9.481235 | 10.518765 | 9.502125 | 10.497875 | 10.020890 | 9.979110 | 15 | 29 |
| 32 | 38 | 9.481334 | 10.518666 | 9.502235 | 10.497765 | 10.020900 | 9.979100 | 22 | 28 |
| 33 | 15 | 9.481434 | 10.518566 | 9.502344 | 10.497656 | 10.020911 | 9.979089 | 45 | 27 |
| 34 | 30 | 9.481533 | 10.518467 | 9.502453 | 10.497547 | 10.020921 | 9.979079 | 30 | 26 |
| 35 | 45 | 9.481632 | 10.518368 | 9.502563 | 10.497437 | 10.020931 | 9.979069 | 15 | 25 |
| 36 | 39 | 9.481731 | 10.518269 | 9.502672 | 10.497328 | 10.020941 | 9.979059 | 21 | 24 |
| 37 | 15 | 9.481831 | 10.518169 | 9.502781 | 10.497219 | 10.020951 | 9.979049 | 45 | 23 |
| 38 | 30 | 9.481930 | 10.518070 | 9.502891 | 10.497109 | 10.020961 | 9.979039 | 30 | 22 |
| 39 | 45 | 9.482029 | 10.517971 | 9.503000 | 10.497000 | 10.020971 | 9.979029 | 15 | 21 |
| 40 | 40 | 9.482128 | 10.517872 | 9.503109 | 10.496891 | 10.020981 | 9.979019 | 20 | 20 |
| 41 | 15 | 9.482227 | 10.517773 | 9.503218 | 10.496782 | 10.020991 | 9.979009 | 45 | 19 |
| 42 | 30 | 9.482327 | 10.517673 | 9.503328 | 10.496672 | 10.021001 | 9.978999 | 30 | 18 |
| 43 | 45 | 9.482426 | 10.517574 | 9.503437 | 10.496563 | 10.021011 | 9.978989 | 15 | 17 |
| 44 | 41 | 9.482525 | 10.517475 | 9.503546 | 10.496454 | 10.021021 | 9.978979 | 19 | 16 |
| 45 | 15 | 9.482624 | 10.517376 | 9.503655 | 10.496345 | 10.021031 | 9.978969 | 45 | 15 |
| 46 | 30 | 9.482723 | 10.517277 | 9.503764 | 10.496236 | 10.021041 | 9.978959 | 30 | 14 |
| 47 | 45 | 9.482822 | 10.517178 | 9.503873 | 10.496127 | 10.021051 | 9.978949 | 15 | 13 |
| 48 | 42 | 9.482921 | 10.517079 | 9.503982 | 10.496018 | 10.021061 | 9.978939 | 18 | 12 |
| 49 | 15 | 9.483020 | 10.516980 | 9.504091 | 10.495909 | 10.021072 | 9.978928 | 45 | 11 |
| 50 | 30 | 9.483119 | 10.516881 | 9.504200 | 10.495800 | 10.021082 | 9.978918 | 30 | 10 |
| 51 | 45 | 9.483218 | 10.516782 | 9.504309 | 10.495691 | 10.021092 | 9.978908 | 15 | 9 |
| 52 | 43 | 9.483316 | 10.516684 | 9.504418 | 10.495582 | 10.021102 | 9.978898 | 17 | 8 |
| 53 | 15 | 9.483415 | 10.516585 | 9.504527 | 10.495473 | 10.021112 | 9.978888 | 45 | 7 |
| 54 | 30 | 9.483514 | 10.516486 | 9.504636 | 10.495364 | 10.021122 | 9.978878 | 30 | 6 |
| 55 | 45 | 9.483613 | 10.516387 | 9.504745 | 10.495255 | 10.021132 | 9.978868 | 15 | 5 |
| 56 | 44 | 9.483712 | 10.516288 | 9.504854 | 10.495146 | 10.021142 | 9.978858 | 16 | 4 |
| 57 | 15 | 9.483810 | 10.516190 | 9.504963 | 10.495037 | 10.021152 | 9.978848 | 45 | 3 |
| 58 | 30 | 9.483909 | 10.516091 | 9.505071 | 10.494929 | 10.021162 | 9.978838 | 30 | 2 |
| 59 | 45 | 9.484008 | 10.515992 | 9.505180 | 10.494820 | 10.021172 | 9.978828 | 15 | 1 |
| 60 | 45 | 9.484107 | 10.515893 | 9.505289 | 10.494711 | 10.021183 | 9.978817 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 49m. | | LOG. SINES, &c. | | | | 72 deg. | | |

| 1h 11m. | | LOG. SINES, &c. (t) | | | | | | 17 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.484107 | 10.515893 | 9.505289 | 10.494711 | 10.021183 | 9.978817 | 15 | 60 |
| 1 | 15 | 9.484205 | 10.515795 | 9.505398 | 10.494602 | 10.021193 | 9.978807 | 45 | 59 |
| 2 | 30 | 9.484304 | 10.515696 | 9.505507 | 10.494493 | 10.021203 | 9.978797 | 30 | 58 |
| 3 | 45 | 9.484402 | 10.515598 | 9.505615 | 10.494385 | 10.021213 | 9.978787 | 15 | 57 |
| 4 | 46 | 9.484501 | 10.515499 | 9.505724 | 10.494276 | 10.021223 | 9.978777 | 14 | 56 |
| 5 | 15 | 9.484600 | 10.515400 | 9.505833 | 10.494167 | 10.021233 | 9.978767 | 45 | 55 |
| 6 | 30 | 9.484698 | 10.515302 | 9.505941 | 10.494059 | 10.021243 | 9.978757 | 30 | 54 |
| 7 | 45 | 9.484797 | 10.515203 | 9.506050 | 10.493950 | 10.021253 | 9.978747 | 15 | 53 |
| 8 | 47 | 9.484895 | 10.515105 | 9.506159 | 10.493841 | 10.021264 | 9.978736 | 13 | 52 |
| 9 | 15 | 9.484994 | 10.515006 | 9.506267 | 10.493733 | 10.021274 | 9.978726 | 45 | 51 |
| 10 | 30 | 9.485092 | 10.514908 | 9.506376 | 10.493624 | 10.021284 | 9.978716 | 30 | 50 |
| 11 | 45 | 9.485190 | 10.514810 | 9.506484 | 10.493516 | 10.021294 | 9.978706 | 15 | 49 |
| 12 | 48 | 9.485289 | 10.514711 | 9.506593 | 10.493407 | 10.021304 | 9.978696 | 12 | 48 |
| 13 | 15 | 9.485387 | 10.514613 | 9.506701 | 10.493299 | 10.021314 | 9.978686 | 45 | 47 |
| 14 | 30 | 9.485485 | 10.514515 | 9.506810 | 10.493190 | 10.021324 | 9.978676 | 30 | 46 |
| 15 | 45 | 9.485584 | 10.514416 | 9.506918 | 10.493082 | 10.021335 | 9.978665 | 15 | 45 |
| 16 | 49 | 9.485682 | 10.514318 | 9.507027 | 10.492973 | 10.021345 | 9.978655 | 11 | 44 |
| 17 | 15 | 9.485780 | 10.514220 | 9.507135 | 10.492865 | 10.021355 | 9.978645 | 45 | 43 |
| 18 | 30 | 9.485878 | 10.514122 | 9.507243 | 10.492757 | 10.021365 | 9.978635 | 30 | 42 |
| 19 | 45 | 9.485977 | 10.514023 | 9.507352 | 10.492648 | 10.021375 | 9.978625 | 15 | 41 |
| 20 | 50 | 9.486075 | 10.513925 | 9.507460 | 10.492540 | 10.021385 | 9.978615 | 10 | 40 |
| 21 | 15 | 9.486173 | 10.513827 | 9.507568 | 10.492432 | 10.021395 | 9.978605 | 45 | 39 |
| 22 | 30 | 9.486271 | 10.513729 | 9.507677 | 10.492323 | 10.021406 | 9.978594 | 30 | 38 |
| 23 | 45 | 9.486369 | 10.513631 | 9.507785 | 10.492215 | 10.021416 | 9.978584 | 15 | 37 |
| 24 | 51 | 9.486467 | 10.513533 | 9.507893 | 10.492107 | 10.021426 | 9.978574 | 9 | 36 |
| 25 | 15 | 9.486565 | 10.513435 | 9.508002 | 10.491998 | 10.021436 | 9.978564 | 45 | 35 |
| 26 | 30 | 9.486663 | 10.513337 | 9.508110 | 10.491890 | 10.021446 | 9.978554 | 30 | 34 |
| 27 | 45 | 9.486761 | 10.513239 | 9.508218 | 10.491782 | 10.021456 | 9.978544 | 15 | 33 |
| 28 | 52 | 9.486859 | 10.513141 | 9.508326 | 10.491674 | 10.021467 | 9.978533 | 8 | 32 |
| 29 | 15 | 9.486957 | 10.513043 | 9.508434 | 10.491566 | 10.021477 | 9.978523 | 45 | 31 |
| 30 | 30 | 9.487055 | 10.512945 | 9.508542 | 10.491458 | 10.021487 | 9.978513 | 30 | 30 |
| 31 | 45 | 9.487153 | 10.512847 | 9.508650 | 10.491350 | 10.021497 | 9.978503 | 15 | 29 |
| 32 | 53 | 9.487251 | 10.512749 | 9.508759 | 10.491241 | 10.021507 | 9.978493 | 7 | 28 |
| 33 | 15 | 9.487349 | 10.512651 | 9.508867 | 10.491133 | 10.021518 | 9.978482 | 45 | 27 |
| 34 | 30 | 9.487447 | 10.512553 | 9.508975 | 10.491025 | 10.021528 | 9.978472 | 30 | 26 |
| 35 | 45 | 9.487545 | 10.512455 | 9.509083 | 10.490917 | 10.021538 | 9.978462 | 15 | 25 |
| 36 | 54 | 9.487643 | 10.512357 | 9.509191 | 10.490809 | 10.021548 | 9.978452 | 6 | 24 |
| 37 | 15 | 9.487740 | 10.512260 | 9.509299 | 10.490701 | 10.021558 | 9.978442 | 45 | 23 |
| 38 | 30 | 9.487838 | 10.512162 | 9.509407 | 10.490593 | 10.021569 | 9.978431 | 30 | 22 |
| 39 | 45 | 9.487936 | 10.512064 | 9.509514 | 10.490486 | 10.021579 | 9.978421 | 15 | 21 |
| 40 | 55 | 9.488033 | 10.511967 | 9.509622 | 10.490378 | 10.021589 | 9.978411 | 5 | 20 |
| 41 | 15 | 9.488131 | 10.511869 | 9.509730 | 10.490270 | 10.021599 | 9.978401 | 45 | 19 |
| 42 | 30 | 9.488229 | 10.511771 | 9.509838 | 10.490162 | 10.021609 | 9.978391 | 30 | 18 |
| 43 | 45 | 9.488326 | 10.511674 | 9.509946 | 10.490054 | 10.021620 | 9.978380 | 15 | 17 |
| 44 | 56 | 9.488424 | 10.511576 | 9.510054 | 10.489946 | 10.021630 | 9.978370 | 4 | 16 |
| 45 | 15 | 9.488522 | 10.511478 | 9.510162 | 10.489838 | 10.021640 | 9.978360 | 45 | 15 |
| 46 | 30 | 9.488619 | 10.511381 | 9.510269 | 10.489731 | 10.021650 | 9.978350 | 30 | 14 |
| 47 | 45 | 9.488717 | 10.511283 | 9.510377 | 10.489623 | 10.021661 | 9.978339 | 15 | 13 |
| 48 | 57 | 9.488814 | 10.511186 | 9.510485 | 10.489515 | 10.021671 | 9.978329 | 3 | 12 |
| 49 | 15 | 9.488912 | 10.511088 | 9.510593 | 10.489407 | 10.021681 | 9.978319 | 45 | 11 |
| 50 | 30 | 9.489009 | 10.510991 | 9.510700 | 10.489300 | 10.021691 | 9.978309 | 30 | 10 |
| 51 | 45 | 9.489107 | 10.510893 | 9.510808 | 10.489192 | 10.021701 | 9.978299 | 15 | 9 |
| 52 | 58 | 9.489204 | 10.510796 | 9.510916 | 10.489084 | 10.021712 | 9.978288 | 2 | 8 |
| 53 | 15 | 9.489301 | 10.510699 | 9.511023 | 10.488977 | 10.021722 | 9.978278 | 45 | 7 |
| 54 | 30 | 9.489399 | 10.510601 | 9.511131 | 10.488869 | 10.021732 | 9.978268 | 30 | 6 |
| 55 | 45 | 9.489496 | 10.510504 | 9.511238 | 10.488762 | 10.021742 | 9.978258 | 15 | 5 |
| 56 | 59 | 9.489593 | 10.510407 | 9.511346 | 10.488654 | 10.021753 | 9.978247 | 1 | 4 |
| 57 | 15 | 9.489691 | 10.510309 | 9.511454 | 10.488546 | 10.021763 | 9.978237 | 45 | 3 |
| 58 | 30 | 9.489788 | 10.510212 | 9.511561 | 10.488439 | 10.021773 | 9.978227 | 30 | 2 |
| 59 | 45 | 9.489885 | 10.510115 | 9.511669 | 10.488331 | 10.021783 | 9.978217 | 15 | 1 |
| 60 | 60 | 9.489982 | 10.510018 | 9.511776 | 10.488224 | 10.021794 | 9.978206 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 48m. | | | | LOG. SINES, &c. | | | | 72 deg. | |

| 1h 12m. | | LOG. SINES, &c. (t.) | | | | | 18 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.489982 | 10.510018 | 9.511776 | 10.488224 | 10.021794 | 9.978206 | 60 | 60 |
| 1 | 15 | 9.490080 | 10.509920 | 9.511883 | 10.488117 | 10.021804 | 9.978196 | 45 | 59 |
| 2 | 30 | 9.490177 | 10.509823 | 9.511991 | 10.488009 | 10.021814 | 9.978186 | 30 | 58 |
| 3 | 45 | 9.490274 | 10.509726 | 9.512098 | 10.487902 | 10.021825 | 9.978175 | 15 | 57 |
| 4 | 1 | 9.490371 | 10.509629 | 9.512206 | 10.487794 | 10.021835 | 9.978165 | 59 | 56 |
| 5 | 15 | 9.490468 | 10.509532 | 9.512313 | 10.487687 | 10.021845 | 9.978155 | 45 | 55 |
| 6 | 30 | 9.490565 | 10.509435 | 9.512420 | 10.487580 | 10.021855 | 9.978145 | 30 | 54 |
| 7 | 45 | 9.490662 | 10.509338 | 9.512528 | 10.487472 | 10.021866 | 9.978134 | 15 | 53 |
| 8 | 2 | 9.490759 | 10.509241 | 9.512635 | 10.487365 | 10.021876 | 9.978124 | 58 | 52 |
| 9 | 15 | 9.490856 | 10.509144 | 9.512742 | 10.487258 | 10.021886 | 9.978114 | 45 | 51 |
| 10 | 30 | 9.490953 | 10.509047 | 9.512850 | 10.487150 | 10.021896 | 9.978104 | 30 | 50 |
| 11 | 45 | 9.491050 | 10.508950 | 9.512957 | 10.487043 | 10.021907 | 9.978093 | 15 | 49 |
| 12 | 3 | 9.491147 | 10.508853 | 9.513064 | 10.486936 | 10.021917 | 9.978083 | 57 | 48 |
| 13 | 15 | 9.491244 | 10.508756 | 9.513171 | 10.486829 | 10.021927 | 9.978073 | 45 | 47 |
| 14 | 30 | 9.491341 | 10.508659 | 9.513278 | 10.486722 | 10.021938 | 9.978062 | 30 | 46 |
| 15 | 45 | 9.491438 | 10.508562 | 9.513386 | 10.486614 | 10.021948 | 9.978052 | 15 | 45 |
| 16 | 4 | 9.491534 | 10.508466 | 9.513493 | 10.486507 | 10.021958 | 9.978042 | 56 | 44 |
| 17 | 15 | 9.491631 | 10.508369 | 9.513600 | 10.486400 | 10.021969 | 9.978031 | 45 | 43 |
| 18 | 30 | 9.491728 | 10.508272 | 9.513707 | 10.486293 | 10.021979 | 9.978021 | 30 | 42 |
| 19 | 45 | 9.491825 | 10.508175 | 9.513814 | 10.486186 | 10.021989 | 9.978011 | 15 | 41 |
| 20 | 5 | 9.491922 | 10.508078 | 9.513921 | 10.486079 | 10.021999 | 9.978001 | 55 | 40 |
| 21 | 15 | 9.492018 | 10.507982 | 9.514028 | 10.485972 | 10.022010 | 9.977990 | 45 | 39 |
| 22 | 30 | 9.492115 | 10.507885 | 9.514135 | 10.485865 | 10.022020 | 9.977980 | 30 | 38 |
| 23 | 45 | 9.492212 | 10.507788 | 9.514242 | 10.485758 | 10.022030 | 9.977970 | 15 | 37 |
| 24 | 6 | 9.492308 | 10.507692 | 9.514349 | 10.485651 | 10.022041 | 9.977959 | 54 | 36 |
| 25 | 15 | 9.492405 | 10.507595 | 9.514456 | 10.485544 | 10.022051 | 9.977949 | 45 | 35 |
| 26 | 30 | 9.492501 | 10.507499 | 9.514563 | 10.485437 | 10.022061 | 9.977939 | 30 | 34 |
| 27 | 45 | 9.492598 | 10.507402 | 9.514670 | 10.485330 | 10.022072 | 9.977928 | 15 | 33 |
| 28 | 7 | 9.492695 | 10.507305 | 9.514777 | 10.485223 | 10.022082 | 9.977918 | 53 | 32 |
| 29 | 15 | 9.492791 | 10.507209 | 9.514883 | 10.485117 | 10.022092 | 9.977908 | 45 | 31 |
| 30 | 30 | 9.492888 | 10.507112 | 9.514990 | 10.485010 | 10.022103 | 9.977897 | 30 | 30 |
| 31 | 45 | 9.492984 | 10.507016 | 9.515097 | 10.484903 | 10.022113 | 9.977887 | 15 | 29 |
| 32 | 8 | 9.493081 | 10.506919 | 9.515204 | 10.484796 | 10.022123 | 9.977877 | 52 | 28 |
| 33 | 15 | 9.493177 | 10.506823 | 9.515311 | 10.484689 | 10.022134 | 9.977866 | 45 | 27 |
| 34 | 30 | 9.493273 | 10.506727 | 9.515417 | 10.484583 | 10.022144 | 9.977856 | 30 | 26 |
| 35 | 45 | 9.493370 | 10.506630 | 9.515524 | 10.484476 | 10.022154 | 9.977846 | 15 | 25 |
| 36 | 9 | 9.493466 | 10.506534 | 9.515631 | 10.484369 | 10.022165 | 9.977835 | 51 | 24 |
| 37 | 15 | 9.493562 | 10.506438 | 9.515738 | 10.484262 | 10.022175 | 9.977825 | 45 | 23 |
| 38 | 30 | 9.493659 | 10.506341 | 9.515844 | 10.484156 | 10.022186 | 9.977814 | 30 | 22 |
| 39 | 45 | 9.493755 | 10.506245 | 9.515951 | 10.484049 | 10.022196 | 9.977804 | 15 | 21 |
| 40 | 10 | 9.493851 | 10.506149 | 9.516057 | 10.483943 | 10.022206 | 9.977794 | 50 | 20 |
| 41 | 15 | 9.493947 | 10.506053 | 9.516164 | 10.483836 | 10.022217 | 9.977783 | 45 | 19 |
| 42 | 30 | 9.494044 | 10.505956 | 9.516271 | 10.483729 | 10.022227 | 9.977773 | 30 | 18 |
| 43 | 45 | 9.494140 | 10.505860 | 9.516377 | 10.483623 | 10.022237 | 9.977763 | 15 | 17 |
| 44 | 11 | 9.494236 | 10.505764 | 9.516484 | 10.483516 | 10.022248 | 9.977752 | 49 | 16 |
| 45 | 15 | 9.494332 | 10.505668 | 9.516590 | 10.483410 | 10.022258 | 9.977742 | 45 | 15 |
| 46 | 30 | 9.494428 | 10.505572 | 9.516697 | 10.483303 | 10.022268 | 9.977732 | 30 | 14 |
| 47 | 45 | 9.494524 | 10.505476 | 9.516803 | 10.483197 | 10.022279 | 9.977721 | 15 | 13 |
| 48 | 12 | 9.494620 | 10.505380 | 9.516910 | 10.483090 | 10.022289 | 9.977711 | 48 | 12 |
| 49 | 15 | 9.494717 | 10.505283 | 9.517016 | 10.482984 | 10.022300 | 9.977700 | 45 | 11 |
| 50 | 30 | 9.494813 | 10.505187 | 9.517123 | 10.482877 | 10.022310 | 9.977690 | 30 | 10 |
| 51 | 45 | 9.494909 | 10.505091 | 9.517229 | 10.482771 | 10.022320 | 9.977680 | 15 | 9 |
| 52 | 13 | 9.495005 | 10.504995 | 9.517335 | 10.482665 | 10.022331 | 9.977669 | 47 | 8 |
| 53 | 15 | 9.495100 | 10.504900 | 9.517442 | 10.482558 | 10.022341 | 9.977659 | 45 | 7 |
| 54 | 30 | 9.495196 | 10.504804 | 9.517548 | 10.482452 | 10.022352 | 9.977648 | 30 | 6 |
| 55 | 45 | 9.495292 | 10.504708 | 9.517654 | 10.482346 | 10.022362 | 9.977638 | 15 | 5 |
| 56 | 14 | 9.495388 | 10.504612 | 9.517761 | 10.482239 | 10.022372 | 9.977628 | 46 | 4 |
| 57 | 15 | 9.495484 | 10.504516 | 9.517867 | 10.482133 | 10.022383 | 9.977617 | 45 | 3 |
| 58 | 30 | 9.495580 | 10.504420 | 9.517973 | 10.482027 | 10.022393 | 9.977607 | 30 | 2 |
| 59 | 45 | 9.495676 | 10.504324 | 9.518079 | 10.481921 | 10.022404 | 9.977596 | 15 | 1 |
| 60 | 15 | 9.495772 | 10.504228 | 9.518185 | 10.481815 | 10.022414 | 9.977586 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 47m. | | | | LOG. SINES, &c. | | | | 71 deg. | |

| sec. | 1h 13m. ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | LOG. SINES, &c. (t.) | | | | | | | 18 deg. | |
| 0 | 15 | 9.495772 | 10.504228 | 9.518185 | 10.481815 | 10.022414 | 9.977586 | 45 | 60 |
| 1 | 15 | 9.495867 | 10.504133 | 9.518292 | 10.481708 | 10.022424 | 9.977576 | 45 | 59 |
| 2 | 30 | 9.495963 | 10.504037 | 9.518398 | 10.481602 | 10.022435 | 9.977565 | 30 | 58 |
| 3 | 45 | 9.496059 | 10.503941 | 9.518504 | 10.481496 | 10.022445 | 9.977555 | 15 | 57 |
| 4 | 16 | 9.496154 | 10.503846 | 9.518610 | 10.481390 | 10.022456 | 9.977544 | 44 | 56 |
| 5 | 15 | 9.496250 | 10.503750 | 9.518716 | 10.481284 | 10 022466 | 9.977534 | 45 | 55 |
| 6 | 30 | 9.496346 | 10.503654 | 9.518822 | 10.481178 | 10.022477 | 9.977523 | 30 | 54 |
| 7 | 45 | 9.496441 | 10.503559 | 9.518928 | 10.481072 | 10.022487 | 9.977513 | 15 | 53 |
| 8 | 17 | 9.496537 | 10.503463 | 9.519034 | 10.480966 | 10.022497 | 9.977503 | 43 | 52 |
| 9 | 15 | 9.496633 | 10.503367 | 9.519140 | 10.480860 | 10.022508 | 9.977492 | 45 | 51 |
| 10 | 30 | 9.496728 | 10.503272 | 9.519246 | 10.480754 | 10.022518 | 9.977482 | 30 | 50 |
| 11 | 45 | 9.496824 | 10.503176 | 9.519352 | 10.480648 | 10.022529 | 9.977471 | 15 | 49 |
| 12 | 18 | 9.496919 | 10.503081 | 9.519458 | 10.480542 | 10.022539 | 9.977461 | 42 | 48 |
| 13 | 15 | 9.497015 | 10.502985 | 9.519564 | 10.480436 | 10.022550 | 9.977450 | 45 | 47 |
| 14 | 30 | 9.497110 | 10.502890 | 9.519670 | 10.480330 | 10.022560 | 9.977440 | 30 | 46 |
| 15 | 45 | 9.497206 | 10.502794 | 9.519776 | 10.480224 | 10.022571 | 9.977429 | 15 | 45 |
| 16 | 19 | 9.497301 | 10.502699 | 9.519882 | 10.480118 | 10.022581 | 9.977419 | 41 | 44 |
| 17 | 15 | 9.497396 | 10.502604 | 9.519988 | 10.480012 | 10.022591 | 9.977409 | 45 | 43 |
| 18 | 30 | 9.497492 | 10.502508 | 9.520094 | 10.479906 | 10.022602 | 9.977398 | 30 | 42 |
| 19 | 45 | 9.497587 | 10.502413 | 9.520199 | 10.479801 | 10.022612 | 9.977388 | 15 | 41 |
| 20 | 20 | 9.497682 | 10.502318 | 9.520305 | 10.479695 | 10.022623 | 9.977377 | 40 | 40 |
| 21 | 15 | 9.497778 | 10.502222 | 9.520411 | 10.479589 | 10.022633 | 9.977367 | 45 | 39 |
| 22 | 30 | 9.497873 | 10.502127 | 9.520517 | 10.479483 | 10.022644 | 9.977356 | 30 | 38 |
| 23 | 45 | 9.497968 | 10.502032 | 9.520622 | 10.479378 | 10.022654 | 9.977346 | 15 | 37 |
| 24 | 21 | 9.498063 | 10.501937 | 9.520728 | 10.479272 | 10.022665 | 9.977335 | 39 | 36 |
| 25 | 15 | 9.498159 | 10.501841 | 9.520834 | 10.479166 | 10.022675 | 9.977325 | 45 | 35 |
| 26 | 30 | 9.498254 | 10.501746 | 9.520939 | 10.479061 | 10.022686 | 9.977314 | 30 | 34 |
| 27 | 45 | 9.498349 | 10.501651 | 9.521045 | 10.478955 | 10.022696 | 9.977304 | 15 | 33 |
| 28 | 22 | 9.498444 | 10.501556 | 9.521151 | 10.478849 | 10.022707 | 9.977293 | 38 | 32 |
| 29 | 15 | 9.498539 | 10.501461 | 9.521256 | 10.478744 | 10.022717 | 9.977283 | 45 | 31 |
| 30 | 30 | 9.498634 | 10.501366 | 9.521362 | 10.478638 | 10.022728 | 9.977272 | 30 | 30 |
| 31 | 45 | 9.498729 | 10.501271 | 9.521467 | 10.478533 | 10.022738 | 9.977262 | 15 | 29 |
| 32 | 23 | 9.498824 | 10.501176 | 9.521573 | 10.478427 | 10.022749 | 9.977251 | 37 | 28 |
| 33 | 15 | 9.498919 | 10.501081 | 9.521679 | 10.478321 | 10.022759 | 9.977241 | 45 | 27 |
| 34 | 30 | 9.499014 | 10.500986 | 9.521784 | 10.478216 | 10.022770 | 9.977230 | 30 | 26 |
| 35 | 45 | 9.499109 | 10.500891 | 9.521889 | 10.478111 | 10.022780 | 9.977220 | 15 | 25 |
| 36 | 24 | 9.499204 | 10.500796 | 9.521995 | 10.478005 | 10.022791 | 9.977209 | 36 | 24 |
| 37 | 15 | 9.499299 | 10.500701 | 9.522100 | 10.477900 | 10.022801 | 9.977199 | 45 | 23 |
| 38 | 30 | 9.499394 | 10.500606 | 9.522206 | 10.477794 | 10.022812 | 9.977188 | 30 | 22 |
| 39 | 45 | 9.499489 | 10.500511 | 9.522311 | 10.477689 | 10.022822 | 9.977178 | 15 | 21 |
| 40 | 25 | 9.499584 | 10.500416 | 9.522417 | 10.477583 | 10.022833 | 9.977167 | 35 | 20 |
| 41 | 15 | 9.499679 | 10.500321 | 9.522522 | 10.477478 | 10.022843 | 9.977157 | 45 | 19 |
| 42 | 30 | 9.499774 | 10.500226 | 9.522627 | 10.477373 | 10.022854 | 9.977146 | 30 | 18 |
| 43 | 45 | 9.499868 | 10.500132 | 9.522733 | 10.477267 | 10.022864 | 9.977136 | 15 | 17 |
| 44 | 26 | 9.499963 | 10.500037 | 9.522838 | 10.477162 | 10.022875 | 9.977125 | 34 | 16 |
| 45 | 15 | 9.500058 | 10.499942 | 9.522943 | 10.477057 | 10.022885 | 9.977115 | 45 | 15 |
| 46 | 30 | 9.500153 | 10.499847 | 9.523048 | 10.476952 | 10.022896 | 9.977104 | 30 | 14 |
| 47 | 45 | 9.500247 | 10.499753 | 9.523154 | 10.476846 | 10.022906 | 9.977094 | 15 | 13 |
| 48 | 27 | 9.500342 | 10.499658 | 9.523259 | 10.476741 | 10.022917 | 9.977083 | 33 | 12 |
| 49 | 15 | 9.500437 | 10.499563 | 9.523364 | 10.476636 | 10.022927 | 9.977073 | 45 | 11 |
| 50 | 30 | 9.500531 | 10.499469 | 9.523469 | 10.476531 | 10.022938 | 9.977062 | 30 | 10 |
| 51 | 45 | 9.500626 | 10.499374 | 9.523574 | 10.476426 | 10.022948 | 9.977052 | 15 | 9 |
| 52 | 28 | 9.500721 | 10.499279 | 9.523679 | 10.476321 | 10.022959 | 9.977041 | 32 | 8 |
| 53 | 15 | 9.500815 | 10.499185 | 9.523785 | 10.476215 | 10.022970 | 9.977030 | 45 | 7 |
| 54 | 30 | 9.500910 | 10.499090 | 9.523890 | 10.476110 | 10.022980 | 9.977020 | 30 | 6 |
| 55 | 45 | 9.501004 | 10.498996 | 9.523995 | 10.476005 | 10.022991 | 9.977009 | 15 | 5 |
| 56 | 29 | 9.501099 | 10.498901 | 9.524100 | 10.475900 | 10.023001 | 9.976999 | 31 | 4 |
| 57 | 15 | 9.501193 | 10.498807 | 9.524205 | 10.475795 | 10.023012 | 9.976988 | 45 | 3 |
| 58 | 30 | 9.501288 | 10.498712 | 9.524310 | 10.475690 | 10.023022 | 9.976978 | 30 | 2 |
| 59 | 45 | 9.501382 | 10.498618 | 9.524415 | 10.475585 | 10.023033 | 9.976967 | 15 | 1 |
| 60 | 30 | 9.501476 | 10.498524 | 9.524520 | 10.475480 | 10.023043 | 9.976957 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 46m. | | | LOG. SINES, &c. | | | | 71 deg. | |

| 1h 14m. | | LOG. SINES, &c. (t.) | | | | | 18 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.501476 | 10.498524 | 9.524520 | 10.475480 | 10.023043 | 9.976957 | 30 | 60 |
| 1 | 15 | 9.501571 | 10.498429 | 9.524625 | 10.475375 | 10.023054 | 9.976946 | 45 | 59 |
| 2 | 30 | 9.501665 | 10.498335 | 9.524730 | 10.475270 | 10.023065 | 9.976935 | 30 | 58 |
| 3 | 45 | 9.501759 | 10.498241 | 9.524836 | 10.475165 | 10.023075 | 9.976925 | 15 | 57 |
| 4 | 31 | 9.501854 | 10.498146 | 9.524939 | 10.475061 | 10.023086 | 9.976914 | 29 | 56 |
| 5 | 15 | 9.501948 | 10.498052 | 9.525044 | 10.474956 | 10.023096 | 9.976904 | 45 | 55 |
| 6 | 30 | 9.502042 | 10.497958 | 9.525149 | 10.474851 | 10.023107 | 9.976893 | 30 | 54 |
| 7 | 45 | 9.502137 | 10.497863 | 9.525254 | 10.474746 | 10.023118 | 9.976882 | 15 | 53 |
| 8 | 32 | 9.502231 | 10.497769 | 9.525359 | 10.474641 | 10.023128 | 9.976872 | 28 | 52 |
| 9 | 15 | 9.502325 | 10.497675 | 9.525464 | 10.474536 | 10.023139 | 9.976861 | 45 | 51 |
| 10 | 30 | 9.502419 | 10.497581 | 9.525568 | 10.474432 | 10.023149 | 9.976851 | 30 | 50 |
| 11 | 45 | 9.502513 | 10.497487 | 9.525673 | 10.474327 | 10.023160 | 9.976840 | 15 | 49 |
| 12 | 33 | 9.502607 | 10.497393 | 9.525778 | 10.474222 | 10.023170 | 9.976830 | 27 | 48 |
| 13 | 15 | 9.502702 | 10.497298 | 9.525883 | 10.474117 | 10.023181 | 9.976819 | 45 | 47 |
| 14 | 30 | 9.502796 | 10.497204 | 9.525987 | 10.474013 | 10.023192 | 9.976808 | 30 | 46 |
| 15 | 45 | 9.502890 | 10.497110 | 9.526092 | 10.473908 | 10.023202 | 9.976798 | 15 | 45 |
| 16 | 34 | 9.502984 | 10.497016 | 9.526197 | 10.473803 | 10.023213 | 9.976787 | 26 | 44 |
| 17 | 15 | 9.503078 | 10.496922 | 9.526301 | 10.473699 | 10.023223 | 9.976777 | 45 | 43 |
| 18 | 30 | 9.503172 | 10.496828 | 9.526406 | 10.473594 | 10.023234 | 9.976766 | 30 | 42 |
| 19 | 45 | 9.503266 | 10.496734 | 9.526510 | 10.473490 | 10.023245 | 9.976755 | 15 | 41 |
| 20 | 35 | 9.503360 | 10.496640 | 9.526615 | 10.473385 | 10.023255 | 9.976745 | 25 | 40 |
| 21 | 15 | 9.503454 | 10.496546 | 9.526719 | 10.473281 | 10.023266 | 9.976734 | 45 | 39 |
| 22 | 30 | 9.503547 | 10.496453 | 9.526824 | 10.473176 | 10.023277 | 9.976723 | 30 | 38 |
| 23 | 45 | 9.503641 | 10.496359 | 9.526929 | 10.473071 | 10.023287 | 9.976713 | 15 | 37 |
| 24 | 36 | 9.503735 | 10.496265 | 9.527033 | 10.472967 | 10.023298 | 9.976702 | 24 | 36 |
| 25 | 15 | 9.503829 | 10.496171 | 9.527137 | 10.472863 | 10.023308 | 9.976692 | 45 | 35 |
| 26 | 30 | 9.503923 | 10.496077 | 9.527242 | 10.472758 | 10.023319 | 9.976681 | 30 | 34 |
| 27 | 45 | 9.504017 | 10.495983 | 9.527346 | 10.472654 | 10.023330 | 9.976670 | 15 | 33 |
| 28 | 37 | 9.504110 | 10.495890 | 9.527451 | 10.472549 | 10.023340 | 9.976660 | 23 | 32 |
| 29 | 15 | 9.504204 | 10.495796 | 9.527555 | 10.472445 | 10.023351 | 9.976649 | 45 | 31 |
| 30 | 30 | 9.504298 | 10.495702 | 9.527659 | 10.472341 | 10.023362 | 9.976638 | 30 | 30 |
| 31 | 45 | 9.504392 | 10.495608 | 9.527764 | 10.472236 | 10.023372 | 9.976628 | 15 | 29 |
| 32 | 38 | 9.504485 | 10.495515 | 9.527868 | 10 472132 | 10.023383 | 9.976617 | 22 | 28 |
| 33 | 15 | 9.504579 | 10.495421 | 9.527972 | 10.472028 | 10.023394 | 9.976606 | 45 | 27 |
| 34 | 30 | 9.504673 | 10.495327 | 9.528077 | 10.471923 | 10.023404 | 9.976596 | 30 | 26 |
| 35 | 45 | 9.504766 | 10.495234 | 9.528181 | 10 471819 | 10.023415 | 9.976585 | 15 | 25 |
| 36 | 39 | 9.504860 | 10.495140 | 9.528285 | 10.471715 | 10.023426 | 9.976574 | 21 | 24 |
| 37 | 15 | 9.504953 | 10.495047 | 9.528389 | 10.471611 | 10.023436 | 9.976564 | 45 | 23 |
| 38 | 30 | 9.505047 | 10.494953 | 9.528494 | 10.471506 | 10.023447 | 9.976553 | 30 | 22 |
| 39 | 45 | 9.505140 | 10.494860 | 9.528598 | 10.471402 | 10.023458 | 9.976542 | 15 | 21 |
| 40 | 40 | 9.505234 | 10.494766 | 9.528702 | 10.471298 | 10.023468 | 9.976532 | 20 | 20 |
| 41 | 15 | 9.505327 | 10.494673 | 9.528806 | 10.471194 | 10.023479 | 9.976521 | 45 | 19 |
| 42 | 30 | 9.505421 | 10.494579 | 9.528910 | 10.471090 | 10.023490 | 9.976510 | 30 | 18 |
| 43 | 45 | 9.505514 | 10.494486 | 9.529014 | 10.470986 | 10.023500 | 9.976500 | 15 | 17 |
| 44 | 41 | 9.505608 | 10.494392 | 9.529119 | 10.470881 | 10.023511 | 9.976489 | 19 | 16 |
| 45 | 15 | 9.505701 | 10.494299 | 9 529223 | 10.470777 | 10.023522 | 9.976478 | 45 | 15 |
| 46 | 30 | 9.505794 | 10.494206 | 9.529327 | 10.470673 | 10.023532 | 9.976468 | 30 | 14 |
| 47 | 45 | 9.505888 | 10.494112 | 9.529431 | 10.470569 | 10.023543 | 9.976457 | 15 | 13 |
| 48 | 42 | 9.505981 | 10.494019 | 9.529535 | 10.470465 | 10.023554 | 9.976446 | 18 | 12 |
| 49 | 15 | 9.506074 | 10.493926 | 9.529639 | 10.470361 | 10.023564 | 9.976436 | 45 | 11 |
| 50 | 30 | 9.506168 | 10.493832 | 9.529743 | 10.470257 | 10.023575 | 9.976425 | 30 | 10 |
| 51 | 45 | 9.506261 | 10.493739 | 9.529847 | 10.470153 | 10.023586 | 9.976414 | 15 | 9 |
| 52 | 43 | 9.506354 | 10.493646 | 9.529950 | 10.470050 | 10.023596 | 9.976404 | 17 | 8 |
| 53 | 15 | 9.506447 | 10.493553 | 9.530054 | 10.469946 | 10.023607 | 9.976393 | 45 | 7 |
| 54 | 30 | 9.506541 | 10.493459 | 9.530158 | 10.469842 | 10.023618 | 9.976382 | 30 | 6 |
| 55 | 45 | 9.506634 | 10.493366 | 9.530262 | 10.469738 | 10.023629 | 9.976371 | 15 | 5 |
| 56 | 44 | 9.506727 | 10.493273 | 9.530366 | 10.469634 | 10.023639 | 9.976361 | 16 | 4 |
| 57 | 15 | 9.506820 | 10.493180 | 9.530470 | 10.469530 | 10.023650 | 9.976350 | 45 | 3 |
| 58 | 30 | 9.506913 | 10.493087 | 9.530574 | 10.469426 | 10.023661 | 9.976339 | 30 | 2 |
| 59 | 45 | 9.507006 | 10.492994 | 9.530677 | 10.469323 | 10.023671 | 9.976329 | 15 | 1 |
| 60 | 45 | 9.507099 | 10.492901 | 9.530781 | 10.469219 | 10.023682 | 9.976318 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 45m. | | | LOG. SINES, &c. | | | | | 71 deg. | |

| 1h 15m. | | LOG. SINES, &c. (t.) | | | | | 18 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.507099 | 10.492901 | 9.530781 | 10.469219 | 10.023682 | 9 976318 | 15 | 60 |
| 1 | 15 | 9.507192 | 10.492808 | 9.530885 | 10.469115 | 10.023693 | 9.976307 | 45 | 59 |
| 2 | 30 | 9.507285 | 10.492715 | 9.530989 | 10.469011 | 10.023704 | 9.976296 | 30 | 58 |
| 3 | 45 | 9.507378 | 10.492622 | 9.531092 | 10.468908 | 10.023714 | 9.976286 | 15 | 57 |
| 4 | 46 | 9.507471 | 10.492529 | 9.531196 | 10.468804 | 10.023725 | 9.976275 | 14 | 56 |
| 5 | 15 | 9.507564 | 10.492436 | 9.531300 | 10.468700 | 10.023736 | 9.976264 | 45 | 55 |
| 6 | 30 | 9.507657 | 10.492343 | 9.531403 | 10.468597 | 10.023746 | 9.976254 | 30 | 54 |
| 7 | 45 | 9.507750 | 10.492250 | 9.531507 | 10.468493 | 10.023757 | 9.976243 | 15 | 53 |
| 8 | 47 | 9.507843 | 10.492157 | 9.531611 | 10.468389 | 10.023768 | 9.976232 | 13 | 52 |
| 9 | 15 | 9.507936 | 10.492064 | 9.531714 | 10.468286 | 10.023779 | 9.976221 | 45 | 51 |
| 10 | 30 | 9.508028 | 10.491972 | 9.531818 | 10.468182 | 10.023789 | 9.976211 | 30 | 50 |
| 11 | 45 | 9.508121 | 10.491879 | 9.531921 | 10.468079 | 10.023800 | 9.976200 | 15 | 49 |
| 12 | 48 | 9.508214 | 10.491786 | 9.532025 | 10.467975 | 10.023811 | 9.976189 | 12 | 48 |
| 13 | 15 | 9.508307 | 10.491693 | 9.532128 | 10.467872 | 10.023822 | 9.976178 | 45 | 47 |
| 14 | 30 | 9.508400 | 10.491600 | 9.532232 | 10.467768 | 10.023832 | 9.976168 | 30 | 46 |
| 15 | 45 | 9 508492 | 10.491508 | 9.532335 | 10.467665 | 10.023843 | 9.976157 | 15 | 45 |
| 16 | 49 | 9.508585 | 10.491415 | 9.532439 | 10.467561 | 10.023854 | 9.976146 | 11 | 44 |
| 17 | 15 | 9.508678 | 10.491322 | 9.532542 | 10.467458 | 10.023865 | 9.976135 | 45 | 43 |
| 18 | 30 | 9.508770 | 10.491230 | 9.532646 | 10.467354 | 10.023876 | 9.976124 | 30 | 42 |
| 19 | 45 | 9.508863 | 10.491137 | 9.532749 | 10.467251 | 10.023886 | 9.976114 | 15 | 41 |
| 20 | 50 | 9.508956 | 10.491044 | 9.532853 | 10.467147 | 10.023897 | 9.976103 | 10 | 40 |
| 21 | 15 | 9.509048 | 10.490952 | 9.532956 | 10.467044 | 10.023908 | 9.976092 | 45 | 39 |
| 22 | 30 | 9.509141 | 10.490859 | 9.533059 | 10.466941 | 10.023919 | 9.976081 | 30 | 38 |
| 23 | 45 | 9.509233 | 10.490767 | 9.533163 | 10.466837 | 10.023929 | 9.976071 | 15 | 37 |
| 24 | 51 | 9.509326 | 10 490674 | 9.533266 | 10.466734 | 10.023940 | 9.976060 | 9 | 36 |
| 25 | 15 | 9.509418 | 10.490582 | 9.533369 | 10.466631 | 10.023951 | 9.976049 | 45 | 35 |
| 26 | 30 | 9.509511 | 10.490489 | 9.533472 | 10.466528 | 10.023962 | 9.976038 | 30 | 34 |
| 27 | 45 | 9.509603 | 10.490397 | 9.533576 | 10.466424 | 10.023973 | 9.976027 | 15 | 33 |
| 28 | 52 | 9.509696 | 10.490304 | 9.533679 | 10.466321 | 10.023983 | 9.976017 | 8 | 32 |
| 29 | 15 | 9.509788 | 10.490212 | 9.533782 | 10.466218 | 10.023994 | 9.976006 | 45 | 31 |
| 30 | 30 | 9.509880 | 10 490120 | 9.533885 | 10.466115 | 10.024005 | 9.975995 | 30 | 30 |
| 31 | 45 | 9.509973 | 10.490027 | 9.533988 | 10.466012 | 10.024016 | 9.975984 | 15 | 29 |
| 32 | 53 | 9.510065 | 10.489935 | 9.534092 | 10.465908 | 10.024026 | 9.975974 | 7 | 28 |
| 33 | 15 | 9.510157 | 10.489843 | 9.534195 | 10.465805 | 10.024037 | 9.975963 | 45 | 27 |
| 34 | 30 | 9.510250 | 10.489750 | 9.534298 | 10.465702 | 10.024048 | 9.975952 | 30 | 26 |
| 35 | 45 | 9.510342 | 10.489658 | 9.534401 | 10.465599 | 10.024059 | 9.975941 | 15 | 25 |
| 36 | 54 | 9.510434 | 10.489566 | 9.534504 | 10.465496 | 10.024070 | 9.975930 | 6 | 24 |
| 37 | 15 | 9.510526 | 10.489474 | 9.534607 | 10.465393 | 10.024081 | 9.975919 | 45 | 23 |
| 38 | 30 | 9.510619 | 10.489381 | 9.534710 | 10.465290 | 10.024091 | 9.975909 | 30 | 22 |
| 39 | 45 | 9.510711 | 10.489289 | 9.534813 | 10.465187 | 10.024102 | 9.975898 | 15 | 21 |
| 40 | 55 | 9.510803 | 10.489197 | 9.534916 | 10.465084 | 10.024113 | 9.975887 | 5 | 20 |
| 41 | 15 | 9.510895 | 10.489105 | 9.535019 | 10.464981 | 10.024124 | 9.975876 | 45 | 19 |
| 42 | 30 | 9.510987 | 10.489013 | 9.535122 | 10.464878 | 10.024135 | 9.975865 | 30 | 18 |
| 43 | 45 | 9.511079 | 10.488921 | 9.535225 | 10.464775 | 10.024145 | 9.975855 | 15 | 17 |
| 44 | 56 | 9.511172 | 10.488828 | 9.535328 | 10.464672 | 10.024156 | 9.975844 | 4 | 16 |
| 45 | 15 | 9.511264 | 10.488736 | 9.535431 | 10.464569 | 10.024167 | 9.975833 | 45 | 15 |
| 46 | 30 | 9.511356 | 10.488644 | 9.535534 | 10.464466 | 10.024178 | 9.975822 | 30 | 14 |
| 47 | 45 | 9.511448 | 10.488552 | 9.535636 | 10.464364 | 10.024189 | 9.975811 | 15 | 13 |
| 48 | 57 | 9.511540 | 10.488460 | 9.535739 | 10.464261 | 10.024200 | 9.975800 | 3 | 12 |
| 49 | 15 | 9.511632 | 10.488368 | 9.535842 | 10 464158 | 10.024211 | 9.975789 | 45 | 11 |
| 50 | 30 | 9.511724 | 10.488276 | 9.535945 | 10.464055 | 10.024221 | 9.975779 | 30 | 10 |
| 51 | 45 | 9.511815 | 10.488185 | 9.536048 | 10 463952 | 10.024232 | 9.975768 | 15 | 9 |
| 52 | 58 | 9.511907 | 10.488093 | 9.536150 | 10 463850 | 10.024243 | 9.975757 | 2 | 8 |
| 53 | 15 | 9.511999 | 10.488001 | 9.536253 | 10 463747 | 10.024254 | 9.975746 | 45 | 7 |
| 54 | 30 | 9.512091 | 10.487909 | 9.536356 | 10 463644 | 10.024265 | 9.975735 | 30 | 6 |
| 55 | 45 | 9.512183 | 10.487817 | 9.536459 | 10.463541 | 10.024276 | 9.975724 | 15 | 5 |
| 56 | 59 | 9.512275 | 10.487725 | 9.536561 | 10.463439 | 10.024287 | 9.975713 | 1 | 4 |
| 57 | 15 | 9.512367 | 10.487633 | 9.536664 | 10.463336 | 10.024297 | 9.975703 | 45 | 3 |
| 58 | 30 | 9.512458 | 10.487542 | 9.536767 | 10.463233 | 10.024308 | 9.975692 | 30 | 2 |
| 59 | 45 | 9.512550 | 10.487450 | 9.536869 | 10.463131 | 10.024319 | 9.975681 | 15 | 1 |
| 60 | 60 | 9.512642 | 10.487358 | 9.536972 | 10.463028 | 10.024330 | 9.975670 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ ″ | sec. |
| 4h 44m. | | | LOG. SINES, &c. | | | | | 71 deg. | |

| . | 1h 16m. | | LOG. SINES, &c. (t.) | | | 19 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.512642 | 10.487358 | 9.536972 | 10.463028 | 10.024330 | 9.975670 | 60 | 60 |
| 1 | 15 | 9.512734 | 10.487266 | 9.537074 | 10.462926 | 10.024341 | 9.975659 | 45 | 59 |
| 2 | 30 | 9.512825 | 10.487175 | 9.537177 | 10.462823 | 10.024352 | 9.975648 | 30 | 58 |
| 3 | 45 | 9.512917 | 10.487083 | 9.537280 | 10.462720 | 10.024363 | 9.975637 | 15 | 57 |
| 4 | 1 | 9.513009 | 10.486991 | 9.537382 | 10.462618 | 10.024374 | 9.975626 | 59 | 56 |
| 5 | 15 | 9.513100 | 10.486900 | 9.537485 | 10.462515 | 10.024384 | 9.975616 | 45 | 55 |
| 6 | 30 | 9.513192 | 10.486808 | 9.537587 | 10.462413 | 10.024395 | 9.975605 | 30 | 54 |
| 7 | 45 | 9.513283 | 10.486717 | 9.537690 | 10.462310 | 10.024406 | 9.975594 | 15 | 53 |
| 8 | 2 | 9.513375 | 10.486625 | 9.537792 | 10.462208 | 10.024417 | 9.975583 | 58 | 52 |
| 9 | 15 | 9.513466 | 10.486534 | 9.537894 | 10.462106 | 10.024428 | 9.975572 | 45 | 51 |
| 10 | 30 | 9.513558 | 10.486442 | 9.537997 | 10.462003 | 10.024439 | 9.975561 | 30 | 50 |
| 11 | 45 | 9.513650 | 10.486350 | 9.538099 | 10.461901 | 10.024450 | 9.975550 | 15 | 49 |
| 12 | 3 | 9.513741 | 10.486259 | 9.538202 | 10.461798 | 10.024461 | 9.975539 | 57 | 48 |
| 13 | 15 | 9.513832 | 10.486168 | 9.538304 | 10.461696 | 10.024472 | 9.975528 | 45 | 47 |
| 14 | 30 | 9.513924 | 10.486076 | 9.538406 | 10.461594 | 10.024482 | 9.975518 | 30 | 46 |
| 15 | 45 | 9.514015 | 10.485985 | 9.538509 | 10.461491 | 10.024493 | 9.975507 | 15 | 45 |
| 16 | 4 | 9.514107 | 10.485893 | 9.538611 | 10.461389 | 10.024504 | 9.975496 | 56 | 44 |
| 17 | 15 | 9.514198 | 10.485802 | 9.538713 | 10.461287 | 10.024515 | 9.975485 | 45 | 43 |
| 18 | 30 | 9.514289 | 10.485711 | 9.538815 | 10.461185 | 10.024526 | 9.975474 | 30 | 42 |
| 19 | 45 | 9.514381 | 10.485619 | 9.538918 | 10.461082 | 10.024537 | 9.975463 | 15 | 41 |
| 20 | 5 | 9.514472 | 10.485528 | 9.539020 | 10.460980 | 10.024548 | 9.975452 | 55 | 40 |
| 21 | 15 | 9.514563 | 10.485437 | 9.539122 | 10.460878 | 10.024559 | 9.975441 | 45 | 39 |
| 22 | 30 | 9.514655 | 10.485345 | 9.539224 | 10.460776 | 10.024570 | 9.975430 | 30 | 38 |
| 23 | 45 | 9.514746 | 10.485254 | 9.539327 | 10.460673 | 10.024581 | 9.975419 | 15 | 37 |
| 24 | 6 | 9.514837 | 10.485163 | 9.539429 | 10.460571 | 10.024592 | 9.975408 | 54 | 36 |
| 25 | 15 | 9.514928 | 10.485072 | 9.539531 | 10.460469 | 10.024603 | 9.975397 | 45 | 35 |
| 26 | 30 | 9.515019 | 10.484981 | 9.539633 | 10.460367 | 10.024614 | 9.975386 | 30 | 34 |
| 27 | 45 | 9.515111 | 10.484889 | 9.539735 | 10.460265 | 10.024625 | 9.975375 | 15 | 33 |
| 28 | 7 | 9.515202 | 10.484798 | 9.539837 | 10.460163 | 10.024635 | 9.975365 | 53 | 32 |
| 29 | 15 | 9.515293 | 10.484707 | 9.539939 | 10.460061 | 10.024646 | 9.975354 | 45 | 31 |
| 30 | 30 | 9.515384 | 10.484616 | 9.540041 | 10.459959 | 10.024657 | 9.975343 | 30 | 30 |
| 31 | 45 | 9.515475 | 10.484525 | 9.540143 | 10.459857 | 10.024668 | 9.975332 | 15 | 29 |
| 32 | 8 | 9.515566 | 10.484434 | 9.540245 | 10.459755 | 10.024679 | 9.975321 | 52 | 28 |
| 33 | 15 | 9.515657 | 10.484343 | 9.540347 | 10.459653 | 10.024690 | 9.975310 | 45 | 27 |
| 34 | 30 | 9.515748 | 10.484252 | 9.540449 | 10.459551 | 10.024701 | 9.975299 | 30 | 26 |
| 35 | 45 | 9.515839 | 10.484161 | 9.540551 | 10.459449 | 10.024712 | 9.975288 | 15 | 25 |
| 36 | 9 | 9.515930 | 10.484070 | 9.540653 | 10.459347 | 10.024723 | 9.975277 | 51 | 24 |
| 37 | 15 | 9.516021 | 10.483979 | 9.540755 | 10.459245 | 10.024734 | 9.975266 | 45 | 23 |
| 38 | 30 | 9.516112 | 10.483888 | 9.540857 | 10.459143 | 10.024745 | 9.975255 | 30 | 22 |
| 39 | 45 | 9.516203 | 10.483797 | 9.540959 | 10.459041 | 10.024756 | 9.975244 | 15 | 21 |
| 40 | 10 | 9.516294 | 10.483706 | 9.541061 | 10.458939 | 10.024767 | 9.975233 | 50 | 20 |
| 41 | 15 | 9.516384 | 10.483616 | 9.541162 | 10.458838 | 10.024778 | 9.975222 | 45 | 19 |
| 42 | 30 | 9.516475 | 10.483525 | 9.541264 | 10.458736 | 10.024789 | 9.975211 | 30 | 18 |
| 43 | 45 | 9.516566 | 10.483434 | 9.541366 | 10.458634 | 10.024800 | 9.975200 | 15 | 17 |
| 44 | 11 | 9.516657 | 10.483343 | 9.541468 | 10.458532 | 10.024811 | 9.975189 | 49 | 16 |
| 45 | 15 | 9.516748 | 10.483252 | 9.541570 | 10.458430 | 10.024822 | 9.975178 | 45 | 15 |
| 46 | 30 | 9.516838 | 10.483162 | 9.541671 | 10.458329 | 10.024833 | 9.975167 | 30 | 14 |
| 47 | 45 | 9.516929 | 10.483071 | 9.541773 | 10.458227 | 10.024844 | 9.975156 | 15 | 13 |
| 48 | 12 | 9.517020 | 10.482980 | 9.541875 | 10.458125 | 10.024855 | 9.975145 | 48 | 12 |
| 49 | 15 | 9.517110 | 10.482890 | 9.541976 | 10.458024 | 10.024866 | 9.975134 | 45 | 11 |
| 50 | 30 | 9.517201 | 10.482799 | 9.542078 | 10.457922 | 10.024877 | 9.975123 | 30 | 10 |
| 51 | 45 | 9.517292 | 10.482708 | 9.542180 | 10.457820 | 10.024888 | 9.975112 | 15 | 9 |
| 52 | 13 | 9.517382 | 10.482618 | 9.542281 | 10.457719 | 10.024899 | 9.975101 | 47 | 8 |
| 53 | 15 | 9.517473 | 10.482527 | 9.542383 | 10.457617 | 10.024910 | 9.975090 | 45 | 7 |
| 54 | 30 | 9.517564 | 10.482436 | 9.542484 | 10.457516 | 10.024921 | 9.975079 | 30 | 6 |
| 55 | 45 | 9.517654 | 10.482346 | 9.542586 | 10.457414 | 10.024932 | 9.975068 | 15 | 5 |
| 56 | 14 | 9.517745 | 10.482255 | 9.542688 | 10.457312 | 10.024943 | 9.975057 | 46 | 4 |
| 57 | 15 | 9.517835 | 10.482165 | 9.542789 | 10.457211 | 10.024954 | 9.975046 | 45 | 3 |
| 58 | 30 | 9.517926 | 10.482074 | 9.542891 | 10.457109 | 10.024965 | 9.975035 | 30 | 2 |
| 59 | 45 | 9.518016 | 10.481984 | 9.542992 | 10.457008 | 10.024976 | 9.975024 | 15 | 1 |
| 60 | 15 | 9.518107 | 10.481893 | 9.543094 | 10.456906 | 10.024987 | 9.975013 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 43m. | | LOG. SINES, &c. | | | | 70 deg. | | |

| 1h 17m. | | LOG. SINES, &c. (t.) | | | | | | 19 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.518107 | 10.481893 | 9.543094 | 10.456906 | 10.024987 | 9.975013 | 45 | 60 |
| 1 | 15 | 9.518197 | 10.481803 | 9.543195 | 10.456805 | 10.024998 | 9.975002 | 45 | 59 |
| 2 | 30 | 9.518287 | 10.481713 | 9.543297 | 10.456703 | 10.025009 | 9 974991 | 30 | 58 |
| 3 | 45 | 9.518378 | 10.481622 | 9.543398 | 10.456602 | 10.025020 | 9.974980 | 15 | 57 |
| 4 | 16 | 9.518468 | 10 481532 | 9.543499 | 10.456501 | 10.025031 | 9.974969 | 44 | 56 |
| 5 | 15 | 9.518559 | 10.481441 | 9.543601 | 10.456399 | 10 025042 | 9.974958 | 45 | 55 |
| 6 | 30 | 9.518649 | 10.481351 | 9.543702 | 10.456298 | 10.025053 | 9.974947 | 30 | 54 |
| 7 | 45 | 9.518739 | 10.481261 | 9.543803 | 10.456197 | 10.025064 | 9.974936 | 15 | 53 |
| 8 | 17 | 9.518829 | 10.481171 | 9.543905 | 10.456095 | 10.025075 | 9.974925 | 43 | 52 |
| 9 | 15 | 9.518920 | 10.481080 | 9.544006 | 10.455994 | 10.025086 | 9.974914 | 45 | 51 |
| 10 | 30 | 9.519010 | 10.480990 | 9.544107 | 10.455893 | 10.025098 | 9 974902 | 30 | 50 |
| 11 | 45 | 9.519100 | 10.480900 | 9.544209 | 10.455791 | 10.025109 | 9.974891 | 15 | 49 |
| 12 | 18 | 9.519190 | 10.480810 | 9.544310 | 10.455690 | 10.025120 | 9.974880 | 42 | 48 |
| 13 | 15 | 9.519281 | 10.480719 | 9.544411 | 10.455589 | 10.025131 | 9.974869 | 45 | 47 |
| 14 | 30 | 9.519371 | 10.480629 | 9.544512 | 10.455488 | 10.025142 | 9.974858 | 30 | 46 |
| 15 | 45 | 9.519461 | 10.480539 | 9.544614 | 10.455386 | 10.025153 | 9.974847 | 15 | 45 |
| 16 | 19 | 9.519551 | 10.480449 | 9.544715 | 10.455285 | 10.025164 | 9.974836 | 41 | 44 |
| 17 | 15 | 9.519641 | 10.480359 | 9.544816 | 10.455184 | 10.025175 | 9.974825 | 45 | 43 |
| 18 | 30 | 9.519731 | 10.480269 | 9 544917 | 10.455083 | 10.025186 | 9.974814 | 30 | 42 |
| 19 | 45 | 9.519821 | 10.480179 | 9.545018 | 10.454982 | 10.025197 | 9.974803 | 15 | 41 |
| 20 | 20 | 9.519911 | 10.480089 | 9.545119 | 10.454881 | 10.025208 | 9.974792 | 40 | 40 |
| 21 | 15 | 9.520001 | 10.479999 | 9.545220 | 10.454780 | 10.025219 | 9.974781 | 45 | 39 |
| 22 | 30 | 9.520091 | 10.479909 | 9.545321 | 10.454679 | 10.025230 | 9.974770 | 30 | 38 |
| 23 | 45 | 9.520181 | 10.479819 | 9.545423 | 10.454577 | 10.025241 | 9.974759 | 15 | 37 |
| 24 | 21 | 9.520271 | 10.479729 | 9.545524 | 10.454476 | 10.025253 | 9.974747 | 39 | 36 |
| 25 | 15 | 9.520361 | 10.479639 | 9.545625 | 10.454375 | 10.025264 | 9.974736 | 45 | 35 |
| 26 | 30 | 9.520451 | 10.479549 | 9.545726 | 10.454274 | 10.025275 | 9 974725 | 30 | 34 |
| 27 | 45 | 9.520541 | 10.479459 | 9.545827 | 10.454173 | 10.025286 | 9.974714 | 15 | 33 |
| 28 | 22 | 9.520631 | 10.479369 | 9.545928 | 10.454072 | 10.025297 | 9.974703 | 38 | 32 |
| 29 | 15 | 9.520720 | 10.479280 | 9.546028 | 10.453972 | 10.025308 | 9.974692 | 45 | 31 |
| 30 | 30 | 9.520810 | 10.479190 | 9.546129 | 10.453871 | 10.025319 | 9.974681 | 30 | 30 |
| 31 | 45 | 9.520900 | 10.479100 | 9.546230 | 10.453770 | 10.025330 | 9.974670 | 15 | 29 |
| 32 | 23 | 9 520990 | 10.479010 | 9.546331 | 10.453669 | 10.025341 | 9.974659 | 37 | 28 |
| 33 | 15 | 9.521080 | 10.478920 | 9.546432 | 10.453568 | 10.025352 | 9.974648 | 45 | 27 |
| 34 | 30 | 9.521169 | 10.478831 | 9.546533 | 10.453467 | 10.025364 | 9.974636 | 30 | 26 |
| 35 | 45 | 9.521259 | 10.478741 | 9.546634 | 10.453366 | 10.025375 | 9.974625 | 15 | 25 |
| 36 | 24 | 9.521349 | 10.478651 | 9.546735 | 10.453265 | 10.025386 | 9.974614 | 36 | 24 |
| 37 | 15 | 9.521438 | 10.478562 | 9.546835 | 10.453165 | 10.025397 | 9.974603 | 45 | 23 |
| 38 | 30 | 9 521528 | 10.478472 | 9.546936 | 10.453064 | 10.025408 | 9.974592 | 30 | 22 |
| 39 | 45 | 9.521618 | 10.478382 | 9.547037 | 10.452963 | 10.025419 | 9.974581 | 15 | 21 |
| 40 | 25 | 9.521707 | 10.478293 | 9.547138 | 10.452862 | 10.025430 | 9.974570 | 35 | 20 |
| 41 | 15 | 9.521797 | 10.478203 | 9.547238 | 10.452762 | 10.025441 | 9.974559 | 45 | 19 |
| 42 | 30 | 9.521886 | 10.478114 | 9.547339 | 10.452661 | 10.025453 | 9.974547 | 30 | 18 |
| 43 | 45 | 9.521976 | 10.478024 | 9.547440 | 10.452560 | 10.025464 | 9.974536 | 15 | 17 |
| 44 | 26 | 9.522066 | 10.477934 | 9.547540 | 10.452460 | 10.025475 | 9.974525 | 34 | 16 |
| 45 | 15 | 9.522155 | 10.477845 | 9.547641 | 10.452359 | 10.025486 | 9.974514 | 45 | 15 |
| 46 | 30 | 9.522245 | 10.477755 | 9.547742 | 10.452258 | 10.025497 | 9.974503 | 30 | 14 |
| 47 | 45 | 9.522334 | 10.477666 | 9.547842 | 10.452158 | 10.025508 | 9.974492 | 15 | 13 |
| 48 | 27 | 9.522423 | 10.477577 | 9.547943 | 10.452057 | 10.025519 | 9.974481 | 33 | 12 |
| 49 | 15 | 9.522513 | 10.477487 | 9.548043 | 10.451957 | 10.025531 | 9.974469 | 45 | 11 |
| 50 | 30 | 9.522602 | 10.477398 | 9.548144 | 10.451856 | 10.025542 | 9.974458 | 30 | 10 |
| 51 | 45 | 9.522692 | 10.477308 | 9.548245 | 10.451755 | 10.025553 | 9.974447 | 15 | 9 |
| 52 | 28 | 9.522781 | 10.477219 | 9.548345 | 10.451655 | 10.025564 | 9.974436 | 32 | 8 |
| 53 | 15 | 9.522870 | 10.477130 | 9.548446 | 10.451554 | 10.025575 | 9.974425 | 45 | 7 |
| 54 | 30 | 9.522960 | 10.477040 | 9.548546 | 10.451454 | 10.025586 | 9.974414 | 30 | 6 |
| 55 | 45 | 9.523049 | 10.476951 | 9.548647 | 10.451353 | 10.025598 | 9.974402 | 15 | 5 |
| 56 | 29 | 9.523138 | 10.476862 | 9.548747 | 10.451253 | 10 025609 | 9.974391 | 31 | 4 |
| 57 | 15 | 9.523228 | 10.476772 | 9.548847 | 10.451153 | 10.025620 | 9.974380 | 45 | 3 |
| 58 | 30 | 9.523317 | 10.476683 | 9.548948 | 10.451052 | 10.025631 | 9.974369 | 30 | 2 |
| 59 | 45 | 9.523406 | 10.476594 | 9.549048 | 10.450952 | 10.025642 | 9.974358 | 15 | 1 |
| 60 | 30 | 9.523495 | 10.476505 | 9.549149 | 10.450851 | 10.025653 | 9.974347 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine | ″ ′ | sec |

| 4h 42m. | LOG. SINES, &c. | 70 deg. |
|---|---|---|

| 1h 18m. | | LOG. SINES, &c. (t.) | | | | | 19 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.523495 | 10.476505 | 9.549149 | 10.450851 | 10.025653 | 9.974347 | 30 | 60 |
| 1 | 15 | 9.523584 | 10.476416 | 9.549249 | 10.450751 | 10.025665 | 9.974335 | 45 | 59 |
| 2 | 30 | 9.523674 | 10.476326 | 9.549349 | 10.450651 | 10.025676 | 9.974324 | 30 | 58 |
| 3 | 45 | 9.523763 | 10.476237 | 9.549450 | 10.450550 | 10.025687 | 9.974313 | 15 | 57 |
| 4 | 31 | 9.523852 | 10.476148 | 9.549550 | 10.450450 | 10.025698 | 9.974302 | 29 | 56 |
| 5 | 15 | 9.523941 | 10.476059 | 9.549650 | 10.450350 | 10.025709 | 9.974291 | 45 | 55 |
| 6 | 30 | 9.524030 | 10.475970 | 9.549751 | 10.450249 | 10.025721 | 9.974279 | 30 | 54 |
| 7 | 45 | 9.524119 | 10.475881 | 9.549851 | 10.450149 | 10.025732 | 9.974268 | 15 | 53 |
| 8 | 32 | 9.524208 | 10.475792 | 9.549951 | 10.450049 | 10.025743 | 9.974257 | 28 | 52 |
| 9 | 15 | 9.524297 | 10.475703 | 9.550051 | 10.449949 | 10.025754 | 9.974246 | 45 | 51 |
| 10 | 30 | 9.524386 | 10.475614 | 9.550151 | 10.449849 | 10.025765 | 9.974235 | 30 | 50 |
| 11 | 45 | 9.524475 | 10.475525 | 9.550252 | 10.449748 | 10.025777 | 9.974223 | 15 | 49 |
| 12 | 33 | 9.524564 | 10.475436 | 9.550352 | 10.449648 | 10.025788 | 9.974212 | 27 | 48 |
| 13 | 15 | 9.524653 | 10.475347 | 9.550452 | 10.449548 | 10.025799 | 9.974201 | 45 | 47 |
| 14 | 30 | 9.524742 | 10.475258 | 9.550552 | 10.449448 | 10.025810 | 9.974190 | 30 | 46 |
| 15 | 45 | 9.524831 | 10.475169 | 9.550652 | 10.449348 | 10 025822 | 9.974178 | 15 | 45 |
| 16 | 34 | 9.524920 | 10.475080 | 9.550752 | 10.449248 | 10.025833 | 9.974167 | 26 | 44 |
| 17 | 15 | 9.525008 | 10.474992 | 9.550852 | 10.449148 | 10.025844 | 9.974156 | 45 | 43 |
| 18 | 30 | 9.525097 | 10.474903 | 9.550952 | 10.449048 | 10.025855 | 9.974145 | 30 | 42 |
| 19 | 45 | 9.525186 | 10.474814 | 9.551052 | 10.448948 | 10.025866 | 9.974134 | 15 | 41 |
| 20 | 35 | 9.525275 | 10.474725 | 9.551152 | 10.448848 | 10.025878 | 9.974122 | 25 | 40 |
| 21 | 15 | 9.525364 | 10.474636 | 9.551252 | 10.448748 | 10.025889 | 9 974111 | 45 | 39 |
| 22 | 30 | 9.525452 | 10.474548 | 9.551352 | 10.448648 | 10.025900 | 9.974100 | 30 | 38 |
| 23 | 45 | 9.525541 | 10.474459 | 9.551452 | 10.448548 | 10.025911 | 9.974089 | 15 | 37 |
| 24 | 36 | 9.525630 | 10.474370 | 9.551552 | 10.448448 | 10.025923 | 9.974077 | 24 | 36 |
| 25 | 15 | 9.525718 | 10.474282 | 9.551652 | 10.448348 | 10.025934 | 9.974066 | 45 | 35 |
| 26 | 30 | 9.525807 | 10.474193 | 9.551752 | 10.448248 | 10.025945 | 9.974055 | 30 | 34 |
| 27 | 45 | 9.525896 | 10.474104 | 9.551852 | 10.448148 | 10.025956 | 9.974044 | 15 | 33 |
| 28 | 37 | 9.525984 | 10.474016 | 9.551952 | 10.448048 | 10.025968 | 9.974032 | 23 | 32 |
| 29 | 15 | 9.526073 | 10.473927 | 9.552052 | 10.447948 | 10.025979 | 9.974021 | 45 | 31 |
| 30 | 30 | 9.526162 | 10.473838 | 9.552152 | 10.447848 | 10.025990 | 9.974010 | 30 | 30 |
| 31 | 45 | 9.526250 | 10.473750 | 9.552252 | 10.447748 | 10.026001 | 9.973999 | 15 | 29 |
| 32 | 38 | 9.526339 | 10.473661 | 9.552351 | 10.447649 | 10.026013 | 9.973987 | 22 | 28 |
| 33 | 15 | 9.526427 | 10.473573 | 9.552451 | 10.447549 | 10.026024 | 9.973976 | 45 | 27 |
| 34 | 30 | 9.526516 | 10.473484 | 9.552551 | 10.447449 | 10.026035 | 9.973965 | 30 | 26 |
| 35 | 45 | 9.526604 | 10.473396 | 9.552651 | 10.447349 | 10.026047 | 9.973953 | 15 | 25 |
| 36 | 39 | 9.526693 | 10.473307 | 9.552750 | 10.447250 | 10.026058 | 9.973942 | 21 | 24 |
| 37 | 15 | 9.526781 | 10.473219 | 9.552850 | 10.447150 | 10.026069 | 9.973931 | 45 | 23 |
| 38 | 30 | 9.526870 | 10.473130 | 9.552950 | 10.447050 | 10.026080 | 9.973920 | 30 | 22 |
| 39 | 45 | 9.526958 | 10.473042 | 9.553050 | 10.446950 | 10.026092 | 9.973908 | 15 | 21 |
| 40 | 40 | 9.527046 | 10.472954 | 9.553149 | 10.446851 | 10.026103 | 9.973897 | 20 | 20 |
| 41 | 15 | 9.527135 | 10.472865 | 9.553249 | 10.446751 | 10.026114 | 9.973886 | 45 | 19 |
| 42 | 30 | 9.527223 | 10.472777 | 9.553348 | 10.446652 | 10.026126 | 9.973874 | 30 | 18 |
| 43 | 45 | 9.527311 | 10.472689 | 9.553448 | 10.446552 | 10.026137 | 9.973863 | 15 | 17 |
| 44 | 41 | 9.527400 | 10.472600 | 9.553548 | 10.446452 | 10.026148 | 9.973852 | 19 | 16 |
| 45 | 15 | 9.527488 | 10.472512 | 9.553647 | 10.446353 | 10.026159 | 9.973841 | 45 | 15 |
| 46 | 30 | 9.527576 | 10.472424 | 9.553747 | 10.446253 | 10.026171 | 9.973829 | 30 | 14 |
| 47 | 45 | 9.527664 | 10.472336 | 9.553846 | 10.446154 | 10.026182 | 9.973818 | 15 | 13 |
| 48 | 42 | 9.527753 | 10.472247 | 9.553946 | 10.446054 | 10.026193 | 9.973807 | 18 | 12 |
| 49 | 15 | 9.527841 | 10.472159 | 9.554045 | 10.445955 | 10.026205 | 9.973795 | 45 | 11 |
| 50 | 30 | 9.527929 | 10.472071 | 9.554145 | 10.445855 | 10.026216 | 9.973784 | 30 | 10 |
| 51 | 45 | 9.528017 | 10.471983 | 9.554244 | 10.445756 | 10.026227 | 9.973773 | 15 | 9 |
| 52 | 43 | 9.528105 | 10.471895 | 9.554344 | 10.445656 | 10.026239 | 9.973761 | 17 | 8 |
| 53 | 15 | 9.528193 | 10.471807 | 9.554443 | 10.445557 | 10.026250 | 9.973750 | 45 | 7 |
| 54 | 30 | 9.528281 | 10.471719 | 9.554543 | 10.445457 | 10.026261 | 9.973739 | 30 | 6 |
| 55 | 45 | 9.528370 | 10.471630 | 9.554642 | 10.445358 | 10.026273 | 9.973727 | 15 | 5 |
| 56 | 44 | 9.528458 | 10.471542 | 9.554741 | 10.445259 | 10.026284 | 9.973716 | 16 | 4 |
| 57 | 15 | 9.528546 | 10.471454 | 9.554841 | 10.445159 | 10.026295 | 9.973705 | 45 | 3 |
| 58 | 30 | 9.528634 | 10.471366 | 9.554940 | 10.445060 | 10.026307 | 9.973693 | 30 | 2 |
| 59 | 45 | 9.528722 | 10.471278 | 9.555039 | 10.444961 | 10.026318 | 9.973682 | 15 | 1 |
| 60 | 45 | 9.528810 | 10.471190 | 9.555139 | 10.444861 | 10.026329 | 9.973671 | 15 | 0 |
| — | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 41m. | | | LOG. SINES, &c. | | | | | 70 deg. | |

| $1^h$ $19^m$. | | | LOG. SINES, &c. (t.) | | | | 19 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine | ″ ′ | sec. |
| 0 | 45 | 9.528810 | 10.471190 | 9.555139 | 10.444861 | 10.026329 | 9.973671 | 15 | 60 |
| 1 | 15 | 9.528898 | 10.471102 | 9.555238 | 10.444762 | 10.026341 | 9.973659 | 45 | 59 |
| 2 | 30 | 9.528986 | 10.471014 | 9.555337 | 10.444663 | 10.026352 | 9.973648 | 30 | 58 |
| 3 | 45 | 9.529073 | 10.470927 | 9.555437 | 10.444563 | 10.026363 | 9.973637 | 15 | 57 |
| 4 | 46 | 9.529161 | 10.470839 | 9.555536 | 10.444464 | 10.026375 | 9.973625 | 14 | 56 |
| 5 | 15 | 9.529249 | 10.470751 | 9.555635 | 10.444365 | 10.026386 | 9.973614 | 45 | 55 |
| 6 | 30 | 9.529337 | 10.470663 | 9.555734 | 10.444266 | 10.026397 | 9.973603 | 30 | 54 |
| 7 | 45 | 9.529425 | 10.470575 | 9.555833 | 10.444167 | 10.026409 | 9.973591 | 15 | 53 |
| 8 | 47 | 9.529513 | 10.470487 | 9.555933 | 10.444067 | 10.026420 | 9.973580 | 13 | 52 |
| 9 | 15 | 9.529601 | 10.470399 | 9.556032 | 10.443968 | 10.026431 | 9.973569 | 45 | 51 |
| 10 | 30 | 9.529688 | 10.470312 | 9.556131 | 10.443869 | 10.026443 | 9.973557 | 30 | 50 |
| 11 | 45 | 9.529776 | 10.470224 | 9.556230 | 10.443770 | 10.026454 | 9.973546 | 15 | 49 |
| 12 | 48 | 9.529864 | 10.470136 | 9.556329 | 10.443671 | 10.026465 | 9.973535 | 12 | 48 |
| 13 | 15 | 9.529951 | 10.470049 | 9.556428 | 10.443572 | 10.026477 | 9.973523 | 45 | 47 |
| 14 | 30 | 9.530039 | 10.469961 | 9.556527 | 10.443473 | 10.026488 | 9.973512 | 30 | 46 |
| 15 | 45 | 9.530127 | 10.469873 | 9.556626 | 10.443374 | 10.026500 | 9.973500 | 15 | 45 |
| 16 | 49 | 9.530215 | 10.469785 | 9.556725 | 10.443275 | 10.026511 | 9.973489 | 11 | 44 |
| 17 | 15 | 9.530302 | 10.469698 | 9.556824 | 10.443176 | 10.026522 | 9.973478 | 45 | 43 |
| 18 | 30 | 9.530390 | 10.469610 | 9.556923 | 10.443077 | 10.026534 | 9.973466 | 30 | 42 |
| 19 | 45 | 9.530477 | 10.469523 | 9.557022 | 10.442978 | 10.026545 | 9.973455 | 15 | 41 |
| 20 | 50 | 9.530565 | 10.469435 | 9.557121 | 10.442879 | 10.026557 | 9.973443 | 10 | 40 |
| 21 | 15 | 9.530652 | 10.469348 | 9.557220 | 10.442780 | 10.026568 | 9.973432 | 45 | 39 |
| 22 | 30 | 9.530740 | 10.469260 | 9.557319 | 10.442681 | 10.026579 | 9.973421 | 30 | 38 |
| 23 | 45 | 9.530828 | 10.469172 | 9.557418 | 10.442582 | 10.026591 | 9.973409 | 15 | 37 |
| 24 | 51 | 9.530915 | 10.469085 | 9.557517 | 10.442483 | 10.026602 | 9.973398 | 9 | 36 |
| 25 | 15 | 9.531002 | 10.468998 | 9.557616 | 10.442384 | 10.026613 | 9.973387 | 45 | 35 |
| 26 | 30 | 9.531090 | 10.468910 | 9.557715 | 10.442285 | 10.026625 | 9.973375 | 30 | 34 |
| 27 | 45 | 9.531177 | 10.468823 | 9.557814 | 10.442186 | 10.026636 | 9.973364 | 15 | 33 |
| 28 | 52 | 9.531265 | 10.468735 | 9.557912 | 10.442088 | 10.026648 | 9.973352 | 8 | 32 |
| 29 | 15 | 9.531352 | 10.468648 | 9.558011 | 10.441989 | 10.026659 | 9.973341 | 45 | 31 |
| 30 | 30 | 9.531440 | 10.468560 | 9.558110 | 10.441890 | 10.026671 | 9.973329 | 30 | 30 |
| 31 | 45 | 9.531527 | 10.468473 | 9.558209 | 10.441791 | 10.026682 | 9.973318 | 15 | 29 |
| 32 | 53 | 9.531614 | 10.468386 | 9.558308 | 10.441692 | 10.026693 | 9.973307 | 7 | 28 |
| 33 | 15 | 9.531702 | 10.468298 | 9.558406 | 10.441594 | 10.026705 | 9.973295 | 45 | 27 |
| 34 | 30 | 9.531789 | 10.468211 | 9.558505 | 10.441495 | 10.026716 | 9.973284 | 30 | 26 |
| 35 | 45 | 9.531876 | 10.468124 | 9.558604 | 10.441396 | 10.026728 | 9.973272 | 15 | 25 |
| 36 | 54 | 9.531963 | 10.468037 | 9.558702 | 10.441298 | 10.026739 | 9.973261 | 6 | 24 |
| 37 | 15 | 9.532051 | 10.467949 | 9.558801 | 10.441199 | 10.026751 | 9.973249 | 45 | 23 |
| 38 | 30 | 9.532138 | 10.467862 | 9.558900 | 10.441100 | 10.026762 | 9.973236 | 30 | 22 |
| 39 | 45 | 9.532225 | 10.467775 | 9.558998 | 10.441002 | 10.026773 | 9.973227 | 15 | 21 |
| 40 | 55 | 9.532312 | 10.467688 | 9.559097 | 10.440903 | 10.026785 | 9.973215 | 5 | 20 |
| 41 | 15 | 9.532399 | 10.467601 | 9.559196 | 10.440804 | 10.026796 | 9.973204 | 45 | 19 |
| 42 | 30 | 9.532487 | 10.467513 | 9.559294 | 10.440706 | 10.026808 | 9.973192 | 30 | 18 |
| 43 | 45 | 9.532574 | 10.467426 | 9.559393 | 10.440607 | 10.026819 | 9.973181 | 15 | 17 |
| 44 | 56 | 9.532661 | 10.467339 | 9.559491 | 10.440509 | 10.026831 | 9.973169 | 4 | 16 |
| 45 | 15 | 9.532748 | 10.467252 | 9.559590 | 10.440410 | 10.026842 | 9.973158 | 45 | 15 |
| 46 | 30 | 9.532835 | 10.467165 | 9.559688 | 10.440312 | 10.026854 | 9.973146 | 30 | 14 |
| 47 | 45 | 9.532922 | 10.467078 | 9.559787 | 10.440213 | 10.026865 | 9.973135 | 15 | 13 |
| 48 | 57 | 9.533009 | 10.466991 | 9.559885 | 10.440115 | 10.026876 | 9.973124 | 3 | 12 |
| 49 | 15 | 9.533096 | 10.466904 | 9.559984 | 10.440016 | 10.026888 | 9.973112 | 45 | 11 |
| 50 | 30 | 9.533183 | 10.466817 | 9.560082 | 10.439918 | 10.026899 | 9.973101 | 30 | 10 |
| 51 | 45 | 9.533270 | 10.466730 | 9.560181 | 10.439819 | 10.026911 | 9.973089 | 15 | 9 |
| 52 | 58 | 9.533357 | 10.466643 | 9.560279 | 10.439721 | 10.026922 | 9.973078 | 2 | 8 |
| 53 | 15 | 9.533444 | 10.466556 | 9.560378 | 10.439622 | 10.026934 | 9.973066 | 45 | 7 |
| 54 | 30 | 9.533531 | 10.466469 | 9.560476 | 10.439524 | 10.026945 | 9.973055 | 30 | 6 |
| 55 | 45 | 9.533618 | 10.466382 | 9.560574 | 10.439426 | 10.026957 | 9.973043 | 15 | 5 |
| 56 | 59 | 9.533704 | 10.466296 | 9.560673 | 10.439327 | 10.026968 | 9.973032 | 1 | 4 |
| 57 | 15 | 9.533791 | 10.466209 | 9.560771 | 10.439229 | 10.026980 | 9.973020 | 45 | 3 |
| 58 | 30 | 9.533878 | 10.466122 | 9.560869 | 10.439131 | 10.026991 | 9.973009 | 30 | 2 |
| 59 | 45 | 9.533965 | 10.466035 | 9.560968 | 10.439032 | 10.027003 | 9.972997 | 15 | 1 |
| 60 | 60 | 9.534052 | 10.465948 | 9.561066 | 10.438934 | 10.027014 | 9.972986 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| $4^h$ $40^m$ | | | LOG. SINES, &c. | | | | 70 deg. | | |

| 1h 20m | | | LOG. SINES, &c. (t.) | | | | 20 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.534052 | 10.465948 | 9.561066 | 10.438934 | 10.027014 | 9.972986 | 60 | 60 |
| 1 | 15 | 9.534138 | 10.465862 | 9.561164 | 10.438836 | 10.027026 | 9.972974 | 45 | 59 |
| 2 | 30 | 9.534225 | 10.465775 | 9.561262 | 10.438738 | 10.027037 | 9.972963 | 30 | 58 |
| 3 | 45 | 9.534312 | 10.465688 | 9.561361 | 10.438639 | 10.027049 | 9.972951 | 15 | 57 |
| 4 | 1 | 9.534399 | 10.465601 | 9.561459 | 10.438541 | 10.027060 | 9.972940 | 59 | 56 |
| 5 | 15 | 9.534485 | 10.465515 | 9.561557 | 10.438443 | 10.027072 | 9.972928 | 45 | 55 |
| 6 | 30 | 9.534572 | 10.465428 | 9.561655 | 10.438345 | 10.027083 | 9.972917 | 30 | 54 |
| 7 | 45 | 9.534659 | 10.465341 | 9.561753 | 10.438247 | 10.027095 | 9.972905 | 15 | 53 |
| 8 | 2 | 9.534745 | 10.465255 | 9.561851 | 10.438149 | 10.027106 | 9.972894 | 58 | 52 |
| 9 | 15 | 9.534832 | 10.465168 | 9.561950 | 10.438050 | 10.027118 | 9.972882 | 45 | 51 |
| 10 | 30 | 9.534918 | 10.465082 | 9.562048 | 10.437952 | 10.027129 | 9.972871 | 30 | 50 |
| 11 | 45 | 9.535005 | 10.464995 | 9.562146 | 10.437854 | 10.027141 | 9.972859 | 15 | 49 |
| 12 | 3 | 9.535091 | 10.464909 | 9.562244 | 10.437756 | 10.027152 | 9.972848 | 57 | 48 |
| 13 | 15 | 9.535178 | 10.464822 | 9.562342 | 10.437658 | 10.027164 | 9.972836 | 45 | 47 |
| 14 | 30 | 9.535265 | 10.464735 | 9.562440 | 10.437560 | 10.027175 | 9.972825 | 30 | 46 |
| 15 | 45 | 9.535351 | 10.464649 | 9.562538 | 10.437462 | 10.027187 | 9.972813 | 15 | 45 |
| 16 | 4 | 9.535437 | 10.464563 | 9.562636 | 10.437364 | 10.027198 | 9.972802 | 56 | 44 |
| 17 | 15 | 9.535524 | 10.464476 | 9.562734 | 10.437266 | 10.027210 | 9.972790 | 45 | 43 |
| 18 | 30 | 9.535610 | 10.464390 | 9.562832 | 10.437168 | 10.027222 | 9.972778 | 30 | 42 |
| 19 | 45 | 9.535697 | 10.464303 | 9.562930 | 10.437070 | 10.027233 | 9.972767 | 15 | 41 |
| 20 | 5 | 9.535783 | 10.464217 | 9.563028 | 10.436972 | 10.027245 | 9.972755 | 55 | 40 |
| 21 | 15 | 9.535870 | 10.464130 | 9.563126 | 10.436874 | 10.027256 | 9.972744 | 45 | 39 |
| 22 | 30 | 9.535956 | 10.464044 | 9.563224 | 10.436776 | 10.027268 | 9.972732 | 30 | 38 |
| 23 | 45 | 9.536042 | 10.463958 | 9.563321 | 10.436679 | 10.027279 | 9.972721 | 15 | 37 |
| 24 | 6 | 9.536129 | 10.463871 | 9.563419 | 10.436581 | 10.027291 | 9.972709 | 54 | 36 |
| 25 | 15 | 9.536215 | 10.463785 | 9.563517 | 10.436483 | 10.027302 | 9.972698 | 45 | 35 |
| 26 | 30 | 9.536301 | 10.463699 | 9.563615 | 10.436385 | 10.027314 | 9.972686 | 30 | 34 |
| 27 | 45 | 9.536387 | 10.463613 | 9.563713 | 10.436287 | 10.027326 | 9.972674 | 15 | 33 |
| 28 | 7 | 9.536474 | 10.463526 | 9.563811 | 10.436189 | 10.027337 | 9.972663 | 53 | 32 |
| 29 | 15 | 9.536560 | 10.463440 | 9.563908 | 10.436092 | 10.027349 | 9.972651 | 45 | 31 |
| 30 | 30 | 9.536646 | 10.463354 | 9.564006 | 10.435994 | 10.027360 | 9.972640 | 30 | 30 |
| 31 | 45 | 9.536732 | 10.463268 | 9.564104 | 10.435896 | 10.027372 | 9.972628 | 15 | 29 |
| 32 | 8 | 9.536818 | 10 463182 | 9.564202 | 10.435798 | 10.027383 | 9.972617 | 52 | 28 |
| 33 | 15 | 9.536904 | 10.463096 | 9.564299 | 10.435701 | 10.027395 | 9.972605 | 45 | 27 |
| 34 | 30 | 9.536991 | 10.463009 | 9.564397 | 10.435603 | 10.027407 | 9.972593 | 30 | 26 |
| 35 | 45 | 9.537077 | 10.462923 | 9.564495 | 10.435505 | 10.027418 | 9.972582 | 15 | 25 |
| 36 | 9 | 9.537163 | 10.462837 | 9.564592 | 10.435408 | 10.027430 | 9.972570 | 51 | 24 |
| 37 | 15 | 9.537249 | 10.462751 | 9.564690 | 10.435310 | 10.027441 | 9.972559 | 45 | 23 |
| 38 | 30 | 9.537335 | 10.462665 | 9.564788 | 10.435212 | 10.027453 | 9.972547 | 30 | 22 |
| 39 | 45 | 9.537421 | 10.462579 | 9.564885 | 10.435115 | 10.027465 | 9.972535 | 15 | 21 |
| 40 | 10 | 9.537507 | 10.462493 | 9.564983 | 10.435017 | 10.027476 | 9.972524 | 50 | 20 |
| 41 | 15 | 9.537593 | 10.462407 | 9.565081 | 10.434919 | 10.027488 | 9 972512 | 45 | 19 |
| 42 | 30 | 9.537679 | 10.462321 | 9.565178 | 10.434822 | 10.027499 | 9.972501 | 30 | 18 |
| 43 | 45 | 9.537765 | 10.462235 | 9·565276 | 10.434724 | 10.027511 | 9.972489 | 15 | 17 |
| 44 | 11 | 9.537851 | 10.462149 | 9.565373 | 10.434627 | 10.027523 | 9.972477 | 49 | 16 |
| 45 | 15 | 9.537937 | 10.462063 | 9.565471 | 10.434529 | 10.027534 | 9.972466 | 45 | 15 |
| 46 | 30 | 9.538023 | 10.461977 | 9.565568 | 10.434432 | 10.027546 | 9.972454 | 30 | 14 |
| 47 | 45 | 9.538108 | 10.461892 | 9.565666 | 10.434334 | 10.027557 | 9.972443 | 15 | 13 |
| 48 | 12 | 9.538194 | 10.461806 | 9.565763 | 10.434237 | 10.027569 | 9.972431 | 48 | 12 |
| 49 | 15 | 9.538280 | 10.461720 | 9.565861 | 10.434139 | 10.027581 | 9.972419 | 45 | 11 |
| 50 | 30 | 9.538366 | 10.461634 | 9.565958 | 10.434042 | 10.027592 | 9.972408 | 30 | 10 |
| 51 | 45 | 9.538452 | 10.461548 | 9.566056 | 10.433944 | 10.027604 | 9.972396 | 15 | 9 |
| 52 | 13 | 9.538537 | 10.461463 | 9.566153 | 10.433847 | 10.027616 | 9.972384 | 47 | 8 |
| 53 | 15 | 9.538623 | 10.461377 | 9.566250 | 10.433750 | 10.027627 | 9.972373 | 45 | 7 |
| 54 | 30 | 9.538709 | 10.461291 | 9.566348 | 10.433652 | 10.027639 | 9.972361 | 30 | 6 |
| 55 | 45 | 9.538795 | 10.461205 | 9.566445 | 10.433555 | 10.027650 | 9.972350 | 15 | 5 |
| 56 | 14 | 9.538880 | 10.461120 | 9.566542 | 10.433458 | 10.027662 | 9.972338 | 46 | 4 |
| 57 | 15 | 9.538966 | 10.461034 | 9.566640 | 10.433360 | 10.027674 | 9.972326 | 45 | 3 |
| 58 | 30 | 9.539052 | 10.460948 | 9.566737 | 10.433263 | 10.027685 | 9.972315 | 30 | 2 |
| 59 | 45 | 9.539137 | 10.460863 | 9.566834 | 10.433166 | 10.027697 | 9.972303 | 15 | 1 |
| 60 | 15 | 9.539223 | 10.460777 | 9.566932 | 10.433068 | 10.027709 | 9.972291 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 39m. | | | LOG. SINES, &c. | | | | 69 deg. | | |

| $1^h\ 21^m$. | | | LOG. SINES, &c. (t.) | | | | 20 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ | sec. |
| 0 | 15 | 9.539223 | 10.460777 | 9.566932 | 10.433068 | 10.027709 | 9.972291 | 45 | 60 |
| 1 | 15 | 9.539309 | 10.460691 | 9.567029 | 10.432971 | 10.027720 | 9.972280 | 45 | 59 |
| 2 | 30 | 9.539394 | 10.460606 | 9.567126 | 10.432874 | 10.027732 | 9.972268 | 30 | 58 |
| 3 | 45 | 9.539480 | 10.460520 | 9.567223 | 10.432777 | 10.027744 | 9.972256 | 15 | 57 |
| 4 | 16 | 9.539565 | 10.460435 | 9.567320 | 10.432680 | 10.027755 | 9.972245 | 44 | 56 |
| 5 | 15 | 9.539651 | 10.460349 | 9.567418 | 10.432582 | 10.027767 | 9.972233 | 45 | 55 |
| 6 | 30 | 9.539736 | 10.460264 | 9.567515 | 10.432485 | 10.027779 | 9.972221 | 30 | 54 |
| 7 | 45 | 9.539822 | 10.460178 | 9.567612 | 10.432388 | 10.027790 | 9.972210 | 15 | 53 |
| 8 | 17 | 9.539907 | 10.460093 | 9.567709 | 10.432291 | 10.027802 | 9.972198 | 43 | 52 |
| 9 | 15 | 9.539993 | 10.460007 | 9.567806 | 10.432194 | 10.027814 | 9.972186 | 45 | 51 |
| 10 | 30 | 9.540078 | 10.459922 | 9.567903 | 10.432097 | 10.027825 | 9.972175 | 30 | 50 |
| 11 | 45 | 9.540163 | 10.459837 | 9.568000 | 10.432000 | 10.027837 | 9.972163 | 15 | 49 |
| 12 | 18 | 9.540249 | 10.459751 | 9.568097 | 10.431903 | 10.027849 | 9.972151 | 42 | 48 |
| 13 | 15 | 9.540334 | 10.459666 | 9.568195 | 10.431805 | 10.027860 | 9.972140 | 45 | 47 |
| 14 | 30 | 9.540420 | 10.459580 | 9.568292 | 10.431708 | 10.027872 | 9.972128 | 30 | 46 |
| 15 | 45 | 9.540505 | 10.459495 | 9.568389 | 10.431611 | 10.027884 | 9.972116 | 15 | 45 |
| 16 | 19 | 9.540590 | 10.459410 | 9.568486 | 10.431514 | 10.027895 | 9.972105 | 41 | 44 |
| 17 | 15 | 9.540676 | 10.459324 | 9.568583 | 10.431417 | 10.027907 | 9.972093 | 45 | 43 |
| 18 | 30 | 9.540761 | 10.459239 | 9.568680 | 10.431320 | 10.027919 | 9.972081 | 30 | 42 |
| 19 | 45 | 9.540846 | 10.459154 | 9.568777 | 10.431223 | 10.027930 | 9.972070 | 15 | 41 |
| 20 | 20 | 9.540931 | 10.459069 | 9.568873 | 10.431127 | 10.027942 | 9.972058 | 40 | 40 |
| 21 | 15 | 9.541017 | 10.458983 | 9.568970 | 10.431030 | 10.027954 | 9.972046 | 45 | 39 |
| 22 | 30 | 9.541102 | 10.458898 | 9.569067 | 10.430933 | 10.027966 | 9.972034 | 30 | 38 |
| 23 | 45 | 9.541187 | 10.458813 | 9.569164 | 10.430836 | 10.027977 | 9.972023 | 15 | 37 |
| 24 | 21 | 9.541272 | 10.458728 | 9.569261 | 10.430739 | 10.027989 | 9.972011 | 39 | 36 |
| 25 | 15 | 9.541357 | 10.458643 | 9.569358 | 10.430642 | 10.028001 | 9.971999 | 45 | 35 |
| 26 | 30 | 9.541442 | 10.458558 | 9.569455 | 10.430545 | 10.028012 | 9.971988 | 30 | 34 |
| 27 | 45 | 9.541527 | 10.458473 | 9.569552 | 10.430448 | 10.028024 | 9.971976 | 15 | 33 |
| 28 | 22 | 9.541613 | 10.458387 | 9.569648 | 10.430352 | 10.028036 | 9.971964 | 38 | 32 |
| 29 | 15 | 9.541698 | 10.458302 | 9.569745 | 10.430255 | 10.028048 | 9.971952 | 45 | 31 |
| 30 | 30 | 9.541783 | 10.458217 | 9.569842 | 10.430158 | 10.028059 | 9.971941 | 30 | 30 |
| 31 | 45 | 9.541868 | 10.458132 | 9.569939 | 10.430061 | 10.028071 | 9.971929 | 15 | 29 |
| 32 | 23 | 9.541953 | 10.458047 | 9.570035 | 10.429965 | 10.028083 | 9.971917 | 37 | 28 |
| 33 | 15 | 9.542038 | 10.457962 | 9.570132 | 10.429868 | 10.028095 | 9.971905 | 45 | 27 |
| 34 | 30 | 9.542123 | 10.457877 | 9.570229 | 10.429771 | 10.028106 | 9.971894 | 30 | 26 |
| 35 | 45 | 9.542208 | 10.457792 | 9.570326 | 10.429674 | 10.028118 | 9.971882 | 15 | 25 |
| 36 | 24 | 9.542293 | 10.457707 | 9.570422 | 10.429578 | 10.028130 | 9.971870 | 36 | 24 |
| 37 | 15 | 9.542377 | 10.457623 | 9.570519 | 10.429481 | 10.028142 | 9.971858 | 45 | 23 |
| 38 | 30 | 9.542462 | 10.457538 | 9.570616 | 10.429384 | 10.028153 | 9.971847 | 30 | 22 |
| 39 | 45 | 9.542547 | 10.457453 | 9.570712 | 10.429288 | 10.028165 | 9.971835 | 15 | 21 |
| 40 | 25 | 9.542632 | 10.457368 | 9.570809 | 10.429191 | 10.028177 | 9.971823 | 35 | 20 |
| 41 | 15 | 9.542717 | 10.457283 | 9.570905 | 10.429095 | 10.028189 | 9.971811 | 45 | 19 |
| 42 | 30 | 9.542802 | 10.457198 | 9.571002 | 10.428998 | 10.028200 | 9.971800 | 30 | 18 |
| 43 | 45 | 9.542887 | 10.457113 | 9.571099 | 10.428901 | 10.028212 | 9.971788 | 15 | 17 |
| 44 | 26 | 9.542971 | 10.457029 | 9.571195 | 10.428805 | 10.028224 | 9.971776 | 34 | 16 |
| 45 | 15 | 9.543056 | 10.456944 | 9.571292 | 10.428708 | 10.028236 | 9.971764 | 45 | 15 |
| 46 | 30 | 9.543141 | 10.456859 | 9.571388 | 10.428612 | 10.028247 | 9.971753 | 30 | 14 |
| 47 | 45 | 9.543226 | 10.456774 | 9.571485 | 10.428515 | 10.028259 | 9.971741 | 15 | 13 |
| 48 | 27 | 9.543310 | 10.456690 | 9.571581 | 10.428419 | 10.028271 | 9.971729 | 33 | 12 |
| 49 | 15 | 9.543395 | 10.456605 | 9.571678 | 10.428322 | 10.028283 | 9.971717 | 45 | 11 |
| 50 | 30 | 9.543480 | 10.456520 | 9.571774 | 10.428226 | 10.028294 | 9.971706 | 30 | 10 |
| 51 | 45 | 9.543564 | 10.456436 | 9.571870 | 10.428130 | 10.028306 | 9.971694 | 15 | 9 |
| 52 | 28 | 9.543649 | 10.456351 | 9.571967 | 10.428033 | 10.028318 | 9.971682 | 32 | 8 |
| 53 | 15 | 9.543733 | 10.456267 | 9.572063 | 10.427937 | 10.028330 | 9.971670 | 45 | 7 |
| 54 | 30 | 9.543818 | 10.456182 | 9.572160 | 10.427840 | 10.028342 | 9.971658 | 30 | 6 |
| 55 | 45 | 9.543903 | 10.456097 | 9.572256 | 10.427744 | 10.028353 | 9.971647 | 15 | 5 |
| 56 | 29 | 9.543987 | 10.456013 | 9.572352 | 10.427648 | 10.028365 | 9.971635 | 31 | 4 |
| 57 | 15 | 9.544072 | 10.455928 | 9.572449 | 10.427551 | 10.028377 | 9.971623 | 45 | 3 |
| 58 | 30 | 9.544156 | 10.455844 | 9.572545 | 10.427455 | 10.028389 | 9.971611 | 30 | 2 |
| 59 | 45 | 9.544241 | 10.455759 | 9.572641 | 10.427359 | 10.028401 | 9.971599 | 15 | 1 |
| 60 | 30 | 9.544325 | 10.455675 | 9.572738 | 10.427262 | 10.028412 | 9.971588 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| $4^h\ 38^m$. | | | LOG. SINES, &c. | | | | 69 deg. | | |

| 1h 22m. | | | LOG. SINES, &c. (t.) | | | | 20 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.544325 | 10.455675 | 9.572738 | 10.427262 | 10.028412 | 9.971588 | 30 | 60 |
| 1 | 15 | 9.544410 | 10.455590 | 9.572834 | 10.427166 | 10.028424 | 9.971576 | 45 | 59 |
| 2 | 30 | 9.544494 | 10.455506 | 9.572930 | 10.427070 | 10.028436 | 9.971564 | 30 | 58 |
| 3 | 45 | 9.544579 | 10.455421 | 9.573026 | 10.426974 | 10.028448 | 9.971552 | 15 | 57 |
| 4 | 31 | 9.544663 | 10.455337 | 9.573123 | 10.426877 | 10.028460 | 9 971540 | 29 | 56 |
| 5 | 15 | 9.544747 | 10.455253 | 9.573219 | 10.426781 | 10.028471 | 9.971529 | 45 | 55 |
| 6 | 30 | 9.544832 | 10.455168 | 9.573315 | 10.426685 | 10.028483 | 9.971517 | 30 | 54 |
| 7 | 45 | 9.544916 | 10.455084 | 9.573411 | 10.426589 | 10.028495 | 9.971505 | 15 | 53 |
| 8 | 32 | 9.545000 | 10.455000 | 9.573507 | 10.426493 | 10.028507 | 9.971493 | 28 | 52 |
| 9 | 15 | 9.545085 | 10.454915 | 9.573603 | 10.426397 | 10.028519 | 9.971481 | 45 | 51 |
| 10 | 30 | 9.545169 | 10.454831 | 9.573700 | 10.426300 | 10.028531 | 9.971469 | 30 | 50 |
| 11 | 45 | 9.545253 | 10.454747 | 9.573796 | 10.426204 | 10.028542 | 9.971458 | 15 | 49 |
| 12 | 33 | 9.545338 | 10.454662 | 9.573892 | 10.426108 | 10.028554 | 9.971446 | 27 | 48 |
| 13 | 15 | 9.545422 | 10.454578 | 9.573988 | 10.426012 | 10.028566 | 9.971434 | 45 | 47 |
| 14 | 30 | 9.545506 | 10.454494 | 9.574084 | 10.425916 | 10.028578 | 9.971422 | 30 | 46 |
| 15 | 45 | 9.545590 | 10.454410 | 9.574180 | 10.425820 | 10.028590 | 9.971410 | 15 | 45 |
| 16 | 34 | 9.545674 | 10.454326 | 9.574276 | 10.425724 | 10.028602 | 9.971398 | 26 | 44 |
| 17 | 15 | 9.545759 | 10.454241 | 9.574372 | 10.425628 | 10.028614 | 9.971386 | 45 | 43 |
| 18 | 30 | 9.545843 | 10.454157 | 9.574468 | 10.425532 | 10.028625 | 9.971375 | 30 | 42 |
| 19 | 45 | 9.545927 | 10.454073 | 9.574564 | 10.425436 | 10.028637 | 9.971363 | 15 | 41 |
| 20 | 35 | 9.546011 | 10.453989 | 9.574660 | 10.425340 | 10.028649 | 9.971351 | 25 | 40 |
| 21 | 15 | 9.546095 | 10.453905 | 9.574756 | 10.425244 | 10.028661 | 9.971339 | 45 | 39 |
| 22 | 30 | 9.546179 | 10.453821 | 9.574852 | 10.425148 | 10.028673 | 9.971327 | 30 | 38 |
| 23 | 45 | 9.546263 | 10.453737 | 9.574948 | 10.425052 | 10.028685 | 9.971315 | 15 | 37 |
| 24 | 36 | 9.546347 | 10.453653 | 9.575044 | 10.424956 | 10.028697 | 9.971303 | 24 | 36 |
| 25 | 15 | 9.546431 | 10.453569 | 9.575140 | 10.424860 | 10.028708 | 9.971292 | 45 | 35 |
| 26 | 30 | 9.546515 | 10.453485 | 9.575235 | 10.424765 | 10.028720 | 9.971280 | 30 | 34 |
| 27 | 45 | 9.546599 | 10.453401 | 9.575331 | 10.424669 | 10.028732 | 9.971268 | 15 | 33 |
| 28 | 37 | 9.546683 | 10.453317 | 9.575427 | 10.424573 | 10.028744 | 9.971256 | 23 | 32 |
| 29 | 15 | 9.546767 | 10.453233 | 9.575523 | 10.424477 | 10.028756 | 9.971244 | 45 | 31 |
| 30 | 30 | 9.546851 | 10.453149 | 9.575619 | 10.424381 | 10.028768 | 9.971232 | 30 | 30 |
| 31 | 45 | 9.546935 | 10.453065 | 9.575715 | 10.424285 | 10.028780 | 9.971220 | 15 | 29 |
| 32 | 38 | 9.547019 | 10.452981 | 9.575810 | 10.424190 | 10.028792 | 9.971208 | 22 | 28 |
| 33 | 15 | 9.547103 | 10.452897 | 9.575906 | 10.424094 | 10.028804 | 9.971196 | 45 | 27 |
| 34 | 30 | 9.547187 | 10.452813 | 9.576002 | 10.423998 | 10.028815 | 9.971185 | 30 | 26 |
| 35 | 45 | 9.547270 | 10.452730 | 9.576098 | 10.423902 | 10.028827 | 9.971173 | 15 | 25 |
| 36 | 39 | 9.547354 | 10.452646 | 9.576193 | 10.423807 | 10.028839 | 9.971161 | 21 | 24 |
| 37 | 15 | 9.547438 | 10.452562 | 9.576289 | 10.423711 | 10.028851 | 9.971149 | 45 | 23 |
| 38 | 30 | 9.547522 | 10.452478 | 9.576385 | 10.423615 | 10.028863 | 9.971137 | 30 | 22 |
| 39 | 45 | 9.547605 | 10.452395 | 9.576480 | 10.423520 | 10.028875 | 9.971125 | 15 | 21 |
| 40 | 40 | 9.547689 | 10.452311 | 9.576576 | 10.423424 | 10.028887 | 9.971113 | 20 | 20 |
| 41 | 15 | 9.547773 | 10.452227 | 9.576672 | 10.423328 | 10.028899 | 9.971101 | 45 | 19 |
| 42 | 30 | 9.547857 | 10.452143 | 9.576767 | 10.423233 | 10.028911 | 9.971089 | 30 | 18 |
| 43 | 45 | 9.547940 | 10.452060 | 9.576863 | 10.423137 | 10.028923 | 9.971077 | 15 | 17 |
| 44 | 41 | 9.548024 | 10.451976 | 9.576958 | 10.423042 | 10.028935 | 9.971065 | 19 | 16 |
| 45 | 15 | 9.548108 | 10.451892 | 9.577054 | 10.422946 | 10.028946 | 9.971054 | 45 | 15 |
| 46 | 30 | 9.548191 | 10.451809 | 9.577150 | 10.422850 | 10.028958 | 9 971042 | 30 | 14 |
| 47 | 45 | 9.548275 | 10.451725 | 9.577245 | 10.422755 | 10.028970 | 9.971030 | 15 | 13 |
| 48 | 42 | 9.548358 | 10.451642 | 9.577341 | 10.422659 | 10.028982 | 9.971018 | 18 | 12 |
| 49 | 15 | 9.548442 | 10.451558 | 9.577436 | 10.422564 | 10.028994 | 9.971006 | 45 | 11 |
| 50 | 30 | 9.548526 | 10.451474 | 9.577532 | 10.422468 | 10.029006 | 9.970994 | 30 | 10 |
| 51 | 45 | 9.548609 | 10.451391 | 9.577627 | 10.422373 | 10.029018 | 9.970982 | 15 | 9 |
| 52 | 43 | 9.548693 | 10.451307 | 9.577723 | 10.422277 | 10 029030 | 9.970970 | 17 | 8 |
| 53 | 15 | 9.548776 | 10.451224 | 9.577818 | 10.422182 | 10.029042 | 9.970958 | 45 | 7 |
| 54 | 30 | 9.548860 | 10.451140 | 9.577913 | 10.422087 | 10.029054 | 9.970946 | 30 | 6 |
| 55 | 45 | 9.548943 | 10.451057 | 9.578009 | 10.421991 | 10.029066 | 9.970934 | 15 | 5 |
| 56 | 44 | 9.549027 | 10.450973 | 9.578104 | 10.421896 | 10.029078 | 9.970922 | 16 | 4 |
| 57 | 15 | 9.549110 | 10.450890 | 9.578200 | 10.421800 | 10.029090 | 9.970910 | 45 | 3 |
| 58 | 30 | 9.549193 | 10.450807 | 9.578295 | 10.421705 | 10.029102 | 9.970898 | 30 | 2 |
| 59 | 45 | 9.549277 | 10.450723 | 9.578390 | 10.421610 | 10.029114 | 9.970886 | 15 | 1 |
| 60 | 45 | 9.549360 | 10.450640 | 9.578486 | 10.421514 | 10.029126 | 9.970874 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 37m. | | | LOG. SINES, &c. | | | | 69 deg. | | |

| 1h 23m. | | | LOG. SINES, &c. (t.) | | | | 20 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.549360 | 10.450640 | 9.578486 | 10.421514 | 10.029126 | 9.970874 | 15 | 60 |
| 1 | 15 | 9.549443 | 10.450557 | 9.578581 | 10.421419 | 10.029138 | 9.970862 | 45 | 59 |
| 2 | 30 | 9.549527 | 10.450473 | 9.578676 | 10.421324 | 10.029150 | 9.970850 | 30 | 58 |
| 3 | 45 | 9.549610 | 10.450390 | 9.578772 | 10.421228 | 10.029162 | 9.970838 | 15 | 57 |
| 4 | 46 | 9.549693 | 10.450307 | 9.578867 | 10.421133 | 10.029174 | 9.970826 | 14 | 56 |
| 5 | 15 | 9.549777 | 10.450223 | 9.578962 | 10.421038 | 10.029186 | 9.970814 | 45 | 55 |
| 6 | 30 | 9.549860 | 10.450140 | 9.579057 | 10.420943 | 10.029197 | 9.970803 | 30 | 54 |
| 7 | 45 | 9.549943 | 10.450057 | 9.579153 | 10.420847 | 10.029209 | 9.970791 | 15 | 53 |
| 8 | 47 | 9.550026 | 10.449974 | 9.579248 | 10.420752 | 10.029221 | 9.970779 | 13 | 52 |
| 9 | 15 | 9.550110 | 10.449890 | 9.579343 | 10.420657 | 10.029233 | 9.970767 | 45 | 51 |
| 10 | 30 | 9.550193 | 10.449807 | 9.579438 | 10.420562 | 10.029245 | 9.970755 | 30 | 50 |
| 11 | 45 | 9.550276 | 10.449724 | 9.579533 | 10.420467 | 10.029257 | 9.970743 | 15 | 49 |
| 12 | 48 | 9.550359 | 10.449641 | 9.579629 | 10.420371 | 10.029269 | 9.970731 | 12 | 48 |
| 13 | 15 | 9.550442 | 10.449558 | 9.579724 | 10.420276 | 10.029281 | 9.970719 | 45 | 47 |
| 14 | 30 | 9.550525 | 10.449475 | 9.579819 | 10.420181 | 10.029293 | 9.970707 | 30 | 46 |
| 15 | 45 | 9.550608 | 10.449392 | 9.579914 | 10.420086 | 10.029305 | 9.970695 | 15 | 45 |
| 16 | 49 | 9.550692 | 10.449308 | 9.580009 | 10.419991 | 10.029317 | 9.970683 | 11 | 44 |
| 17 | 15 | 9.550775 | 10.449225 | 9.580104 | 10.419896 | 10 029329 | 9.970671 | 45 | 43 |
| 18 | 30 | 9.550858 | 10.449142 | 9.580199 | 10.419801 | 10.029341 | 9.970659 | 30 | 42 |
| 19 | 45 | 9.550941 | 10.449059 | 9.580294 | 10.419706 | 10.029353 | 9.970647 | 15 | 41 |
| 20 | 50 | 9 551024 | 10.448976 | 9.580389 | 10.419611 | 10.029365 | 9.970635 | 10 | 40 |
| 21 | 15 | 9.551107 | 10.448893 | 9.580484 | 10.419516 | 10.029377 | 9.970623 | 45 | 39 |
| 22 | 30 | 9.551190 | 10.448810 | 9.580579 | 10.419421 | 10.029390 | 9.970610 | 30 | 38 |
| 23 | 45 | 9.551273 | 10.448727 | 9.580674 | 10.419326 | 10.029402 | 9.970598 | 15 | 37 |
| 24 | 51 | 9.551356 | 10.448644 | 9.580769 | 10.419231 | 10.029414 | 9.970586 | 9 | 36 |
| 25 | 15 | 9.551438 | 10.448562 | 9.580864 | 10.419136 | 10.029426 | 9.970574 | 45 | 35 |
| 26 | 30 | 9.551521 | 10.448479 | 9.580959 | 10.419041 | 10.029438 | 9.970562 | 30 | 34 |
| 27 | 45 | 9.551604 | 10.448396 | 9.581054 | 10.418946 | 10.029450 | 9.970550 | 15 | 33 |
| 28 | 52 | 9.551687 | 10.448313 | 9.581149 | 10.418851 | 10.029462 | 9.970538 | 8 | 32 |
| 29 | 15 | 9.551770 | 10.448230 | 9.581244 | 10.418756 | 10.029474 | 9.970596 | 45 | 31 |
| 30 | 30 | 9.551853 | 10.448147 | 9.581338 | 10.418662 | 10.029486 | 9.970514 | 30 | 30 |
| 31 | 45 | 9.551936 | 10.448064 | 9.581433 | 10.418567 | 10.029498 | 9.970502 | 15 | 29 |
| 32 | 53 | 9.552018 | 10.447982 | 9.581528 | 10.418472 | 10.029510 | 9.970490 | 7 | 28 |
| 33 | 15 | 9.552101 | 10.447899 | 9.581623 | 10.418377 | 10.029522 | 9.970478 | 45 | 27 |
| 34 | 30 | 9.552184 | 10.447816 | 9.581718 | 10.418282 | 10.029534 | 9.970466 | 30 | 26 |
| 35 | 45 | 9.552267 | 10.447733 | 9.581813 | 10.418187 | 10.029546 | 9.970454 | 15 | 25 |
| 36 | 54 | 9.552349 | 10.447651 | 9.581907 | 10.418093 | 10.029558 | 9.970442 | 6 | 24 |
| 37 | 15 | 9.552432 | 10.447568 | 9.582002 | 10.417998 | 10.029570 | 9.970430 | 45 | 23 |
| 38 | 30 | 9.552515 | 10.447485 | 9.582097 | 10.417903 | 10.029582 | 9.970418 | 30 | 22 |
| 39 | 45 | 9.552597 | 10.447403 | 9.582192 | 10.417808 | 10.029594 | 9.970406 | 15 | 21 |
| 40 | 55 | 9.552680 | 10.447320 | 9.582286 | 10.417714 | 10.029606 | 9.970394 | 5 | 20 |
| 41 | 15 | 9.552763 | 10.447237 | 9.582381 | 10.417619 | 10.029618 | 9.970382 | 45 | 19 |
| 42 | 30 | 9.552845 | 10.447155 | 9.582476 | 10.417524 | 10.029631 | 9.970369 | 30 | 18 |
| 43 | 45 | 9.552928 | 10.447072 | 9.582570 | 10.417430 | 10.029643 | 9.970357 | 15 | 17 |
| 44 | 56 | 9.553010 | 10.446990 | 9.582665 | 10.417335 | 10.029655 | 9.970345 | 4 | 16 |
| 45 | 15 | 9.553093 | 10.446907 | 9.582760 | 10.417240 | 10.029667 | 9.970333 | 45 | 15 |
| 46 | 30 | 9.553175 | 10.446825 | 9.582854 | 10.417146 | 10.029679 | 9.970321 | 30 | 14 |
| 47 | 45 | 9 553258 | 10.446742 | 9.582949 | 10.417051 | 10.029691 | 9.970309 | 15 | 13 |
| 48 | 57 | 9.553341 | 10.446659 | 9.583043 | 10.416957 | 10.029703 | 9.970297 | 3 | 12 |
| 49 | 15 | 9.553423 | 10.446577 | 9.583138 | 10.416862 | 10.029715 | 9.970285 | 45 | 11 |
| 50 | 30 | 9.553505 | 10.446495 | 9.583233 | 10.416767 | 10.029727 | 9.970273 | 30 | 10 |
| 51 | 45 | 9.553588 | 10.446412 | 9.583327 | 10.416673 | 10.029739 | 9.970261 | 15 | 9 |
| 52 | 58 | 9.553670 | 10.446330 | 9.583422 | 10.416578 | 10.029751 | 9.970249 | 2 | 8 |
| 53 | 15 | 9.553753 | 10.446247 | 9.583516 | 10.416484 | 10.029764 | 9.970236 | 45 | 7 |
| 54 | 30 | 9.553835 | 10.446165 | 9.583611 | 10.416389 | 10.029776 | 9.970224 | 30 | 6 |
| 55 | 45 | 9.553918 | 10.446082 | 9.583705 | 10.416295 | 10.029788 | 9.970212 | 15 | 5 |
| 56 | 59 | 9.554000 | 10.446000 | 9.583800 | 10.416200 | 10.029800 | 9.970200 | 1 | 4 |
| 57 | 15 | 9.554082 | 10.445918 | 9.583894 | 10.416106 | 10.029812 | 9.970188 | 45 | 3 |
| 58 | 30 | 9.554165 | 10.445835 | 9.583989 | 10.416011 | 10.029824 | 9.970176 | 30 | 2 |
| 59 | 45 | 9.554247 | 10.445753 | 9.584083 | 10.415917 | 10.029836 | 9.970164 | 15 | 1 |
| 60 | 60 | 9.554329 | 10.445671 | 9.584177 | 10.415823 | 10.029848 | 9.970152 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 36m. | | | LOG. SINES, &c. | | | | 69 deg. | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ ″ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 1h 24m. | | LOG. SINES, &c. (t.) | | | | | 21 deg. | |
| 0 | 0 | 9.554329 | 10.445671 | 9.584177 | 10.415823 | 10.029848 | 9.970152 | 60 | 60 |
| 1 | 15 | 9.554411 | 10.445589 | 9.584272 | 10.415728 | 10.029860 | 9.970140 | 45 | 59 |
| 2 | 30 | 9.554494 | 10.445506 | 9.584366 | 10.415634 | 10.029873 | 9.970127 | 30 | 58 |
| 3 | 45 | 9.554576 | 10.445424 | 9.584461 | 10.415539 | 10.029885 | 9.970115 | 15 | 57 |
| 4 | 1 | 9.554658 | 10.445342 | 9.584555 | 10.415445 | 10.029897 | 9.970103 | 59 | 56 |
| 5 | 15 | 9.554740 | 10.445260 | 9.584649 | 10.415351 | 10.029909 | 9.970091 | 45 | 55 |
| 6 | 30 | 9.554822 | 10.445178 | 9.584743 | 10.415257 | 10.029921 | 9.970079 | 30 | 54 |
| 7 | 45 | 9.554905 | 10.445095 | 9.584838 | 10.415162 | 10.029933 | 9.970067 | 15 | 53 |
| 8 | 2 | 9.554987 | 10.445013 | 9.584932 | 10.415068 | 10 029945 | 9.970055 | 58 | 52 |
| 9 | 15 | 9.555069 | 10.444931 | 9.585026 | 10.414974 | 10.029958 | 9.970042 | 45 | 51 |
| 10 | 30 | 9.555151 | 10.444849 | 9.585121 | 10.414879 | 10.029970 | 9.970030 | 30 | 50 |
| 11 | 45 | 9.555233 | 10.444767 | 9.585215 | 10.414785 | 10.029982 | 9.970018 | 15 | 49 |
| 12 | 3 | 9.555315 | 10.444685 | 9.585309 | 10.414691 | 10.029994 | 9.970006 | 57 | 48 |
| 13 | 15 | 9.555397 | 10.444603 | 9.585403 | 10.414597 | 10 030006 | 9.969994 | 45 | 47 |
| 14 | 30 | 9.555479 | 10.444521 | 9.585497 | 10.414503 | 10.030018 | 9.969982 | 30 | 46 |
| 15 | 45 | 9.555561 | 10.444439 | 9.585592 | 10.414408 | 10.030030 | 9.969970 | 15 | 45 |
| 16 | 4 | 9.555643 | 10.444357 | 9.585686 | 10.414314 | 10.030043 | 9.969957 | 56 | 44 |
| 17 | 15 | 9.555725 | 10.444275 | 9.585780 | 10.414220 | 10.030055 | 9.969945 | 45 | 43 |
| 18 | 30 | 9.555807 | 10 444193 | 9 585874 | 10.414126 | 10.030067 | 9.969933 | 30 | 42 |
| 19 | 45 | 9.555889 | 10.444111 | 9.585968 | 10.414032 | 10.030079 | 9.969921 | 15 | 41 |
| 20 | 5 | 9.555971 | 10.444029 | 9.586062 | 10.413938 | 10.030091 | 9.969909 | 55 | 40 |
| 21 | 15 | 9.556053 | 10.443947 | 9.586156 | 10.413844 | 10.030103 | 9.969897 | 45 | 39 |
| 22 | 30 | 9.556135 | 10.443865 | 9.586250 | 10.413750 | 10.030116 | 9.969884 | 30 | 38 |
| 23 | 45 | 9.556217 | 10.443783 | 9.586345 | 10.413655 | 10.030128 | 9.969872 | 15 | 37 |
| 24 | 6 | 9.556299 | 10.443701 | 9.586439 | 10.413561 | 10.030140 | 9 969860 | 54 | 36 |
| 25 | 15 | 9.556380 | 10.443620 | 9 586533 | 10.413467 | 10.030152 | 9.969848 | 45 | 35 |
| 26 | 30 | 9.556462 | 10.443538 | 9.586627 | 10.413373 | 10.030164 | 9.969836 | 30 | 34 |
| 27 | 45 | 9.556544 | 10.443456 | 9.586721 | 10.413279 | 10.030177 | 9.969823 | 15 | 33 |
| 28 | 7 | 9.556626 | 10.443374 | 9.586815 | 10.413185 | 10.030189 | 9.969811 | 53 | 32 |
| 29 | 15 | 9.556708 | 10.443292 | 9.586909 | 10.413091 | 10.030201 | 9.969799 | 45 | 31 |
| 30 | 30 | 9.556789 | 10.443211 | 9.587003 | 10.412997 | 10.030213 | 9.969787 | 30 | 30 |
| 31 | 45 | 9.556871 | 10.443129 | 9.587096 | 10.412904 | 10.030225 | 9.969775 | 15 | 29 |
| 32 | 8 | 9.556953 | 10.443047 | 9.587190 | 10.412810 | 10.030238 | 9.969762 | 52 | 28 |
| 33 | 15 | 9.557035 | 10.442965 | 9.587284 | 10.412716 | 10.030250 | 9.969750 | 45 | 27 |
| 34 | 30 | 9.557116 | 10.442884 | 9.587378 | 10.412622 | 10.030262 | 9.969738 | 30 | 26 |
| 35 | 45 | 9.557198 | 10.442802 | 9.587472 | 10.412528 | 10.030274 | 9.969726 | 15 | 25 |
| 36 | 9 | 9.557280 | 10.442720 | 9.587566 | 10.412434 | 10 030286 | 9.969714 | 51 | 24 |
| 37 | 15 | 9.557361 | 10.442639 | 9.587660 | 10.412340 | 10.030299 | 9.969701 | 45 | 23 |
| 38 | 30 | 9.557443 | 10.442557 | 9.587754 | 10.412246 | 10.030311 | 9.969689 | 30 | 22 |
| 39 | 45 | 9.557524 | 10.442476 | 9.587847 | 10.412153 | 10.030323 | 9.969677 | 15 | 21 |
| 40 | 10 | 9.557606 | 10.442394 | 9.587941 | 10.412059 | 10.030335 | 9.969665 | 50 | 20 |
| 41 | 15 | 9.557687 | 10.442313 | 9.588035 | 10.411965 | 10.030348 | 9.969652 | 45 | 19 |
| 42 | 30 | 9.557769 | 10.442231 | 9.588129 | 10.411871 | 10.030360 | 9.969640 | 30 | 18 |
| 43 | 45 | 9.557851 | 10.442149 | 9.588223 | 10.411777 | 10.030372 | 9.969628 | 15 | 17 |
| 44 | 11 | 9.557932 | 10.442068 | 9.588316 | 10.411684 | 10.030384 | 9.969616 | 49 | 16 |
| 45 | 15 | 9.558014 | 10.441986 | 9.588410 | 10.411590 | 10.030397 | 9.969603 | 45 | 15 |
| 46 | 30 | 9.558095 | 10.441905 | 9.588504 | 10.411496 | 10.030409 | 9.969591 | 30 | 14 |
| 47 | 45 | 9.558176 | 10.441824 | 9.588597 | 10.411403 | 10.030421 | 9.969579 | 15 | 13 |
| 48 | 12 | 9.558258 | 10.441742 | 9.588691 | 10.411309 | 10.030433 | 9.969567 | 48 | 12 |
| 49 | 15 | 9.558339 | 10.441661 | 9.588785 | 10.411215 | 10.030446 | 9.969554 | 45 | 11 |
| 50 | 30 | 9.558421 | 10.441579 | 9.588878 | 10.411122 | 10.030458 | 9.969542 | 30 | 10 |
| 51 | 45 | 9.558502 | 10.441498 | 9.588972 | 10.411028 | 10.030470 | 9.969530 | 15 | 9 |
| 52 | 13 | 9.558583 | 10.441417 | 9.589066 | 10.410934 | 10.030482 | 9.969518 | 47 | 8 |
| 53 | 15 | 9.558665 | 10.441335 | 9.589159 | 10.410841 | 10.030495 | 9.969505 | 45 | 7 |
| 54 | 30 | 9.558746 | 10.441254 | 9.589253 | 10.410747 | 10.030507 | 9.969493 | 30 | 6 |
| 55 | 45 | 9.558827 | 10.441173 | 9.589346 | 10.410654 | 10.030519 | 9.969481 | 15 | 5 |
| 56 | 14 | 9.558909 | 10.441091 | 9.589440 | 10.410560 | 10.030531 | 9.969469 | 46 | 4 |
| 57 | 15 | 9.558990 | 10.441010 | 9.589534 | 10.410466 | 10.030544 | 9.969456 | 45 | 3 |
| 58 | 30 | 9.559071 | 10 440929 | 9.589627 | 10.410373 | 10.030556 | 9.969444 | 30 | 2 |
| 59 | 45 | 9.559152 | 10.440848 | 9.589721 | 10.410279 | 10.030568 | 9.969432 | 15 | 1 |
| 60 | 15 | 9.559234 | 10.440766 | 9.589814 | 10.410186 | 10.030580 | 9.969420 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 35m. | | LOG. SINES, &c. | | | | | 68 deg. | |

| 1h 25m. | | LOG. SINES, &c. (t.) | | | | | 21 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.559234 | 10.440766 | 9.589814 | 10.410186 | 10.030580 | 9.969420 | 45 | 60 |
| 1 | 15 | 9.559315 | 10.440685 | 9.589908 | 10.410092 | 10.030593 | 9.969407 | 45 | 59 |
| 2 | 30 | 9.559396 | 10.440604 | 9.590001 | 10.409999 | 10.030605 | 9.969395 | 30 | 58 |
| 3 | 45 | 9.559477 | 10.440523 | 9.590095 | 10.409905 | 10.030617 | 9.969383 | 15 | 57 |
| 4 | 16 | 9.559558 | 10.440442 | 9.590188 | 10.409812 | 10.030630 | 9.969370 | 44 | 56 |
| 5 | 15 | 9.559640 | 10.440360 | 9.590281 | 10.409719 | 10.030642 | 9.969358 | 45 | 55 |
| 6 | 30 | 9.559721 | 10.440279 | 9.590375 | 10.409625 | 10.030654 | 9.969346 | 30 | 54 |
| 7 | 45 | 9.559802 | 10.440198 | 9.590468 | 10.409532 | 10.030667 | 9.969333 | 15 | 53 |
| 8 | 17 | 9.559883 | 10.440117 | 9.590562 | 10.409438 | 10.030679 | 9 969321 | 43 | 52 |
| 9 | 15 | 9.559964 | 10.440036 | 9.590655 | 10.409345 | 10.030691 | 9.969309 | 45 | 51 |
| 10 | 30 | 9.560045 | 10.439955 | 9.590748 | 10.409252 | 10.030703 | 9 969297 | 30 | 50 |
| 11 | 45 | 9.560126 | 10.439874 | 9.590842 | 10.409158 | 10.030716 | 9.969284 | 15 | 49 |
| 12 | 18 | 9.560207 | 10.439793 | 9.590935 | 10.409065 | 10.030728 | 9.969272 | 42 | 48 |
| 13 | 15 | 9.560288 | 10.439712 | 9.591028 | 10.408972 | 10.030740 | 9.969260 | 45 | 47 |
| 14 | 30 | 9.560369 | 10.439631 | 9.591122 | 10.408878 | 10.030753 | 9.969247 | 30 | 46 |
| 15 | 45 | 9.560450 | 10.439550 | 9.591215 | 10.408785 | 10.030765 | 9.969235 | 15 | 45 |
| 16 | 19 | 9.560531 | 10.439469 | 9.591308 | 10.408692 | 10.030777 | 9.969223 | 41 | 44 |
| 17 | 15 | 9.560612 | 10.439388 | 9.591401 | 10.408599 | 10.030790 | 9.969210 | 45 | 43 |
| 18 | 30 | 9.560693 | 10.439307 | 9.591495 | 10.408505 | 10.030802 | 9.969198 | 30 | 42 |
| 19 | 45 | 9.560774 | 10.439226 | 9.591588 | 10.408412 | 10.030814 | 9.969186 | 15 | 41 |
| 20 | 20 | 9.560855 | 10.439145 | 9.591681 | 10.408319 | 10.030827 | 9.969173 | 40 | 40 |
| 21 | 15 | 9.560935 | 10.439065 | 9.591774 | 10.408226 | 10.030839 | 9.969161 | 45 | 39 |
| 22 | 30 | 9.561016 | 10.438984 | 9.591867 | 10.408133 | 10.030851 | 9.969149 | 30 | 38 |
| 23 | 45 | 9.561097 | 10.438903 | 9.591961 | 10.408039 | 10.030864 | 9.969136 | 15 | 37 |
| 24 | 21 | 9.561178 | 10.438822 | 9.592054 | 10.407946 | 10.030876 | 9.969124 | 39 | 36 |
| 25 | 15 | 9.561259 | 10.438741 | 9.592147 | 10.407853 | 10.030888 | 9.969112 | 45 | 35 |
| 26 | 30 | 9.561339 | 10.438661 | 9.592240 | 10.407760 | 10.030901 | 9.969099 | 30 | 34 |
| 27 | 45 | 9 561420 | 10.438580 | 9.592333 | 10 407667 | 10.030913 | 9.969067 | 15 | 33 |
| 28 | 22 | 9.561501 | 10.438499 | 9.592426 | 10.407574 | 10.030925 | 9.969075 | 38 | 32 |
| 29 | 15 | 9.561582 | 10.438418 | 9.592519 | 10.407481 | 10.030938 | 9.969062 | 45 | 31 |
| 30 | 30 | 9.561662 | 10.438338 | 9.592612 | 10.407388 | 10.030950 | 9.969050 | 30 | 30 |
| 31 | 45 | 9.561743 | 10.438257 | 9.592705 | 10 407295 | 10.030962 | 9.969038 | 15 | 29 |
| 32 | 23 | 9 561824 | 10.438176 | 9.592798 | 10.407202 | 10.030975 | 9.969025 | 37 | 28 |
| 33 | 15 | 9.561904 | 10.438096 | 9.592891 | 10.407109 | 10.030987 | 9.969013 | 45 | 27 |
| 34 | 30 | 9.561985 | 10.438015 | 9.592985 | 10.407015 | 10.031000 | 9.969000 | 30 | 26 |
| 35 | 45 | 9.562066 | 10.437934 | 9.593077 | 10.406923 | 10.031012 | 9.968988 | 15 | 25 |
| 36 | 24 | 9 562146 | 10.437854 | 9.593170 | 10.406830 | 10.031024 | 9.968976 | 36 | 24 |
| 37 | 15 | 9.562227 | 10.437773 | 9.593263 | 10.406737 | 10.031037 | 9.968963 | 45 | 23 |
| 38 | 30 | 9.562307 | 10.437693 | 9.593356 | 10.406644 | 10.031049 | 9.968951 | 30 | 22 |
| 39 | 45 | 9.562388 | 10.437612 | 9.593449 | 10.406551 | 10.031061 | 9.968939 | 15 | 21 |
| 40 | 25 | 9.562468 | 10.437532 | 9.593542 | 10.406458 | 10.031074 | 9.968926 | 35 | 20 |
| 41 | 15 | 9.562549 | 10.437451 | 9.593635 | 10.406365 | 10.031086 | 9.968914 | 45 | 19 |
| 42 | 30 | 9.562629 | 10.437371 | 9.593728 | 10.406272 | 10.031099 | 9.968901 | 30 | 18 |
| 43 | 45 | 9.562710 | 10.437290 | 9.593821 | 10.406179 | 10.031111 | 9.968889 | 15 | 17 |
| 44 | 26 | 9.562790 | 10 437210 | 9.593914 | 10.406086 | 10.031123 | 9.968877 | 34 | 16 |
| 45 | 15 | 9.562871 | 10.437129 | 9 594007 | 10.405993 | 10.031136 | 9.968864 | 45 | 15 |
| 46 | 30 | 9.562951 | 10.437049 | 9.594099 | 10.405901 | 10.031148 | 9.968852 | 30 | 14 |
| 47 | 45 | 9.563032 | 10.436968 | 9.594192 | 10.405808 | 10.031161 | 9.968839 | 15 | 13 |
| 48 | 27 | 9.563112 | 10.436888 | 9.594285 | 10.405715 | 10.031173 | 9.968827 | 33 | 12 |
| 49 | 15 | 9.563192 | 10.436808 | 9.594378 | 10.405622 | 10 031185 | 9.968815 | 45 | 11 |
| 50 | 30 | 9.563273 | 10.436727 | 9.594471 | 10.405529 | 10.031198 | 9.968802 | 30 | 10 |
| 51 | 45 | 9.563353 | 10.436647 | 9.594563 | 10.405437 | 10.031210 | 9.968790 | 15 | 9 |
| 52 | 28 | 9.563433 | 10.436567 | 9.594656 | 10.405344 | 10.031223 | 9.968777 | 32 | 8 |
| 53 | 15 | 9.563514 | 10.436486 | 9.594749 | 10.405251 | 10 031235 | 9.968765 | 45 | 7 |
| 54 | 30 | 9.563594 | 10.436406 | 9.594842 | 10.405158 | 10.031248 | 9.968752 | 30 | 6 |
| 55 | 45 | 9.563674 | 10.436326 | 9.594934 | 10.405066 | 10.031260 | 9.968740 | 15 | 5 |
| 56 | 29 | 9.563755 | 10.436245 | 9.595027 | 10.404973 | 10.031272 | 9.968728 | 31 | 4 |
| 57 | 15 | 9.563835 | 10.436165 | 9.595120 | 10.404880 | 10.031285 | 9.968715 | 45 | 3 |
| 58 | 30 | 9.563915 | 10.436085 | 9.595212 | 10.404788 | 10.031297 | 9.968703 | 30 | 2 |
| 59 | 45 | 9.563995 | 10.436005 | 9.595305 | 10.404695 | 10.031310 | 9.968690 | 15 | 1 |
| 60 | 30 | 9.564075 | 10.435925 | 9.595397 | 10.404603 | 10.031322 | 9.968678 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 34m. | | | | LOG. SINES, &c. | | | | 68 deg. | |

| | 1h 26m. | | LOG. SINES, &c. (t.) | | | | 21 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.564075 | 10.435925 | 9.595397 | 10.404603 | 10.031322 | 9.968678 | 30 | 60 |
| 1 | 15 | 9.564156 | 10.435844 | 9.595490 | 10.404510 | 10.031335 | 9.968665 | 45 | 59 |
| 2 | 30 | 9.564236 | 10.435764 | 9.595583 | 10.404417 | 10.031347 | 9.968653 | 30 | 58 |
| 3 | 45 | 9.564316 | 10.435684 | 9.595675 | 10.404325 | 10.031359 | 9.968641 | 15 | 57 |
| 4 | 31 | 9.564396 | 10.435604 | 9.595768 | 10.404232 | 10.031372 | 9.968628 | 29 | 56 |
| 5 | 15 | 9.564476 | 10.435524 | 9.595860 | 10.404140 | 10.031384 | 9.968616 | 45 | 55 |
| 6 | 30 | 9.564556 | 10.435444 | 9.595953 | 10.404047 | 10.031397 | 9.968603 | 30 | 54 |
| 7 | 45 | 9.564636 | 10.435364 | 9.596045 | 10.403955 | 10.031409 | 9.968591 | 15 | 53 |
| 8 | 32 | 9.564716 | 10.435284 | 9.596138 | 10.403862 | 10.031422 | 9.968578 | 28 | 52 |
| 9 | 15 | 9.564796 | 10.435204 | 9.596230 | 10.403770 | 10.031434 | 9.968566 | 45 | 51 |
| 10 | 30 | 9.564876 | 10.435124 | 9.596323 | 10.403677 | 10.031447 | 9.968553 | 30 | 50 |
| 11 | 45 | 9.564956 | 10.435044 | 9.596415 | 10.403585 | 10.031459 | 9.968541 | 15 | 49 |
| 12 | 33 | 9.565036 | 10.434964 | 9.596508 | 10.403492 | 10.031472 | 9.968528 | 27 | 48 |
| 13 | 15 | 9.565116 | 10.434884 | 9.596600 | 10.403400 | 10.031484 | 9.968516 | 45 | 47 |
| 14 | 30 | 9.565196 | 10.434804 | 9.596693 | 10.403307 | 10.031497 | 9.968503 | 30 | 46 |
| 15 | 45 | 9.565276 | 10.434724 | 9.596785 | 10.403215 | 10.031509 | 9.968491 | 15 | 45 |
| 16 | 34 | 9.565356 | 10.434644 | 9.596878 | 10.403122 | 10.031522 | 9.968478 | 26 | 44 |
| 17 | 15 | 9.565436 | 10.434564 | 9.596970 | 10.403030 | 10.031534 | 9.968466 | 45 | 43 |
| 18 | 30 | 9.565516 | 10.434484 | 9.597062 | 10.402938 | 10.031547 | 9.968453 | 30 | 42 |
| 19 | 45 | 9.565596 | 10.434404 | 9.597155 | 10.402845 | 10.031559 | 9.968441 | 15 | 41 |
| 20 | 35 | 9.565676 | 10.434324 | 9.597247 | 10.402753 | 10.031571 | 9.968429 | 25 | 40 |
| 21 | 15 | 9.565755 | 10.434245 | 9.597339 | 10.402661 | 10.031584 | 9.968416 | 45 | 39 |
| 22 | 30 | 9.565835 | 10.434165 | 9.597432 | 10.402568 | 10.031596 | 9.968404 | 30 | 38 |
| 23 | 45 | 9.565915 | 10.434085 | 9.597524 | 10.402476 | 10.031609 | 9.968391 | 15 | 37 |
| 24 | 36 | 9.565995 | 10.434005 | 9.597616 | 10.402384 | 10.031621 | 9.968379 | 24 | 36 |
| 25 | 15 | 9.566074 | 10.433926 | 9.597708 | 10.402292 | 10.031634 | 9.968366 | 45 | 35 |
| 26 | 30 | 9.566154 | 10.433846 | 9.597801 | 10.402199 | 10.031647 | 9.968353 | 30 | 34 |
| 27 | 45 | 9.566234 | 10.433766 | 9.597893 | 10.402107 | 10.031659 | 9.968341 | 15 | 33 |
| 28 | 37 | 9.566314 | 10.433686 | 9.597985 | 10.402015 | 10.031672 | 9.968328 | 23 | 32 |
| 29 | 15 | 9.566393 | 10.433607 | 9.598077 | 10.401923 | 10.031684 | 9.968316 | 45 | 31 |
| 30 | 30 | 9.566473 | 10.433527 | 9.598170 | 10.401830 | 10.031697 | 9.968303 | 30 | 30 |
| 31 | 45 | 9.566553 | 10.433447 | 9.598262 | 10.401738 | 10.031709 | 9.968291 | 15 | 29 |
| 32 | 38 | 9.566632 | 10.433368 | 9.598354 | 10.401646 | 10.031722 | 9.968278 | 22 | 28 |
| 33 | 15 | 9.566712 | 10.433288 | 9.598446 | 10.401554 | 10.031734 | 9.968266 | 45 | 27 |
| 34 | 30 | 9.566792 | 10.433208 | 9.598538 | 10.401462 | 10.031747 | 9.968253 | 30 | 26 |
| 35 | 45 | 9.566871 | 10.433129 | 9.598630 | 10.401370 | 10.031759 | 9.968241 | 15 | 25 |
| 36 | 39 | 9.566951 | 10.433049 | 9.598722 | 10.401278 | 10.031772 | 9.968228 | 21 | 24 |
| 37 | 15 | 9.567030 | 10.432970 | 9.598815 | 10.401185 | 10.031784 | 9.968216 | 45 | 23 |
| 38 | 30 | 9.567110 | 10.432890 | 9.598907 | 10.401093 | 10.031797 | 9.968203 | 30 | 22 |
| 39 | 45 | 9.567189 | 10.432811 | 9.598999 | 10.401001 | 10.031809 | 9.968191 | 15 | 21 |
| 40 | 40 | 9.567269 | 10.432731 | 9.599091 | 10.400909 | 10.031822 | 9.968178 | 20 | 20 |
| 41 | 15 | 9.567348 | 10.432652 | 9.599183 | 10.400817 | 10.031834 | 9.968166 | 45 | 19 |
| 42 | 30 | 9.567428 | 10.432572 | 9.599275 | 10.400725 | 10.031847 | 9.968153 | 30 | 18 |
| 43 | 45 | 9.567507 | 10.432493 | 9.599367 | 10.400633 | 10.031860 | 9.968140 | 15 | 17 |
| 44 | 41 | 9.567587 | 10.432413 | 9.599459 | 10.400541 | 10.031872 | 9.968128 | 19 | 16 |
| 45 | 15 | 9.567666 | 10.432334 | 9.599551 | 10.400449 | 10.031885 | 9.968115 | 45 | 15 |
| 46 | 30 | 9.567746 | 10.432254 | 9.599643 | 10.400357 | 10.031897 | 9.968103 | 30 | 14 |
| 47 | 46 | 9.567825 | 10.432175 | 9.599735 | 10.400265 | 10.031910 | 9.968090 | 15 | 13 |
| 48 | 42 | 9.567904 | 10.432096 | 9.599827 | 10.400173 | 10.031922 | 9.968078 | 18 | 12 |
| 49 | 15 | 9.567984 | 10.432016 | 9.599919 | 10.400081 | 10.031935 | 9.968065 | 45 | 11 |
| 50 | 30 | 9.568063 | 10.431937 | 9.600010 | 10.399990 | 10.031948 | 9.968052 | 30 | 10 |
| 51 | 45 | 9.568142 | 10.431858 | 9.600102 | 10.399898 | 10.031960 | 9.968040 | 15 | 9 |
| 52 | 43 | 9.568222 | 10.431778 | 9.600194 | 10.399806 | 10.031973 | 9.968027 | 17 | 8 |
| 53 | 15 | 9.568301 | 10.431699 | 9.600286 | 10.399714 | 10.031985 | 9.968015 | 45 | 7 |
| 54 | 30 | 9.568380 | 10.431620 | 9.600378 | 10.399622 | 10.031998 | 9.968002 | 30 | 6 |
| 55 | 45 | 9.568459 | 10.431541 | 9.600470 | 10.399530 | 10.032010 | 9.967990 | 15 | 5 |
| 56 | 44 | 9.568539 | 10.431461 | 9.600562 | 10.399438 | 10.032023 | 9.967977 | 16 | 4 |
| 57 | 15 | 9.568618 | 10.431382 | 9.600653 | 10.399347 | 10.032036 | 9.967964 | 45 | 3 |
| 58 | 30 | 9.568697 | 10.431303 | 9.600745 | 10.399255 | 10.032048 | 9.967952 | 30 | 2 |
| 59 | 45 | 9.568776 | 10.431224 | 9.600837 | 10.399163 | 10.032061 | 9.967939 | 15 | 1 |
| 60 | 45 | 9.568855 | 10.431145 | 9.600929 | 10.399071 | 10.032073 | 9.967927 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 4h 33m. | LOG. SINES, &c. | 68 deg. |
|---|---|---|

| 1h 27m. | | | LOG. SINES, &c. (t.) | | | | 21 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9 568855 | 10.431145 | 9.600929 | 10 399071 | 10.032073 | 9.967927 | 15 | 60 |
| 1 | 15 | 9.568935 | 10.431065 | 9.601021 | 10.398979 | 10.032086 | 9.967914 | 45 | 59 |
| 2 | 30 | 9.569014 | 10.430986 | 9.601112 | 10.398888 | 10.032099 | 9.967901 | 30 | 58 |
| 3 | 45 | 9.569093 | 10.430907 | 9.601204 | 10.398796 | 10.032111 | 9.967889 | 15 | 57 |
| 4 | 46 | 9.569172 | 10.430828 | 9.601296 | 10.398704 | 10.032124 | 9 967876 | 14 | 56 |
| 5 | 15 | 9.569251 | 10.430749 | 9.601387 | 10.398613 | 10.032136 | 9.967864 | 45 | 55 |
| 6 | 30 | 9.569330 | 10.430670 | 9 601479 | 10.398521 | 10.032149 | 9.967851 | 30 | 54 |
| 7 | 45 | 9.569409 | 10.430591 | 9.601571 | 10.398429 | 10.032162 | 9.967838 | 15 | 53 |
| 8 | 47 | 9.569488 | 10.430512 | 9 601662 | 10.398338 | 10.032174 | 9.967826 | 13 | 52 |
| 9 | 15 | 9.569567 | 10.430433 | 9.601754 | 10.398246 | 10.032187 | 9.967813 | 45 | 51 |
| 10 | 30 | 9.569646 | 10.430354 | 9.601846 | 10.398154 | 10.032200 | 9.967800 | 30 | 50 |
| 11 | 45 | 9.569725 | 10.430275 | 9.601937 | 10.398063 | 10.032212 | 9.967788 | 15 | 49 |
| 12 | 48 | 9.569804 | 10.430196 | 9.602029 | 10.397971 | 10.032225 | 9.967775 | 12 | 48 |
| 13 | 15 | 9.569883 | 10.430117 | 9.602121 | 10.397879 | 10.032237 | 9.967763 | 45 | 47 |
| 14 | 30 | 9.569962 | 10.430038 | 9.602212 | 10.397788 | 10 032250 | 9.967750 | 30 | 46 |
| 15 | 45 | 9.570041 | 10.429959 | 9.602304 | 10.397696 | 10.032263 | 9.967737 | 15 | 45 |
| 16 | 49. | 9.570120 | 10.429880 | 9.602395 | 10.397605 | 10.032275 | 9.967725 | 11 | 44 |
| 17 | 15 | 9.570199 | 10.429801 | 9.602487 | 10.397513 | 10.032288 | 9 967712 | 45 | 43 |
| 18 | 30 | 9.570278 | 10.429722 | 9.602578 | 10.397422 | 10.032301 | 9.967699 | 30 | 42 |
| 19 | 45 | 9.570357 | 10.429643 | 9.602670 | 10.397330 | 10.032313 | 9.967687 | 15 | 41 |
| 20 | 50 | 9.570435 | 10.429565 | 9.602761 | 10.397239 | 10.032326 | 9.967674 | 10 | 40 |
| 21 | 15 | 9.570514 | 10.429486 | 9.602853 | 10.397147 | 10.032339 | 9.967661 | 45 | 39 |
| 22 | 30 | 9.570593 | 10.429407 | 9.602944 | 10.397056 | 10.032351 | 9.967649 | 30 | 38 |
| 23 | 45 | 9.570672 | 10.429328 | 9.603036 | 10.396964 | 10.032364 | 9.967636 | 15 | 37 |
| 24 | 51 | 9.570751 | 10.429249 | 9.603127 | 10.396873 | 10.032377 | 9.967623 | 9 | 36 |
| 25 | 15 | 9.570829 | 10.429171 | 9.603219 | 10.396781 | 10.032389 | 9.967611 | 45 | 35 |
| 26 | 30 | 9.570908 | 10.429092 | 9 603310 | 10.396690 | 10.032402 | 9.967598 | 30 | 34 |
| 27 | 45 | 9.570987 | 10.429013 | 9 603401 | 10.396599 | 10.032415 | 9.967585 | 15 | 33 |
| 28 | 52 | 9.571066 | 10.428934 | 9.603493 | 10.396507 | 10.032427 | 9.967573 | 8 | 32 |
| 29 | 15 | 9.571144 | 10.428856 | 9.603584 | 10.396416 | 10.032440 | 9.967560 | 45 | 31 |
| 30 | 30 | 9.571223 | 10.428777 | 9.603675 | 10.396325 | 10.032453 | 9.967547 | 30 | 30 |
| 31 | 45 | 9.571302 | 10.428698 | 9.603767 | 10.396233 | 10.032465 | 9.967535 | 15 | 29 |
| 32 | 53 | 9.571380 | 10.428620 | 9.603858 | 10.396142 | 10.032478 | 9.967522 | 7 | 28 |
| 33 | 15 | 9.571459 | 10.428541 | 9.603949 | 10.396051 | 10.032491 | 9.967509 | 45 | 27 |
| 34 | 30 | 9.571537 | 10.428463 | 9.604041 | 10.395959 | 10.032503 | 9.967497 | 30 | 26 |
| 35 | 45 | 9.571616 | 10.428384 | 9.604132 | 10.395868 | 10.032516 | 9.967484 | 15 | 25 |
| 36 | 54 | 9.571695 | 10.428305 | 9.604223 | 10.395777 | 10.032529 | 9.967471 | 6 | 24 |
| 37 | 15 | 9.571773 | 10.428227 | 9.604314 | 10.395686 | 10.032541 | 9.967459 | 45 | 23 |
| 38 | 30 | 9.571852 | 10.428148 | 9.604406 | 10.395594 | 10.032554 | 9.967446 | 30 | 22 |
| 39 | 45 | 9.571930 | 10.428070 | 9.604497 | 10.395503 | 10.032567 | 9.967433 | 15 | 21 |
| 40 | 55 | 9.572009 | 10.427991 | 9.604588 | 10.395412 | 10.032580 | 9.967420 | 5 | 20 |
| 41 | 15 | 9.572087 | 10.427913 | 9.604679 | 10.395321 | 10.032592 | 9.967408 | 45 | 19 |
| 42 | 30 | 9.572166 | 10.427834 | 9.604771 | 10.395229 | 10.032605 | 9.967395 | 30 | 18 |
| 43 | 45 | 9.572244 | 10.427756 | 9.604862 | 10.395138 | 10.032618 | 9.967382 | 15 | 17 |
| 44 | 56 | 9.572323 | 10.427677 | 9.604953 | 10.395047 | 10.032630 | 9.967370 | 4 | 16 |
| 45 | 15 | 9.572401 | 10.427599 | 9.605044 | 10.394956 | 10.032643 | 9.967357 | 45 | 15 |
| 46 | 30 | 9.572479 | 10.427521 | 9.605135 | 10.394865 | 10.032656 | 9.967344 | 30 | 14 |
| 47 | 45 | 9.572558 | 10.427442 | 9.605226 | 10.394774 | 10.032669 | 9.967331 | 15 | 13 |
| 48 | 57 | 9.572636 | 10.427364 | 9.605317 | 10.394683 | 10.032681 | 9.967319 | 3 | 12 |
| 49 | 15 | 9.572715 | 10.427285 | 9.605408 | 10.394592 | 10.032694 | 9.967306 | 45 | 11 |
| 50 | 30 | 9.572793 | 10.427207 | 9.605500 | 10.394500 | 10.032707 | 9.967293 | 30 | 10 |
| 51 | 45 | 9.572871 | 10.427129 | 9.605591 | 10.394409 | 10.032719 | 9 967281 | 15 | 9 |
| 52 | 58 | 9.572949 | 10.427051 | 9.605682 | 10.394318 | 10.032732 | 9.967268 | 2 | 8 |
| 53 | 15 | 9.573028 | 10.426972 | 9.605773 | 10.394227 | 10.032745 | 9.967255 | 45 | 7 |
| 54 | 30 | 9.573106 | 10.426894 | 9.605864 | 10.394136 | 10.032758 | 9.967242 | 30 | 6 |
| 55 | 45 | 9.573184 | 10.426816 | 9.605955 | 10.394045 | 10.032770 | 9.967230 | 15 | 5 |
| 56 | 59 | 9.573263 | 10.426737 | 9 606046 | 10.393954 | 10.032783 | 9.967217 | 1 | 4 |
| 57 | 15 | 9.573341 | 10.426659 | 9.606137 | 10.393863 | 10.032796 | 9.967204 | 45 | 3 |
| 58 | 30 | 9 573419 | 10.426581 | 9.606228 | 10.393772 | 10.032809 | 9.967191 | 30 | 2 |
| 59 | 45 | 9.573497 | 10.426503 | 9.606319 | 10.393681 | 10.032821 | 9.967179 | 15 | 1 |
| 60 | 60 | 9.573575 | 10.426425 | 9.606410 | 10.393590 | 10.032834 | 9.967166 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 32m. | | | LOG. SINES, &c. | | | | 68 deg. | | |

| 1h 28m | | | LOG. SINES, &c. (t.) | | | | 22 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.573575 | 10.426425 | 9.606410 | 10.393590 | 10.032834 | 9.967166 | 60 | 60 |
| 1 | 15 | 9.573654 | 10.426346 | 9.606500 | 10.393500 | 10.032847 | 9.967153 | 45 | 59 |
| 2 | 30 | 9.573732 | 10.426268 | 9.606591 | 10.393409 | 10.032860 | 9.967140 | 30 | 58 |
| 3 | 45 | 9.573810 | 10.426190 | 9.606682 | 10.393318 | 10.032872 | 9.967128 | 15 | 57 |
| 4 | 1 | 9.573888 | 10.426112 | 9.606773 | 10.393227 | 10.032885 | 9.967115 | 59 | 56 |
| 5 | 15 | 9.573966 | 10.426034 | 9.606864 | 10.393136 | 10.032898 | 9.967102 | 45 | 55 |
| 6 | 30 | 9.574044 | 10.425956 | 9.606955 | 10.393045 | 10.032911 | 9.967089 | 30 | 54 |
| 7 | 45 | 9.574122 | 10.425878 | 9.607046 | 10.392954 | 10.032924 | 9.967076 | 15 | 53 |
| 8 | 2 | 9.574200 | 10.425800 | 9.607137 | 10.392863 | 10.032936 | 9.967064 | 58 | 52 |
| 9 | 15 | 9.574278 | 10.425722 | 9.607227 | 10.392773 | 10.032949 | 9.967051 | 45 | 51 |
| 10 | 30 | 9.574356 | 10.425644 | 9.607318 | 10.392682 | 10.032962 | 9.967038 | 30 | 50 |
| 11 | 45 | 9.574434 | 10.425566 | 9.607409 | 10.392591 | 10.032975 | 9.967025 | 15 | 49 |
| 12 | 3 | 9.574512 | 10.425488 | 9.607500 | 10.392500 | 10.032988 | 9.967012 | 57 | 48 |
| 13 | 15 | 9.574590 | 10.425410 | 9.607590 | 10.392410 | 10.033000 | 9.967000 | 45 | 47 |
| 14 | 30 | 9.574668 | 10.425332 | 9.607681 | 10.392319 | 10.033013 | 9.966987 | 30 | 46 |
| 15 | 45 | 9.574746 | 10.425254 | 9.607772 | 10.392228 | 10.033026 | 9.966974 | 15 | 45 |
| 16 | 4 | 9.574824 | 10.425176 | 9.607863 | 10.392137 | 10.033039 | 9.966961 | 56 | 44 |
| 17 | 15 | 9.574902 | 10.425098 | 9.607953 | 10.392047 | 10.033052 | 9.966948 | 45 | 43 |
| 18 | 30 | 9.574980 | 10.425020 | 9.608044 | 10.391956 | 10.033064 | 9.966936 | 30 | 42 |
| 19 | 45 | 9.575058 | 10.424942 | 9.608135 | 10.391865 | 10.033077 | 9.966923 | 15 | 41 |
| 20 | 5 | 9.575136 | 10.424864 | 9.608225 | 10.391775 | 10.033090 | 9.966910 | 55 | 40 |
| 21 | 15 | 9.575213 | 10.424787 | 9.608316 | 10.391684 | 10.033103 | 9.966897 | 45 | 39 |
| 22 | 30 | 9.575291 | 10.424709 | 9.608407 | 10.391593 | 10.033116 | 9.966884 | 30 | 38 |
| 23 | 45 | 9.575369 | 10.424631 | 9.608497 | 10.391503 | 10.033128 | 9.966872 | 15 | 37 |
| 24 | 6 | 9.575447 | 10.424553 | 9.608588 | 10.391412 | 10.033141 | 9.966859 | 54 | 36 |
| 25 | 15 | 9.575525 | 10.424475 | 9.608679 | 10.391321 | 10.033154 | 9.966846 | 45 | 35 |
| 26 | 30 | 9.575602 | 10.424398 | 9.608769 | 10.391231 | 10.033167 | 9.966833 | 30 | 34 |
| 27 | 45 | 9.575680 | 10.424320 | 9.608860 | 10.391140 | 10.033180 | 9.966820 | 15 | 33 |
| 28 | 7 | 9.575758 | 10.424242 | 9.608950 | 10.391050 | 10.033193 | 9.966807 | 53 | 32 |
| 29 | 15 | 9.575835 | 10.424165 | 9.609041 | 10.390959 | 10.033205 | 9.966795 | 45 | 31 |
| 30 | 30 | 9.575913 | 10.424087 | 9.609131 | 10.390869 | 10.033218 | 9.966782 | 30 | 30 |
| 31 | 45 | 9.575991 | 10.424009 | 9.609222 | 10.390778 | 10.033231 | 9.966769 | 15 | 29 |
| 32 | 8 | 9.576068 | 10.423932 | 9.609312 | 10.390688 | 10.033244 | 9.966756 | 52 | 28 |
| 33 | 15 | 9.576146 | 10.423854 | 9.609403 | 10.390597 | 10.033257 | 9.966743 | 45 | 27 |
| 34 | 30 | 9.576224 | 10.423776 | 9.609493 | 10.390507 | 10.033270 | 9.966730 | 30 | 26 |
| 35 | 45 | 9.576301 | 10.423699 | 9.609584 | 10.390416 | 10.033282 | 9.966718 | 15 | 25 |
| 36 | 9 | 9.576379 | 10.423621 | 9.609674 | 10.390326 | 10.033295 | 9.966705 | 51 | 24 |
| 37 | 15 | 9.576457 | 10.423543 | 9.609765 | 10.390235 | 10.033308 | 9.966692 | 45 | 23 |
| 38 | 30 | 9.576534 | 10.423466 | 9.609855 | 10.390145 | 10.033321 | 9.966679 | 30 | 22 |
| 39 | 45 | 9.576612 | 10.423388 | 9.609945 | 10.390055 | 10.033334 | 9.966666 | 15 | 21 |
| 40 | 10 | 9.576689 | 10.423311 | 9.610036 | 10.389964 | 10.033347 | 9.966653 | 50 | 20 |
| 41 | 15 | 9.576767 | 10.423233 | 9.610126 | 10.389874 | 10.033360 | 9.966640 | 45 | 19 |
| 42 | 30 | 9.576844 | 10.423156 | 9.610217 | 10.389783 | 10.033372 | 9.966628 | 30 | 18 |
| 43 | 45 | 9.576922 | 10.423078 | 9.610307 | 10.389693 | 10.033385 | 9.966615 | 15 | 17 |
| 44 | 11 | 9.576999 | 10.423001 | 9.610397 | 10.389603 | 10.033398 | 9.966602 | 49 | 16 |
| 45 | 15 | 9.577077 | 10.422923 | 9.610488 | 10.389512 | 10.033411 | 9.966589 | 45 | 15 |
| 46 | 30 | 9.577154 | 10.422846 | 9.610578 | 10.389422 | 10.033424 | 9.966576 | 30 | 14 |
| 47 | 45 | 9.577231 | 10.422769 | 9.610668 | 10.389332 | 10.033437 | 9.966563 | 15 | 13 |
| 48 | 12 | 9.577309 | 10.422691 | 9.610759 | 10.389241 | 10.033450 | 9.966550 | 48 | 12 |
| 49 | 15 | 9.577386 | 10.422614 | 9.610849 | 10.389151 | 10.033463 | 9.966537 | 45 | 11 |
| 50 | 30 | 9.577464 | 10.422536 | 9.610939 | 10.389061 | 10.033476 | 9.966524 | 30 | 10 |
| 51 | 45 | 9.577541 | 10.422459 | 9.611029 | 10.388971 | 10.033488 | 9.966512 | 15 | 9 |
| 52 | 13 | 9.577618 | 10.422382 | 9.611120 | 10.388880 | 10.033501 | 9.966499 | 47 | 8 |
| 53 | 15 | 9.577696 | 10.422304 | 9.611210 | 10.388790 | 10.033514 | 9.966486 | 45 | 7 |
| 54 | 30 | 9.577773 | 10.422227 | 9.611300 | 10.388700 | 10.033527 | 9.966473 | 30 | 6 |
| 55 | 45 | 9.577850 | 10.422150 | 9.611390 | 10.388610 | 10.033540 | 9.966460 | 15 | 5 |
| 56 | 14 | 9.577927 | 10.422073 | 9.611480 | 10.388520 | 10.033553 | 9.966447 | 46 | 4 |
| 57 | 15 | 9.578005 | 10.421995 | 9.611570 | 10.388430 | 10.033566 | 9.966434 | 45 | 3 |
| 58 | 30 | 9.578082 | 10.421918 | 9.611661 | 10.388339 | 10.033579 | 9.966421 | 30 | 2 |
| 59 | 45 | 9.578159 | 10.421841 | 9.611751 | 10.388249 | 10.033592 | 9.966408 | 15 | 1 |
| 60 | 15 | 9.578236 | 10.421764 | 9.611841 | 10.388159 | 10.033606 | 9.966395 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 31 . | | | LOG. SINES, &c. | | | | 67 deg. | | |

| 1h 29m | | LOG. SINES, &c. (t.) | | | | | 22 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.578236 | 10.421764 | 9.611841 | 10.388159 | 10.033605 | 9.966395 | 45 | 60 |
| 1 | 15 | 9.578314 | 10.421686 | 9.611931 | 10.388069 | 10.033618 | 9.966382 | 45 | 59 |
| 2 | 30 | 9.578391 | 10.421609 | 9.612021 | 10.387979 | 10.033630 | 9.966370 | 30 | 58 |
| 3 | 45 | 9.578468 | 10.421532 | 9.612111 | 10.387889 | 10.033643 | 9.966357 | 15 | 57 |
| 4 | 16 | 9.578545 | 10.421455 | 9.612201 | 10 387799 | 10.033656 | 9.966344 | 44 | 56 |
| 5 | 15 | 9.578622 | 10.421378 | 9.612291 | 10.387709 | 10.033669 | 9.966331 | 45 | 55 |
| 6 | 30 | 9.578699 | 10,421301 | 9.612381 | 10.387619 | 10.033682 | 9.966318 | 30 | 54 |
| 7 | 45 | 9.578776 | 10.421224 | 9.612471 | 10.387529 | 10.033695 | 9.966305 | 15 | 53 |
| 8 | 17 | 9.578853 | 10.421147 | 9.612561 | 10.387439 | 10.033708 | 9.966292 | 43 | 52 |
| 9 | 15 | 9.578930 | 10.421070 | 9.612651 | 10.387349 | 10.033721 | 9.966279 | 45 | 51 |
| 10 | 30 | 9.579008 | 10.420992 | 9.612741 | 10.387259 | 10.033734 | 9.966266 | 30 | 50 |
| 11 | 45 | 9.579085 | 10.420915 | 9.612831 | 10.387169 | 10.033747 | 9.966253 | 15 | 49 |
| 12 | 18 | 9.579162 | 10.420838 | 9.612921 | 10.387079 | 10.033760 | 9.966240 | 42 | 48 |
| 13 | 15 | 9.579239 | 10.420761 | 9.613011 | 10.386989 | 10.033773 | 9.966227 | 45 | 47 |
| 14 | 30 | 9.579316 | 10.420684 | 9.613101 | 10.386899 | 10.033786 | 9.966214 | 30 | 46 |
| 15 | 45 | 9.579393 | 10.420607 | 9.613191 | 10.386809 | 10.033799 | 9.966201 | 15 | 45 |
| 16 | 19 | 9.579469 | 10.420531 | 9.613281 | 10.386719 | 10.033812 | 9.966188 | 41 | 44 |
| 17 | 15 | 9.579546 | 10.420454 | 9.613371 | 10.386629 | 10.033825 | 9.966175 | 45 | 43 |
| 18 | 30 | 9.579623 | 10.420377 | 9.613461 | 10.386539 | 10.033838 | 9.966162 | 30 | 42 |
| 19 | 45 | 9.579700 | 10.420300 | 9·613551 | 10.386449 | 10.033851 | 9.966149 | 15 | 41 |
| 20 | 20 | 9.579777 | 10.420223 | 9.613641 | 10.386359 | 10.033864 | 9.966136 | 40 | 40 |
| 21 | 15 | 9.579854 | 10.420146 | 9.613730 | 10.386270 | 10.033877 | 9.966123 | 45 | 39 |
| 22 | 30 | 9.579931 | 10.420069 | 9.613820 | 10.386180 | 10.033890 | 9.966110 | 30 | 38 |
| 23 | 45 | 9.580008 | 10.419992 | 9.613910 | 10.386090 | 10.033903 | 9.966097 | 15 | 37 |
| 24 | 21 | 9.580084 | 10.419916 | 9.614000 | 10.386000 | 10.033915 | 9.966085 | 39 | 36 |
| 25 | 15 | 9.580161 | 10.419839 | 9.614090 | 10.385910 | 10.033928 | 9.966072 | 45 | 35 |
| 26 | 30 | 9.580238 | 10.419762 | 9.614180 | 10.385820 | 10.033941 | 9.966059 | 30 | 34 |
| 27 | 45 | 9.580315 | 10.419685 | 9.614269 | 10.385731 | 10.033954 | 9.966046 | 15 | 33 |
| 28 | 22 | 9.580392 | 10.419608 | 9.614359 | 10.385641 | 10.033967 | 9.966033 | 38 | 32 |
| 29 | 15 | 9.580468 | 10.419532 | 9.614449 | 10.385551 | 10.033980 | 9.966020 | 45 | 31 |
| 30 | 30 | 9.580545 | 10.419455 | 9.614539 | 10.385461 | 10.033993 | 9.966007 | 30 | 30 |
| 31 | 45 | 9.580622 | 10.419378 | 9.614628 | 10.385372 | 10.034006 | 9.965994 | 15 | 29 |
| 32 | 23 | 9.580699 | 10.419301 | 9.614718 | 10.385282 | 10.034019 | 9.965981 | 37 | 28 |
| 33 | 15 | 9.580775 | 10.419225 | 9.614808 | 10.385192 | 10.034032 | 9.965968 | 45 | 27 |
| 34 | 30 | 9.580852 | 10.419148 | 9.614897 | 10.385103 | 10.034045 | 9.965955 | 30 | 26 |
| 35 | 45 | 9.580929 | 10.419071 | 9.614987 | 10.385013 | 10.034058 | 9.965942 | 15 | 25 |
| 36 | 24 | 9.581005 | 10.418995 | 9.615077 | 10.384923 | 10.034072 | 9.965928 | 36 | 24 |
| 37 | 15 | 9.581082 | 10.418918 | 9.615166 | 10.384834 | 10.034085 | 9.965915 | 45 | 23 |
| 38 | 30 | 9.581158 | 10 418842 | 9.615256 | 10.384744 | 10.034098 | 9.965902 | 30 | 22 |
| 39 | 45 | 9 581235 | 10.418765 | 9.615345 | 10.384655 | 10.034111 | 9.965889 | 15 | 21 |
| 40 | 25 | 9.581312 | 10.418688 | 9.615435 | 10.384565 | 10.034124 | 9.965876 | 35 | 20 |
| 41 | 15 | 9.581388 | 10.418612 | 9.615525 | 10.384475 | 10.034137 | 9.965863 | 45 | 19 |
| 42 | 30 | 9.581465 | 10.418535 | 9.615614 | 10.384386 | 10.034150 | 9.965850 | 30 | 18 |
| 43 | 45 | 9.581541 | 10.418459 | 9.615704 | 10.384296 | 10.034163 | 9.965837 | 15 | 17 |
| 44 | 26 | 9.58·618 | 10.418382 | 9.615793 | 10.384207 | 10.034176 | 9.965824 | 34 | 16 |
| 45 | 15 | 9.581694 | 10.418306 | 9.615883 | 10.384117 | 10.034189 | 9.965811 | 45 | 15 |
| 46 | 30 | 9.581771 | 10.418229 | 9.615972 | 10.384028 | 10.034202 | 9.965798 | 30 | 14 |
| 47 | 45 | 9.581847 | 10.418153 | 9.616062 | 10.383938 | 10.034215 | 9.965785 | 15 | 13 |
| 48 | 27 | 9.581924 | 10.418076 | 9.616151 | 10.383849 | 10.034228 | 9.965772 | 33 | 12 |
| 49 | 15 | 9.582000 | 10.418000 | 9.616241 | 10.383759 | 10.034241 | 9.965759 | 45 | 11 |
| 50 | 30 | 9.582076 | 10.417924 | 9.616330 | 10.383670 | 10.034254 | 9.965746 | 30 | 10 |
| 51 | 45 | 9.582153 | 10.417847 | 9.616420 | 10.383580 | 10.034267 | 9.965733 | 15 | 9 |
| 52 | 28 | 9.582229 | 10.417771 | 9 616509 | 10.383491 | 10.034280 | 9.965720 | 32 | 8 |
| 53 | 15 | 9.582305 | 10.417695 | 9.616599 | 10.383401 | 10.034293 | 9.965707 | 45 | 7 |
| 54 | 30 | 9 582382 | 10.417618 | 9 616688 | 10.383312 | 10.034306 | 9.965694 | 30 | 6 |
| 55 | 45 | 9.582458 | 10.417542 | 9.616777 | 10 383223 | 10.034319 | 9 965681 | 15 | 5 |
| 56 | 29 | 9.582534 | 10.417466 | 9.616867 | 10.383133 | 10.034332 | 9.965668 | 31 | 4 |
| 57 | 15 | 9.582611 | 10.417389 | 9.616956 | 10.383044 | 10.034345 | 9.965655 | 45 | 3 |
| 58 | 30 | 9.582687 | 10.417313 | 9.617046 | 10.382954 | 10.034359 | 9.965641 | 30 | 2 |
| 59 | 45 | 9.582763 | 10.417237 | 9.617135 | 10.382865 | 10.034372 | 9.965628 | 15 | 1 |
| 60 | 30 | 9.582840 | 10.417160 | 9.617224 | 10.382776 | 10.034385 | 9.965615 | 30 | 0 |
| ″ | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 30m. | | | LOG. SINES, &c. | | | | | 67 deg. | |

| 1h 30m. | | | LOG. SINES, &c. (t.) | | | | 22 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.582840 | 10.417160 | 9.617224 | 10.382776 | 10.034385 | 9.965615 | 30 | 60 |
| 1 | 15 | 9.582916 | 10.417084 | 9.617314 | 10.382686 | 10.034398 | 9.965602 | 45 | 59 |
| 2 | 30 | 9.582992 | 10.417008 | 9.617403 | 10.382597 | 10.034411 | 9.965589 | 30 | 58 |
| 3 | 45 | 9.583068 | 10.416932 | 9.617492 | 10.382508 | 10.034424 | 9.965576 | 15 | 57 |
| 4 | 31 | 9.583144 | 10.416856 | 9.617581 | 10.382419 | 10.034437 | 9.965563 | 29 | 56 |
| 5 | 15 | 9.583221 | 10.416779 | 9.617671 | 10.382329 | 10.034450 | 9.965550 | 45 | 55 |
| 6 | 30 | 9.583297 | 10.416703 | 9.617760 | 10.382240 | 10.034463 | 9.965537 | 30 | 54 |
| 7 | 45 | 9.583373 | 10.416627 | 9.617849 | 10.382151 | 10.034476 | 9.965524 | 15 | 53 |
| 8 | 32 | 9.583449 | 10.416551 | 9.617938 | 10.382062 | 10.034489 | 9.965511 | 28 | 52 |
| 9 | 15 | 9.583525 | 10.416475 | 9.618028 | 10.381972 | 10.034503 | 9.965497 | 45 | 51 |
| 10 | 30 | 9.583601 | 10.416399 | 9.618117 | 10.381883 | 10.034516 | 9.965484 | 30 | 50 |
| 11 | 45 | 9.583677 | 10.416323 | 9.618206 | 10.381794 | 10.034529 | 9.965471 | 15 | 49 |
| 12 | 33 | 9.583753 | 10.416247 | 9.618295 | 10.381705 | 10.034542 | 9.965458 | 27 | 48 |
| 13 | 15 | 9.583830 | 10.416170 | 9.618384 | 10.381616 | 10.034555 | 9.965445 | 45 | 47 |
| 14 | 30 | 9.583906 | 10.416094 | 9.618474 | 10.381526 | 10.034568 | 9.965432 | 30 | 46 |
| 15 | 45 | 9.583982 | 10.416018 | 9.618563 | 10.381437 | 10.034581 | 9.965419 | 15 | 45 |
| 16 | 34 | 9.584058 | 10.415942 | 9.618652 | 10.381348 | 10.034594 | 9.965406 | 26 | 44 |
| 17 | 15 | 9.584134 | 10.415866 | 9.618741 | 10.381259 | 10.034607 | 9.965393 | 45 | 43 |
| 18 | 30 | 9.584210 | 10.415790 | 9.618830 | 10.381170 | 10.034621 | 9.965379 | 30 | 42 |
| 19 | 45 | 9.584285 | 10.415715 | 9.618919 | 10.381081 | 10.034634 | 9.965366 | 15 | 41 |
| 20 | 35 | 9.584361 | 10.415639 | 9.619008 | 10.380992 | 10.034647 | 9.965353 | 25 | 40 |
| 21 | 15 | 9.584437 | 10.415563 | 9.619097 | 10.380903 | 10.034660 | 9.965340 | 45 | 39 |
| 22 | 30 | 9.584513 | 10.415487 | 9.619186 | 10.380814 | 10.034673 | 9.965327 | 30 | 38 |
| 23 | 45 | 9.584589 | 10.415411 | 9.619275 | 10.380725 | 10.034686 | 9.965314 | 15 | 37 |
| 24 | 36 | 9.584665 | 10.415335 | 9.619364 | 10.380636 | 10.034699 | 9.965301 | 24 | 36 |
| 25 | 15 | 9.584741 | 10.415259 | 9.619453 | 10.380547 | 10.034713 | 9.965287 | 45 | 35 |
| 26 | 30 | 9.584817 | 10.415183 | 9.619542 | 10.380458 | 10.034726 | 9.965274 | 30 | 34 |
| 27 | 45 | 9.584893 | 10.415107 | 9.619631 | 10.380369 | 10.034739 | 9.965261 | 15 | 33 |
| 28 | 37 | 9.584968 | 10.415032 | 9.619720 | 10.380280 | 10.034752 | 9.965248 | 23 | 32 |
| 29 | 15 | 9.585044 | 10.414956 | 9.619809 | 10.380191 | 10.034765 | 9.965235 | 45 | 31 |
| 30 | 30 | 9.585120 | 10.414880 | 9.619898 | 10.380102 | 10.034778 | 9.965222 | 30 | 30 |
| 31 | 45 | 9.585196 | 10.414804 | 9.619987 | 10.380013 | 10.034792 | 9.965208 | 15 | 29 |
| 32 | 38 | 9.585272 | 10.414728 | 9.620076 | 10.379924 | 10.034805 | 9.965195 | 22 | 28 |
| 33 | 15 | 9.585347 | 10.414653 | 9.620165 | 10.379835 | 10.034818 | 9.965182 | 45 | 27 |
| 34 | 30 | 9.585423 | 10.414577 | 9.620254 | 10.379746 | 10.034831 | 9.965169 | 30 | 26 |
| 35 | 45 | 9.585499 | 10.414501 | 9.620343 | 10.379657 | 10.034844 | 9.965156 | 15 | 25 |
| 36 | 39 | 9.585574 | 10.414426 | 9.620432 | 10.379568 | 10.034857 | 9.965143 | 21 | 24 |
| 37 | 15 | 9.585650 | 10.414350 | 9.620521 | 10.379479 | 10.034871 | 9.965129 | 45 | 23 |
| 38 | 30 | 9.585726 | 10.414274 | 9.620609 | 10.379391 | 10.034884 | 9.965116 | 30 | 22 |
| 39 | 45 | 9.585801 | 10.414199 | 9.620698 | 10.379302 | 10.034897 | 9.965103 | 15 | 21 |
| 40 | 40 | 9.585877 | 10.414123 | 9.620787 | 10.379213 | 10.034910 | 9.965090 | 20 | 20 |
| 41 | 15 | 9.585953 | 10.414047 | 9.620876 | 10.379124 | 10.034923 | 9.965077 | 45 | 19 |
| 42 | 30 | 9.586028 | 10.413972 | 9.620965 | 10.379035 | 10.034937 | 9.965063 | 30 | 18 |
| 43 | 45 | 9.586104 | 10.413896 | 9.621054 | 10.378946 | 10.034950 | 9.965050 | 15 | 17 |
| 44 | 41 | 9.586179 | 10.413821 | 9.621142 | 10.378858 | 10.034963 | 9.965037 | 19 | 16 |
| 45 | 15 | 9.586255 | 10.413745 | 9.621231 | 10.378769 | 10.034976 | 9.965024 | 45 | 15 |
| 46 | 30 | 9.586330 | 10.413670 | 9.621320 | 10.378680 | 10.034989 | 9.965011 | 30 | 14 |
| 47 | 45 | 9.586406 | 10.413594 | 9.621409 | 10.378591 | 10.035003 | 9.964997 | 15 | 13 |
| 48 | 42 | 9.586482 | 10.413518 | 9.621497 | 10.378503 | 10.035016 | 9.964984 | 18 | 12 |
| 49 | 15 | 9.586557 | 10.413443 | 9.621586 | 10.378414 | 10.035029 | 9.964971 | 45 | 11 |
| 50 | 30 | 9.586632 | 10.413368 | 9.621675 | 10.378325 | 10.035042 | 9.964958 | 30 | 10 |
| 51 | 45 | 9.586708 | 10.413292 | 9.621763 | 10.378237 | 10.035055 | 9.964945 | 15 | 9 |
| 52 | 43 | 9.586783 | 10.413217 | 9.621852 | 10.378148 | 10.035069 | 9.964931 | 17 | 8 |
| 53 | 15 | 9.586859 | 10.413141 | 9.621941 | 10.378059 | 10.035082 | 9.964918 | 45 | 7 |
| 54 | 30 | 9.586934 | 10.413066 | 9.622029 | 10.377971 | 10.035095 | 9.964905 | 30 | 6 |
| 55 | 45 | 9.587010 | 10.412990 | 9.622118 | 10.377882 | 10.035108 | 9.964892 | 15 | 5 |
| 56 | 44 | 9.587085 | 10.412915 | 9.622207 | 10.377793 | 10.035122 | 9.964878 | 16 | 4 |
| 57 | 15 | 9.587160 | 10.412840 | 9.622295 | 10.377705 | 10.035135 | 9.964865 | 45 | 3 |
| 58 | 30 | 9.587236 | 10.412764 | 9.622384 | 10.377616 | 10.035148 | 9.964852 | 30 | 2 |
| 59 | 45 | 9.587311 | 10.412689 | 9.622472 | 10.377528 | 10.035161 | 9.964839 | 15 | 1 |
| 60 | 45 | 9.587386 | 10.412614 | 9.622561 | 10.377439 | 10.035174 | 9.964826 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant | sine. | ″ ′ | sec. |
| 4h 29m. | | | LOG. SINES, &c. | | | | 67 deg. | | |

| 1h 31m. | | LOG. SINES, &c. (t.) | | | | | 22 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | ver. |
| 0 | 45 | 9.587386 | 10.412614 | 9.622561 | 10.377439 | 10.035174 | 9.964826 | 15 | 60 |
| 1 | 15 | 9.587462 | 10.412538 | 9.622649 | 10.377351 | 10.035188 | 9.964812 | 45 | 59 |
| 2 | 30 | 9.587537 | 10.412463 | 9.622738 | 10.377262 | 10.035201 | 9.964799 | 30 | 58 |
| 3 | 45 | 9.587612 | 10.412388 | 9.622826 | 10.377174 | 10.035214 | 9.964786 | 15 | 57 |
| 4 | 46 | 9.587688 | 10.412312 | 9.622915 | 10.377085 | 10.035227 | 9.964773 | 14 | 56 |
| 5 | 15 | 9.587763 | 10.412237 | 9.623003 | 10.376997 | 10.035241 | 9.964759 | 45 | 55 |
| 6 | 30 | 9.587838 | 10.412162 | 9.623092 | 10.376908 | 10.035254 | 9.964746 | 30 | 54 |
| 7 | 45 | 9.587913 | 10.412087 | 9.623180 | 10.376820 | 10.035267 | 9.964733 | 15 | 53 |
| 8 | 47 | 9.587988 | 10.412012 | 9.623269 | 10.376731 | 10.035281 | 9.964719 | 13 | 52 |
| 9 | 15 | 9.588064 | 10.411936 | 9.623357 | 10.376643 | 10.035294 | 9.964706 | 45 | 51 |
| 10 | 30 | 9.588139 | 10.411861 | 9.623446 | 10.376554 | 10.035307 | 9.964693 | 30 | 50 |
| 11 | 45 | 9.588214 | 10.411786 | 9.623534 | 10.376466 | 10.035320 | 9.964680 | 15 | 49 |
| 12 | 48 | 9.588289 | 10.411711 | 9.623623 | 10.376377 | 10.035334 | 9.964666 | 12 | 48 |
| 13 | 15 | 9.588364 | 10.411636 | 9.623711 | 10.376289 | 10.035347 | 9.964653 | 45 | 47 |
| 14 | 30 | 9.588439 | 10.411561 | 9.623799 | 10.376201 | 10.035360 | 9.964640 | 30 | 46 |
| 15 | 45 | 9.588514 | 10.411486 | 9.623888 | 10.376112 | 10.035373 | 9.964627 | 15 | 45 |
| 16 | 49 | 9.588590 | 10.411410 | 9.623976 | 10.376024 | 10.035387 | 9.964613 | 11 | 44 |
| 17 | 15 | 9.588665 | 10.411335 | 9.624065 | 10.375935 | 10.035400 | 9.964600 | 45 | 43 |
| 18 | 30 | 9.588740 | 10.411260 | 9.624153 | 10.375847 | 10.035413 | 9.964587 | 30 | 42 |
| 19 | 45 | 9.588815 | 10.411185 | 9.624241 | 10.375759 | 10.035427 | 9.964573 | 15 | 41 |
| 20 | 50 | 9.588890 | 10.411110 | 9.624330 | 10.375670 | 10.035440 | 9.964560 | 10 | 40 |
| 21 | 15 | 9.588965 | 10.411035 | 9.624418 | 10.375582 | 10.035453 | 9.964547 | 45 | 39 |
| 22 | 30 | 9.589040 | 10.410960 | 9.624506 | 10.375494 | 10.035466 | 9.964534 | 30 | 38 |
| 23 | 45 | 9.589115 | 10.410885 | 9.624594 | 10.375406 | 10.035480 | 9.964520 | 15 | 37 |
| 24 | 51 | 9.589190 | 10.410810 | 9.624683 | 10.375317 | 10.035493 | 9.964507 | 9 | 36 |
| 25 | 15 | 9.589265 | 10.410735 | 9.624771 | 10.375229 | 10.035506 | 9.964494 | 45 | 35 |
| 26 | 30 | 9.589339 | 10.410661 | 9.624859 | 10.375141 | 10.035520 | 9.964480 | 30 | 34 |
| 27 | 45 | 9.589414 | 10.410586 | 9.624947 | 10.375053 | 10.035533 | 9.964467 | 15 | 33 |
| 28 | 52 | 9.589489 | 10.410511 | 9.625036 | 10.374964 | 10.035546 | 9.964454 | 8 | 32 |
| 29 | 15 | 9.589564 | 10.410436 | 9.625124 | 10.374876 | 10.035560 | 9.964440 | 45 | 31 |
| 30 | 30 | 9.589639 | 10.410361 | 9.625212 | 10.374788 | 10.035573 | 9.964427 | 30 | 30 |
| 31 | 45 | 9.589714 | 10.410286 | 9.625300 | 10.374700 | 10.035586 | 9.964414 | 15 | 29 |
| 32 | 53 | 9.589789 | 10.410211 | 9.625388 | 10.374612 | 10.035600 | 9.964400 | 7 | 28 |
| 33 | 15 | 9.589864 | 10.410136 | 9.625476 | 10.374524 | 10.035613 | 9.964387 | 45 | 27 |
| 34 | 30 | 9.589938 | 10.410062 | 9.625565 | 10.374435 | 10.035626 | 9.964374 | 30 | 26 |
| 35 | 45 | 9.590013 | 10.409987 | 9.625653 | 10.374347 | 10.035640 | 9.964360 | 15 | 25 |
| 36 | 54 | 9.590088 | 10.409912 | 9.625741 | 10.374259 | 10.035653 | 9.964347 | 6 | 24 |
| 37 | 15 | 9.590163 | 10.409837 | 9.625829 | 10.374171 | 10.035666 | 9.964334 | 45 | 23 |
| 38 | 30 | 9.590237 | 10.409763 | 9.625917 | 10.374083 | 10.035680 | 9.964320 | 30 | 22 |
| 39 | 45 | 9.590312 | 10.409688 | 9.626005 | 10.373995 | 10.035693 | 9.964307 | 15 | 21 |
| 40 | 55 | 9.590387 | 10.409613 | 9.626093 | 10.373907 | 10.035706 | 9.964294 | 5 | 20 |
| 41 | 15 | 9.590462 | 10.409538 | 9.626181 | 10.373819 | 10.035720 | 9.964280 | 45 | 19 |
| 42 | 30 | 9.590536 | 10.409464 | 9.626269 | 10.373731 | 10.035733 | 9.964267 | 30 | 18 |
| 43 | 45 | 9.590611 | 10.409389 | 9.626357 | 10.373643 | 10.035746 | 9.964254 | 15 | 17 |
| 44 | 56 | 9.590686 | 10.409314 | 9.626445 | 10.373555 | 10.035760 | 9.964240 | 4 | 16 |
| 45 | 15 | 9.590760 | 10.409240 | 9.626533 | 10.373467 | 10.035773 | 9.964227 | 45 | 15 |
| 46 | 30 | 9.590835 | 10.409165 | 9.626621 | 10.373379 | 10.035787 | 9.964213 | 30 | 14 |
| 47 | 45 | 9.590909 | 10.409091 | 9.626709 | 10.373291 | 10.035800 | 9.964200 | 15 | 13 |
| 48 | 57 | 9.590984 | 10.409016 | 9.626797 | 10.373203 | 10.035813 | 9.964187 | 3 | 12 |
| 49 | 15 | 9.591059 | 10.408941 | 9.626885 | 10.373115 | 10.035827 | 9.964173 | 45 | 11 |
| 50 | 30 | 9.591133 | 10.408867 | 9.626973 | 10.373027 | 10.035840 | 9.964160 | 30 | 10 |
| 51 | 45 | 9.591208 | 10.408792 | 9.627061 | 10.372939 | 10.035853 | 9.964147 | 15 | 9 |
| 52 | 58 | 9.591282 | 10.408718 | 9.627149 | 10.372851 | 10.035867 | 9.964133 | 2 | 8 |
| 53 | 15 | 9.591357 | 10.408643 | 9.627237 | 10.372763 | 10.035880 | 9.964120 | 45 | 7 |
| 54 | 30 | 9.591431 | 10.408569 | 9.627325 | 10.372675 | 10.035894 | 9.964106 | 30 | 6 |
| 55 | 45 | 9.591506 | 10.408494 | 9.627413 | 10.372587 | 10.035907 | 9.964093 | 15 | 5 |
| 56 | 59 | 9.591580 | 10.408420 | 9.627501 | 10.372499 | 10.035920 | 9.964080 | 1 | 4 |
| 57 | 15 | 9.591655 | 10.408345 | 9.627588 | 10.372412 | 10.035934 | 9.964066 | 45 | 3 |
| 58 | 30 | 9.591729 | 10.408271 | 9.627676 | 10.372324 | 10.035947 | 9.964053 | 30 | 2 |
| 59 | 45 | 9.591804 | 10.408196 | 9.627764 | 10.372236 | 10.035961 | 9.964039 | 15 | 1 |
| 60 | 60 | 9.591878 | 10.408122 | 9.627852 | 10.372148 | 10.035974 | 9.964026 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | ver. |
| 4h 28m. | | | LOG. SINES, &c. | | | | 67 deg. | | |

| sec. | 1h 32m. ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 9.591878 | 10.408122 | 9.627852 | 10.372148 | 10.035974 | 9.964026 | 60 | 60 |
| 1 | 15 | 9.591952 | 10.408048 | 9.627940 | 10.372060 | 10.035987 | 9.964013 | 45 | 59 |
| 2 | 30 | 9.592027 | 10.407973 | 9.628027 | 10.371973 | 10.036001 | 9.963999 | 30 | 58 |
| 3 | 45 | 9.592101 | 10.407899 | 9.628115 | 10.371885 | 10.036014 | 9.963986 | 15 | 57 |
| 4 | 1 | 9.592175 | 10.407825 | 9.628203 | 10.371797 | 10.036028 | 9.963972 | 59 | 56 |
| 5 | 15 | 9.592250 | 10.407750 | 9.628291 | 10.371709 | 10.036041 | 9.963959 | 45 | 55 |
| 6 | 30 | 9.592324 | 10.407676 | 9.628379 | 10.371621 | 10.036054 | 9.963946 | 30 | 54 |
| 7 | 45 | 9.592398 | 10.407602 | 9 628466 | 10.371534 | 10.036068 | 9.963932 | 15 | 53 |
| 8 | 2 | 9.592473 | 10.407527 | 9.628554 | 10 371446 | 10.036081 | 9.963919 | 58 | 52 |
| 9 | 15 | 9.592547 | 10.407453 | 9.628642 | 10.371358 | 10.036095 | 9.963905 | 45 | 51 |
| 10 | 30 | 9.592621 | 10.407379 | 9.628729 | 10.371271 | 10.036108 | 9.963892 | 30 | 50 |
| 11 | 45 | 9.592696 | 10.407304 | 9.628817 | 10.371183 | 10.036122 | 9.963878 | 15 | 49 |
| 12 | 3 | 9.592770 | 10.407230 | 9.628905 | 10.371095 | 10.036135 | 9.963865 | 57 | 48 |
| 13 | 15 | 9.592844 | 10.407156 | 9.628992 | 10.371008 | 10.036148 | 9.963852 | 45 | 47 |
| 14 | 30 | 9.592918 | 10.407082 | 9.629080 | 10.370920 | 10 036162 | 9.963838 | 30 | 46 |
| 15 | 45 | 9.592992 | 10.407008 | 9.629168 | 10.370832 | 10.036175 | 9.963825 | 15 | 45 |
| 16 | 4 | 9.593067 | 10.406933 | 9.629255 | 10.370745 | 10.036189 | 9.963811 | 56 | 44 |
| 17 | 15 | 9.593141 | 10.406859 | 9.629343 | 10.370657 | 10.036202 | 9.963798 | 45 | 43 |
| 18 | 30 | 9.593215 | 10.406785 | 9.629430 | 10.370570 | 10.036216 | 9.963784 | 30 | 42 |
| 19 | 45 | 9.593289 | 10.406711 | 9.629518 | 10.370482 | 10.036229 | 9.963771 | 15 | 41 |
| 20 | 5 | 9.593363 | 10.406637 | 9.629606 | 10.370394 | 10.036243 | 9.963757 | 55 | 40 |
| 21 | 15 | 9.593437 | 10.406563 | 9.629693 | 10.370307 | 10.036256 | 9.963744 | 45 | 39 |
| 22 | 30 | 9.593511 | 10.406489 | 9.629781 | 10.370219 | 10.036270 | 9.963730 | 30 | 38 |
| 23 | 45 | 9.593585 | 10.406415 | 9.629868 | 10.370132 | 10.036283 | 9.963717 | 15 | 37 |
| 24 | 6 | 9.593659 | 10.406341 | 9.629956 | 10.370044 | 10.036296 | 9.963704 | 54 | 36 |
| 25 | 15 | 9.593733 | 10.406267 | 9.630043 | 10.369957 | 10.036310 | 9.963690 | 45 | 35 |
| 26 | 30 | 9.593807 | 10.406193 | 9.630131 | 10.369869 | 10.036323 | 9.963677 | 30 | 34 |
| 27 | 45 | 9.593881 | 10.406119 | 9.630218 | 10.369782 | 10.036337 | 9.963663 | 15 | 33 |
| 28 | 7 | 9.593955 | 10.406045 | 9 630306 | 10.369694 | 10.036350 | 9 963650 | 53 | 32 |
| 29 | 15 | 9.594029 | 10.405971 | 9.630393 | 10.369607 | 10.036364 | 9.963636 | 45 | 31 |
| 30 | 30 | 9.594103 | 10.405897 | 9.630481 | 10.369519 | 10.036377 | 9.963623 | 30 | 30 |
| 31 | 45 | 9.594177 | 10.405823 | 9.630568 | 10.369432 | 10.036391 | 9.963609 | 15 | 29 |
| 32 | 8 | 9.594251 | 10.405749 | 9.630656 | 10.369344 | 10.036404 | 9.963596 | 52 | 28 |
| 33 | 15 | 9.594325 | 10.405675 | 9.630743 | 10.369257 | 10.036418 | 9.963582 | 45 | 27 |
| 34 | 30 | 9.594399 | 10.405601 | 9.630830 | 10.369170 | 10.036431 | 9.963569 | 30 | 26 |
| 35 | 45 | 9.594473 | 10.405527 | 9.630918 | 10.369082 | 10.036445 | 9.963555 | 15 | 25 |
| 36 | 9 | 9.594547 | 10.405453 | 9.631005 | 10.368995 | 10.036458 | 9.963542 | 51 | 24 |
| 37 | 15 | 9.594621 | 10.405379 | 9.631092 | 10.368908 | 10.036472 | 9.963528 | 45 | 23 |
| 38 | 30 | 9.594695 | 10.405305 | 9.631180 | 10.368820 | 10.036485 | 9.963515 | 30 | 22 |
| 39 | 45 | 9.594768 | 10.405232 | 9.631267 | 10.368733 | 10.036499 | 9.963501 | 15 | 21 |
| 40 | 10 | 9.594842 | 10.405158 | 9.631354 | 10.368646 | 10.036512 | 9.963488 | 50 | 20 |
| 41 | 15 | 9.594916 | 10.405084 | 9.631442 | 10.368558 | 10.036526 | 9.963474 | 45 | 19 |
| 42 | 30 | 9.594990 | 10 405010 | 9 631529 | 10.368471 | 10.036539 | 9.963461 | 30 | 18 |
| 43 | 45 | 9.595064 | 10.404936 | 9.631616 | 10.368384 | 10.036553 | 9.963447 | 15 | 17 |
| 44 | 11 | 9.595137 | 10.404863 | 9.631704 | 10.368296 | 10.036566 | 9.963434 | 49 | 16 |
| 45 | 15 | 9.595211 | 10.404789 | 9.631791 | 10.368209 | 10 036580 | 9.963420 | 45 | 15 |
| 46 | 30 | 9.595285 | 10.404715 | 9.631878 | 10.368122 | 10.036594 | 9.963406 | 30 | 14 |
| 47 | 45 | 9.595358 | 10 404642 | 9.631965 | 10.368035 | 10 036607 | 9.963393 | 15 | 13 |
| 48 | 12 | 9.595432 | 10.404568 | 9.632053 | 10.367947 | 10.036621 | 9.963379 | 48 | 12 |
| 49 | 15 | 9.595506 | 10.404494 | 9.632140 | 10.367860 | 10.036634 | 9.963366 | 45 | 11 |
| 50 | 30 | 9.595579 | 10.404421 | 9.632227 | 10.367773 | 10.036648 | 9.963352 | 30 | 10 |
| 51 | 45 | 9 595653 | 10.404347 | 9.632314 | 10.367686 | 10.036661 | 9.963339 | 15 | 9 |
| 52 | 13 | 9.595727 | 10.404273 | 9.632401 | 10.367599 | 10 036675 | 9.963325 | 47 | 8 |
| 53 | 15 | 9 595800 | 10.404200 | 9.632489 | 10.367511 | 10.036688 | 9.963312 | 45 | 7 |
| 54 | 30 | 9.595874 | 10.404126 | 9.632576 | 10.367424 | 10.036702 | 9.963298 | 30 | 6 |
| 55 | 45 | 9.595948 | 10.404052 | 9.632663 | 10.367337 | 10.036715 | 9.963285 | 15 | 5 |
| 56 | 14 | 9.596021 | 10.403979 | 9.632750 | 10.367250 | 10.036729 | 9.963271 | 46 | 4 |
| 57 | 15 | 9.596095 | 10.403905 | 9.632837 | 10.367163 | 10.036743 | 9.963257 | 45 | 3 |
| 58 | 30 | 9.596168 | 10.403832 | 9.632924 | 10.367076 | 10.036756 | 9.963244 | 30 | 2 |
| 59 | 45 | 9 596242 | 10.403758 | 9.633011 | 10.366989 | 10.036770 | 9.963230 | 15 | 1 |
| 60 | 15 | 9.596315 | 10.403685 | 9.633098 | 10.366902 | 10.036783 | 9.963217 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 1h 33m. | | LOG. SINES, &c. (t.) | | | | | 23 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.596315 | 10.403685 | 9.633098 | 10.366902 | 10.036783 | 9.963217 | 45 | 60 |
| 1 | 15 | 9.596389 | 10.403611 | 9.633186 | 10.366814 | 10.036797 | 9.963203 | 45 | 59 |
| 2 | 30 | 9.596462 | 10.403538 | 9.633273 | 10.366727 | 10.036810 | 9.963190 | 30 | 58 |
| 3 | 45 | 9.596536 | 10.403464 | 9.633360 | 10.366640 | 10.036824 | 9.963176 | 15 | 57 |
| 4 | 16 | 9.596609 | 10.403391 | 9.633447 | 10.366553 | 10.036838 | 9.963162 | 44 | 56 |
| 5 | 15 | 9.596683 | 10.403317 | 9.633534 | 10.366466 | 10.036851 | 9.963149 | 45 | 55 |
| 6 | 30 | 9.596756 | 10.403244 | 9.633621 | 10.366379 | 10.036865 | 9.963135 | 30 | 54 |
| 7 | 45 | 9.596830 | 10.403170 | 9.633708 | 10.366292 | 10.036878 | 9.963122 | 15 | 53 |
| 8 | 17 | 9.596903 | 10.403097 | 9.633795 | 10.366205 | 10.036892 | 9.963108 | 43 | 52 |
| 9 | 15 | 9.596976 | 10.403024 | 9.633882 | 10.366118 | 10 036905 | 9.963095 | 45 | 51 |
| 10 | 30 | 9.597050 | 10.402950 | 9.633969 | 10.366031 | 10.036919 | 9.963081 | 30 | 50 |
| 11 | 45 | 9.597123 | 10.402877 | 9.634056 | 10.365944 | 10.036933 | 9.963067 | 15 | 49 |
| 12 | 18 | 9.597196 | 10.402804 | 9.634143 | 10.365857 | 10.036946 | 9.963054 | 42 | 48 |
| 13 | 15 | 9.597270 | 10.402730 | 9.634230 | 10.365770 | 10.036960 | 9.963040 | 45 | 47 |
| 14 | 30 | 9.597343 | 10.402657 | 9.634316 | 10.365684 | 10.036973 | 9.963027 | 30 | 46 |
| 15 | 45 | 9.597416 | 10.402584 | 9.634403 | 10.365597 | 10.036987 | 9.963013 | 15 | 45 |
| 16 | 19 | 9.597490 | 10.402510 | 9.634490 | 10.365510 | 10.037001 | 9.962999 | 41 | 44 |
| 17 | 15 | 9.597563 | 10.402437 | 9.634577 | 10.365423 | 10.037014 | 9.962986 | 45 | 43 |
| 18 | 30 | 9.597636 | 10.402364 | 9.634664 | 10.365336 | 10.037028 | 9.962972 | 30 | 42 |
| 19 | 45 | 9.597709 | 10.402291 | 9.634751 | 10.365249 | 10.037042 | 9.962958 | 15 | 41 |
| 20 | 20 | 9.597783 | 10.402217 | 9.634838 | 10.365162 | 10.037055 | 9 962945 | 40 | 40 |
| 21 | 15 | 9.597856 | 10.402144 | 9.634925 | 10.365075 | 10.037069 | 9.962931 | 45 | 39 |
| 22 | 30 | 9.597929 | 10.402071 | 9.635011 | 10 364989 | 10.037082 | 9.962918 | 30 | 38 |
| 23 | 45 | 9.598002 | 10.401998 | 9.635098 | 10.364902 | 10.037096 | 9.962904 | 15 | 37 |
| 24 | 21 | 9 598075 | 10.401925 | 9.635185 | 10.364815 | 10.037110 | 9.962890 | 39 | 36 |
| 25 | 15 | 9.598149 | 10.401851 | 9.635272 | 10.364728 | 10.037123 | 9.962877 | 45 | 35 |
| 26 | 30 | 9.598222 | 10.401778 | 9.635359 | 10.364641 | 10.037137 | 9.962863 | 30 | 34 |
| 27 | 45 | 9.598295 | 10.401705 | 9.635445 | 10.364555 | 10.037151 | 9.962849 | 15 | 33 |
| 28 | 22 | 9 598368 | 10.401632 | 9.635532 | 10.364468 | 10.037164 | 9.962836 | 38 | 32 |
| 29 | 15 | 9.598441 | 10.401559 | 9.635619 | 10.364381 | 10.037178 | 9.962822 | 45 | 31 |
| 30 | 30 | 9.598514 | 10.401486 | 9.635706 | 10.364294 | 10.037192 | 9.962808 | 30 | 30 |
| 31 | 45 | 9.598587 | 10.401413 | 9.635792 | 10 364208 | 10.037205 | 9.962795 | 15 | 29 |
| 32 | 23 | 9.598660 | 10.401340 | 9.635879 | 10.364121 | 10.037219 | 9.962781 | 37 | 28 |
| 33 | 15 | 9.598733 | 10.401267 | 9.635966 | 10.364034 | 10.037232 | 9.962768 | 45 | 27 |
| 34 | 30 | 9.598806 | 10.401194 | 9 636052 | 10.363948 | 10.037246 | 9.962754 | 30 | 26 |
| 35 | 45 | 9.598879 | 10.401121 | 9.636139 | 10 363861 | 10.037260 | 9.962740 | 15 | 25 |
| 36 | 24 | 9.598952 | 10.401048 | 9.636226 | 10.363774 | 10.037273 | 9.962727 | 36 | 24 |
| 37 | 15 | 9.599025 | 10.400975 | 9.636312 | 10.363688 | 10.037287 | 9.962713 | 45 | 23 |
| 38 | 30 | 9.599098 | 10.400902 | 9.636399 | 10.363601 | 10.037301 | 9.962699 | 30 | 22 |
| 39 | 45 | 9.599171 | 10.400829 | 9.636486 | 10.363514 | 10.037314 | 9.962686 | 15 | 21 |
| 40 | 25 | 9.599244 | 10.400756 | 9.636572 | 10.363428 | 10.037328 | 9.962672 | 35 | 20 |
| 41 | 15 | 9.599317 | 10.400683 | 9.636659 | 10.363341 | 10.037342 | 9.962658 | 45 | 19 |
| 42 | 30 | 9.599390 | 10.400610 | 9.636745 | 10.363255 | 10.037356 | 9.962644 | 30 | 18 |
| 43 | 45 | 9.599463 | 10.400537 | 9.636832 | 10.363168 | 10.037369 | 9.962631 | 15 | 17 |
| 44 | 26 | 9.599536 | 10.400464 | 9.636918 | 10.363082 | 10.037383 | 9.962617 | 34 | 16 |
| 45 | 15 | 9.599608 | 10.400392 | 9.637005 | 10.362995 | 10.037397 | 9.962603 | 45 | 15 |
| 46 | 30 | 9.599681 | 10.400319 | 9.637092 | 10.362908 | 10.037410 | 9.962590 | 30 | 14 |
| 47 | 45 | 9.599754 | 10.400246 | 9.637178 | 10.362822 | 10.037424 | 9.962576 | 15 | 13 |
| 48 | 27 | 9.599827 | 10.400173 | 9.637265 | 10.362735 | 10.037438 | 9.962562 | 33 | 12 |
| 49 | 15 | 9.599900 | 10.400100 | 9.637351 | 10.362649 | 10.037451 | 9.962549 | 45 | 11 |
| 50 | 30 | 9.599973 | 10.400027 | 9.637438 | 10.362562 | 10.037465 | 9 962535 | 30 | 10 |
| 51 | 45 | 9.600045 | 10.399955 | 9.637524 | 10.362476 | 10.037479 | 9.962521 | 15 | 9 |
| 52 | 28 | 9.600118 | 10.399882 | 9.637611 | 10.362389 | 10.037492 | 9.962508 | 32 | 8 |
| 53 | 15 | 9.600191 | 10.399809 | 9.637697 | 10.362303 | 10.037506 | 9 962494 | 45 | 7 |
| 54 | 30 | 9.600264 | 10.399736 | 9.637783 | 10 362217 | 10.037520 | 9.962480 | 30 | 6 |
| 55 | 45 | 9.600336 | 10.399664 | 9.637870 | 10.362130 | 10.037534 | 9.962466 | 15 | 5 |
| 56 | 29 | 9.600409 | 10.399591 | 9.637956 | 10.362044 | 10.037547 | 9.962453 | 31 | 4 |
| 57 | 15 | 9 600482 | 10.399518 | 9.638043 | 10.361957 | 10.037561 | 9.962439 | 45 | 3 |
| 58 | 30 | 9.600554 | 10.399446 | 9.638129 | 10.361871 | 10.037575 | 9.962425 | 30 | 2 |
| 59 | 45 | 9.600627 | 10.399373 | 9.638215 | 10.361785 | 10.037589 | 9.962411 | 15 | 1 |
| 60 | 30 | 9.600700 | 10.399300 | 9.638302 | 10.361698 | 10.037602 | 9.962398 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec |
| 4h 26m. | | | LOG. SINES, &c. | | | | | 66 deg. | |

| 1h 34m. | LOG. SINES, &c. (t.) | 23 deg. |
|---|---|---|

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 30 | 9.600700 | 10.399300 | 9.638302 | 10.361698 | 10.037602 | 9.962398 | 30 | 60 |
| 1 | 15 | 9.600772 | 10.399228 | 9.638388 | 10.361612 | 10.037616 | 9.962384 | 45 | 59 |
| 2 | 30 | 9.600845 | 10.399155 | 9.638475 | 10.361525 | 10.037630 | 9.962370 | 30 | 58 |
| 3 | 45 | 9.600917 | 10.399083 | 9.638561 | 10.361439 | 10.037643 | 9.962357 | 15 | 57 |
| 4 | 31 | 9.600990 | 10.399010 | 9.638647 | 10.361353 | 10.037657 | 9.962343 | 29 | 56 |
| 5 | 15 | 9.601063 | 10.398937 | 9.638734 | 10.361266 | 10.037671 | 9.962329 | 45 | 55 |
| 6 | 30 | 9.601135 | 10.398865 | 9.638820 | 10.361180 | 10.037685 | 9.962315 | 30 | 54 |
| 7 | 45 | 9.601208 | 10.398792 | 9.638906 | 10.361094 | 10.037698 | 9.962302 | 15 | 53 |
| 8 | 32 | 9.601280 | 10.398720 | 9.638992 | 10.361008 | 10.037712 | 9.962288 | 28 | 52 |
| 9 | 15 | 9.601353 | 10.398647 | 9.639079 | 10.360921 | 10.037726 | 9.962274 | 45 | 51 |
| 10 | 30 | 9.601425 | 10.398575 | 9.639165 | 10.360835 | 10.037740 | 9.962260 | 30 | 50 |
| 11 | 45 | 9.601498 | 10.398502 | 9.639251 | 10.360749 | 10.037753 | 9.962247 | 15 | 49 |
| 12 | 33 | 9.601570 | 10.398430 | 9.639337 | 10.360663 | 10.037767 | 9.962233 | 27 | 48 |
| 13 | 15 | 9.601643 | 10.398357 | 9.639424 | 10.360576 | 10.037781 | 9.962219 | 45 | 47 |
| 14 | 30 | 9.601715 | 10.398285 | 9.639510 | 10.360490 | 10.037795 | 9.962205 | 30 | 46 |
| 15 | 45 | 9.601788 | 10.398212 | 9.639596 | 10.360404 | 10.037809 | 9.962191 | 15 | 45 |
| 16 | 34 | 9.601860 | 10.398140 | 9.639682 | 10.360318 | 10.037822 | 9.962178 | 26 | 44 |
| 17 | 15 | 9.601932 | 10.398068 | 9.639768 | 10.360232 | 10.037836 | 9.962164 | 45 | 43 |
| 18 | 30 | 9.602005 | 10.397995 | 9.639855 | 10.360145 | 10.037850 | 9.962150 | 30 | 42 |
| 19 | 45 | 9.602077 | 10.397923 | 9.639941 | 10.360059 | 10.037864 | 9.962136 | 15 | 41 |
| 20 | 35 | 9.602149 | 10.397851 | 9.640027 | 10.359973 | 10.037877 | 9.962123 | 25 | 40 |
| 21 | 15 | 9.602222 | 10.397778 | 9.640113 | 10.359887 | 10.037891 | 9.962109 | 45 | 39 |
| 22 | 30 | 9.602294 | 10.397706 | 9.640199 | 10.359801 | 10.037905 | 9.962095 | 30 | 38 |
| 23 | 45 | 9.602366 | 10.397634 | 9.640285 | 10.359715 | 10.037919 | 9.962081 | 15 | 37 |
| 24 | 36 | 9.602439 | 10.397561 | 9.640371 | 10.359629 | 10.037933 | 9.962067 | 24 | 36 |
| 25 | 15 | 9.602511 | 10.397489 | 9.640457 | 10.359543 | 10.037946 | 9.962054 | 45 | 35 |
| 26 | 30 | 9.602583 | 10.397417 | 9.640543 | 10.359457 | 10.037960 | 9.962040 | 30 | 34 |
| 27 | 45 | 9.602656 | 10.397344 | 9.640630 | 10.359370 | 10.037974 | 9.962026 | 15 | 33 |
| 28 | 37 | 9.602728 | 10.397272 | 9.640716 | 10.359284 | 10.037988 | 9.962012 | 23 | 32 |
| 29 | 15 | 9.602800 | 10.397200 | 9.640802 | 10.359198 | 10.038002 | 9.961998 | 45 | 31 |
| 30 | 30 | 9.602872 | 10.397128 | 9.640888 | 10.359112 | 10.038015 | 9.961985 | 30 | 30 |
| 31 | 45 | 9.602944 | 10.397056 | 9.640974 | 10.359026 | 10.038029 | 9.961971 | 15 | 29 |
| 32 | 38 | 9.603017 | 10.396983 | 9.641060 | 10.358940 | 10.038043 | 9.961957 | 22 | 28 |
| 33 | 15 | 9.603089 | 10.396911 | 9.641146 | 10.358854 | 10.038057 | 9.961943 | 45 | 27 |
| 34 | 30 | 9.603161 | 10.396839 | 9.641232 | 10.358768 | 10.038071 | 9.961929 | 30 | 26 |
| 35 | 45 | 9.603233 | 10.396767 | 9.641318 | 10.358682 | 10.038085 | 9.961915 | 15 | 25 |
| 36 | 39 | 9.603305 | 10.396695 | 9.641404 | 10.358596 | 10.038098 | 9.961902 | 21 | 24 |
| 37 | 15 | 9.603377 | 10.396623 | 9.641489 | 10.358511 | 10.038112 | 9.961888 | 45 | 23 |
| 38 | 30 | 9.603449 | 10.396551 | 9.641575 | 10.358425 | 10.038126 | 9.961874 | 30 | 22 |
| 39 | 45 | 9.603521 | 10.396479 | 9.641661 | 10.358339 | 10.038140 | 9.961860 | 15 | 21 |
| 40 | 40 | 9.603594 | 10.396406 | 9.641747 | 10.358253 | 10.038154 | 9.961846 | 20 | 20 |
| 41 | 15 | 9.603666 | 10.396334 | 9.641833 | 10.358167 | 10.038168 | 9.961832 | 45 | 19 |
| 42 | 30 | 9.603738 | 10.396262 | 9.641919 | 10.358081 | 10.038181 | 9.961819 | 30 | 18 |
| 43 | 45 | 9.603810 | 10.396190 | 9.642005 | 10.357995 | 10.038195 | 9.961805 | 15 | 17 |
| 44 | 41 | 9.603882 | 10.396118 | 9.642091 | 10.357909 | 10.038209 | 9.961791 | 19 | 16 |
| 45 | 15 | 9.603954 | 10.396046 | 9.642177 | 10.357823 | 10.038223 | 9.961777 | 45 | 15 |
| 46 | 30 | 9.604026 | 10.395974 | 9.642262 | 10.357738 | 10.038237 | 9.961763 | 30 | 14 |
| 47 | 45 | 9.604098 | 10.395902 | 9.642348 | 10.357652 | 10.038251 | 9.961749 | 15 | 13 |
| 48 | 42 | 9.604170 | 10.395830 | 9.642434 | 10.357566 | 10.038265 | 9.961735 | 18 | 12 |
| 49 | 15 | 9.604242 | 10.395758 | 9.642520 | 10.357480 | 10.038278 | 9.961722 | 45 | 11 |
| 50 | 30 | 9.604313 | 10.395687 | 9.642606 | 10.357394 | 10.038292 | 9.961708 | 30 | 10 |
| 51 | 45 | 9.604385 | 10.395615 | 9.642691 | 10.357309 | 10.038306 | 9.961694 | 15 | 9 |
| 52 | 43 | 9.604457 | 10.395543 | 9.642777 | 10.357223 | 10.038320 | 9.961680 | 17 | 8 |
| 53 | 15 | 9.604529 | 10.395471 | 9.642863 | 10.357137 | 10 038334 | 9.961666 | 45 | 7 |
| 54 | 30 | 9.604601 | 10.395399 | 9.642949 | 10.357051 | 10.038348 | 9.961652 | 30 | 6 |
| 55 | 45 | 9.604673 | 10.395327 | 9.643035 | 10.356965 | 10.038362 | 9.961638 | 15 | 5 |
| 56 | 44 | 9.604745 | 10.395255 | 9.643120 | 10.356880 | 10.038376 | 9.961624 | 16 | 4 |
| 57 | 15 | 9.604817 | 10.395183 | 9.643206 | 10.356794 | 10.038389 | 9.961611 | 45 | 3 |
| 58 | 30 | 9.604888 | 10.395112 | 9.643292 | 10.356708 | 10.038403 | 9.961597 | 30 | 2 |
| 59 | 45 | 9.604960 | 10.395040 | 9.643377 | 10.356623 | 10.038417 | 9.961583 | 15 | 1 |
| 60 | 45 | 9.605032 | 10.394968 | 9.643463 | 10.356537 | 10.038431 | 9.961569 | 15 | 0 |

| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|

| 1h 37m | | LOG. SINES, &c. (t.) | | | | | 24 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ′ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ ′ | sec |
| 0 | 15 | 9.613545 | 10.386455 | 9.653663 | 10.346337 | 10 040119 | 9.959881 | 45 | 60 |
| 1 | 15 | 9.613615 | 10.386385 | 9.653747 | 10.346253 | 10.040133 | 9.959867 | 45 | 59 |
| 2 | 30 | 9.613685 | 10.386315 | 9.653832 | 10.346168 | 10.040147 | 9.959853 | 30 | 58 |
| 3 | 45 | 9.613755 | 10.386245 | 9.653916 | 10.346084 | 10.040161 | 9.959839 | 15 | 57 |
| 4 | 16 | 9.613825 | 10.386175 | 9.654000 | 10.346000 | 10.040175 | 9.959825 | 44 | 56 |
| 5 | 15 | 9.613895 | 10.386105 | 9.654085 | 10.345915 | 10.040190 | 9.959810 | 45 | 55 |
| 6 | 30 | 9.613965 | 10.386035 | 9.654169 | 10.345831 | 10.040204 | 9.959796 | 30 | 54 |
| 7 | 45 | 9.614035 | 10.385965 | 9.654253 | 10.345747 | 10.040218 | 9.959782 | 15 | 53 |
| 8 | 17 | 9.614105 | 10.385895 | 9.654337 | 10.345663 | 10.040232 | 9.959768 | 43 | 52 |
| 9 | 15 | 9.614175 | 10.385825 | 9.654422 | 10.345578 | 10.040247 | 9.959753 | 45 | 51 |
| 10 | 30 | 9.614245 | 10.385755 | 9.654506 | 10.345494 | 10.040261 | 9.959739 | 30 | 50 |
| 11 | 45 | 9.614315 | 10.385685 | 9.654590 | 10.345410 | 10.040275 | 9.959725 | 15 | 49 |
| 12 | 18 | 9.614385 | 10.385615 | 9.654674 | 10.345326 | 10.040289 | 9.959711 | 42 | 48 |
| 13 | 15 | 9.614455 | 10.385545 | 9.654759 | 10.345241 | 10.040304 | 9.959696 | 45 | 47 |
| 14 | 30 | 9.614525 | 10.385475 | 9.654843 | 10.345157 | 10.040318 | 9.959682 | 30 | 46 |
| 15 | 45 | 9.614595 | 10.385405 | 9.654927 | 10.345073 | 10.040332 | 9.959668 | 15 | 45 |
| 16 | 19 | 9.614665 | 10.385335 | 9.655011 | 10.344989 | 10.040347 | 9.959653 | 41 | 44 |
| 17 | 15 | 9.614735 | 10.385265 | 9.655095 | 10.344905 | 10.040361 | 9.959639 | 45 | 43 |
| 18 | 30 | 9.614804 | 10.385196 | 9.655179 | 10.344821 | 10.040375 | 9.959625 | 30 | 42 |
| 19 | 45 | 9.614874 | 10.385126 | 9.655264 | 10.344736 | 10.040389 | 9.959611 | 15 | 41 |
| 20 | 20 | 9.614944 | 10.385056 | 9.655348 | 10.344652 | 10.040404 | 9.959596 | 40 | 40 |
| 21 | 15 | 9.615014 | 10.384986 | 9.655432 | 10.344568 | 10.040418 | 9.959582 | 45 | 39 |
| 22 | 30 | 9.615084 | 10.384916 | 9.655516 | 10.344484 | 10.040432 | 9.959568 | 30 | 38 |
| 23 | 45 | 9.615154 | 10.384846 | 9.655600 | 10.344400 | 10.040446 | 9.959554 | 15 | 37 |
| 24 | 21 | 9.615223 | 10.384777 | 9.655684 | 10.344316 | 10.040461 | 9.959539 | 39 | 36 |
| 25 | 15 | 9.615293 | 10.384707 | 9.655768 | 10.344232 | 10.040475 | 9.959525 | 45 | 35 |
| 26 | 30 | 9.615363 | 10.384637 | 9.655852 | 10.344148 | 10.040489 | 9.959511 | 30 | 34 |
| 27 | 45 | 9.615433 | 10.384567 | 9.655936 | 10.344064 | 10.040504 | 9.959496 | 15 | 33 |
| 28 | 22 | 9.615502 | 10.384498 | 9.656020 | 10.343980 | 10 040518 | 9.959482 | 38 | 32 |
| 29 | 15 | 9.615572 | 10.384428 | 9.656104 | 10.343896 | 10.040532 | 9.959468 | 45 | 31 |
| 30 | 30 | 9.615642 | 10.384358 | 9.656188 | 10.343812 | 10 040547 | 9.959453 | 30 | 30 |
| 31 | 45 | 9.615712 | 10.384288 | 9.656272 | 10.343728 | 10.040561 | 9.959439 | 15 | 29 |
| 32 | 23 | 9.615781 | 10.384219 | 9.656356 | 10.343644 | 10.040575 | 9.959425 | 37 | 28 |
| 33 | 15 | 9.615851 | 10.384149 | 9.656440 | 10.343560 | 10.040590 | 9.959410 | 45 | 27 |
| 34 | 30 | 9.615921 | 10.384079 | 9.656524 | 10.343476 | 10.040604 | 9.959396 | 30 | 26 |
| 35 | 45 | 9.615990 | 10.384010 | 9.656608 | 10.343392 | 10.040618 | 9.959382 | 15 | 25 |
| 36 | 24 | 9.616060 | 10.383940 | 9.656692 | 10.343308 | 10.040633 | 9.959367 | 36 | 24 |
| 37 | 15 | 9.616129 | 10.383871 | 9.656776 | 10.343224 | 10.040647 | 9.959353 | 45 | 23 |
| 38 | 30 | 9.616199 | 10.383801 | 9.656860 | 10.343140 | 10.040661 | 9.959339 | 30 | 22 |
| 39 | 45 | 9.616269 | 10.383731 | 9.656944 | 10.343056 | 10.040675 | 9.959325 | 15 | 21 |
| 40 | 25 | 9.616338 | 10.383662 | 9.657028 | 10.342972 | 10.040690 | 9.959310 | 35 | 20 |
| 41 | 15 | 9.616408 | 10.383592 | 9.657112 | 10.342888 | 10.040704 | 9.959296 | 45 | 19 |
| 42 | 30 | 9.616477 | 10.383523 | 9.657196 | 10.342804 | 10.040719 | 9.959281 | 30 | 18 |
| 43 | 45 | 9.616547 | 10.383453 | 9.657280 | 10.342720 | 10.040733 | 9.959267 | 15 | 17 |
| 44 | 26 | 9.616616 | 10.383384 | 9.657364 | 10.342636 | 10.040747 | 9.959253 | 34 | 16 |
| 45 | 15 | 9.616686 | 10.383314 | 9.657447 | 10.342553 | 10.040762 | 9.959238 | 45 | 15 |
| 46 | 30 | 9.616755 | 10.383245 | 9.657531 | 10.342469 | 10.040776 | 9.959224 | 30 | 14 |
| 47 | 45 | 9.616825 | 10.383175 | 9.657615 | 10.342385 | 10.040790 | 9.959210 | 15 | 13 |
| 48 | 27 | 9.616894 | 10.383106 | 9.657699 | 10.342301 | 10.040805 | 9.959195 | 33 | 12 |
| 49 | 15 | 9.616964 | 10.383036 | 9.657783 | 10.342217 | 10.040819 | 9.959181 | 45 | 11 |
| 50 | 30 | 9.617033 | 10.382967 | 9.657867 | 10.342133 | 10.040833 | 9.959167 | 30 | 10 |
| 51 | 45 | 9.617103 | 10.382897 | 9.657950 | 10.342050 | 10.040848 | 9.959152 | 15 | 9 |
| 52 | 28 | 9.617172 | 10.382828 | 9.658034 | 10.341966 | 10.040862 | 9.959138 | 32 | 8 |
| 53 | 15 | 9.617241 | 10.382759 | 9.658118 | 10.341882 | 10.040876 | 9.959124 | 45 | 7 |
| 54 | 30 | 9.617311 | 10.382689 | 9.658202 | 10.341798 | 10.040891 | 9.959109 | 30 | 6 |
| 55 | 45 | 9.617380 | 10.382620 | 9.658285 | 10.341715 | 10.040905 | 9.959095 | 15 | 5 |
| 56 | 29 | 9.617450 | 10.382550 | 9.658369 | 10.341631 | 10.040920 | 9.959080 | 31 | 4 |
| 57 | 15 | 9.617519 | 10.382481 | 9.658453 | 10.341547 | 10.040934 | 9.959066 | 45 | 3 |
| 58 | 30 | 9.617588 | 10.382412 | 9.658537 | 10.341463 | 10.040948 | 9.959052 | 30 | 2 |
| 59 | 45 | 9.617658 | 10.382342 | 9.658620 | 10.341380 | 10.040963 | 9.959037 | 15 | 1 |
| 60 | 30 | 9.617727 | 10.382273 | 9.658704 | 10.341296 | 10.040977 | 9.959023 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ ′ | sec. |
| 4h 22m. | | | LOG. SINES, &c. | | | | 65 deg. | | |

| 1h 38m. | | LOG. SINES, &c. (t.) | | | | | 24 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.617727 | 10.382273 | 9.658704 | 10.341296 | 10.040977 | 9.959023 | 30 | 60 |
| 1 | 15 | 9.617796 | 10.382204 | 9.658788 | 10.341212 | 10.040992 | 9.959008 | 45 | 59 |
| 2 | 30 | 9.617865 | 10.382135 | 9.658871 | 10.341129 | 10.041006 | 9.958994 | 30 | 58 |
| 3 | 45 | 9.617935 | 10.382065 | 9.658955 | 10.341045 | 10.041020 | 9.958980 | 15 | 57 |
| 4 | 31 | 9.618004 | 10.381996 | 9.659039 | 10.340961 | 10.041035 | 9 958965 | 29 | 56 |
| 5 | 15 | 9.618073 | 10.381927 | 9.659122 | 10.340878 | 10.041049 | 9.958951 | 45 | 55 |
| 6 | 30 | 9.618142 | 10.381858 | 9.659206 | 10.340794 | 10.041064 | 9.958936 | 30 | 54 |
| 7 | 45 | 9.618212 | 10.381788 | 9.659290 | 10.340710 | 10.041078 | 9.958922 | 15 | 53 |
| 8 | 32 | 9.618281 | 10.381719 | 9.659373 | 10.340627 | 10.041092 | 9.958908 | 28 | 52 |
| 9 | 15 | 9.618350 | 10.381650 | 9.659457 | 10.340543 | 10.041107 | 9.958893 | 45 | 51 |
| 10 | 30 | 9.618419 | 10.381581 | 9.659540 | 10.340460 | 10.041121 | 9.958879 | 30 | 50 |
| 11 | 45 | 9.618488 | 10.381512 | 9.659624 | 10.340376 | 10.041136 | 9.958864 | 15 | 49 |
| 12 | 33 | 9.618558 | 10.381442 | 9.659708 | 10.340292 | 10.041150 | 9.958850 | 27 | 48 |
| 13 | 15 | 9.618627 | 10.381373 | 9.659791 | 10.340209 | 10.041164 | 9.958836 | 45 | 47 |
| 14 | 30 | 9.618696 | 10.381304 | 9.659875 | 10.340125 | 10.041179 | 9.958821 | 30 | 46 |
| 15 | 45 | 9.618765 | 10.381235 | 9.659958 | 10.340042 | 10.041193 | 9.958807 | 15 | 45 |
| 16 | 34 | 9.618834 | 10.381166 | 9.660042 | 10.339958 | 10.041208 | 9.958792 | 26 | 44 |
| 17 | 15 | 9.618903 | 10.381097 | 9.660125 | 10.339875 | 10.041222 | 9.958778 | 45 | 43 |
| 18 | 30 | 9.618972 | 10.381028 | 9.660209 | 10.339791 | 10.041237 | 9.958763 | 30 | 42 |
| 19 | 45 | 9.619041 | 10.380959 | 9.660292 | 10.339708 | 10.041251 | 9.958749 | 15 | 41 |
| 20 | 35 | 9.619110 | 10.380890 | 9.660376 | 10.339624 | 10.041266 | 9.958734 | 25 | 40 |
| 21 | 15 | 9.619179 | 10.380821 | 9.660459 | 10.339541 | 10.041280 | 9.958720 | 45 | 39 |
| 22 | 30 | 9.619248 | 10.380752 | 9.660543 | 10.339457 | 10.041294 | 9.958706 | 30 | 38 |
| 23 | 45 | 9.619317 | 10.380683 | 9 660626 | 10.339374 | 10.041309 | 9.958691 | 15 | 37 |
| 24 | 36 | 9.619386 | 10.380614 | 9.660710 | 10.339290 | 10.041323 | 9.958677 | 24 | 36 |
| 25 | 15 | 9.619455 | 10.380545 | 9.660793 | 10.339207 | 10.041338 | 9.958662 | 45 | 35 |
| 26 | 30 | 9.619524 | 10.380476 | 9.660877 | 10.339123 | 10.041352 | 9.958648 | 30 | 34 |
| 27 | 45 | 9.619593 | 10.380407 | 9.660960 | 10.339040 | 10.041367 | 9.958633 | 15 | 33 |
| 28 | 37 | 9.619662 | 10.380338 | 9.661043 | 10.338957 | 10.041381 | 9.958619 | 23 | 32 |
| 29 | 15 | 9.619731 | 10.380269 | 9.661127 | 10.338873 | 10.041396 | 9.958604 | 45 | 31 |
| 30 | 30 | 9.619800 | 10.380200 | 9.661210 | 10.338790 | 10.041410 | 9.958590 | 30 | 30 |
| 31 | 45 | 9.619869 | 10.380131 | 9.661293 | 10.338707 | 10.041425 | 9.958575 | 15 | 29 |
| 32 | 38 | 9.619938 | 10.380062 | 9.661377 | 10.338623 | 10.041439 | 9.958561 | 22 | 28 |
| 33 | 15 | 9.620007 | 10.379993 | 9.661460 | 10.338540 | 10.041454 | 9.958546 | 45 | 27 |
| 34 | 30 | 9.620075 | 10.379925 | 9.661544 | 10.338456 | 10.041468 | 9.958532 | 30 | 26 |
| 35 | 45 | 9.620144 | 10.379856 | 9.661627 | 10.338373 | 10.041483 | 9.958517 | 15 | 25 |
| 36 | 39 | 9.620213 | 10.379787 | 9.661710 | 10.338290 | 10.041497 | 9.958503 | 21 | 24 |
| 37 | 15 | 9.620282 | 10.379718 | 9.661794 | 10.338206 | 10.041512 | 9.958488 | 45 | 23 |
| 38 | 30 | 9.620351 | 10.379649 | 9.661877 | 10.338123 | 10.041526 | 9.958474 | 30 | 22 |
| 39 | 45 | 9.620420 | 10.379580 | 9.661960 | 10.338040 | 10.041541 | 9.958459 | 15 | 21 |
| 40 | 40 | 9.620488 | 10.379512 | 9.662043 | 10.337957 | 10.041555 | 9.958445 | 20 | 20 |
| 41 | 15 | 9.620557 | 10.379443 | 9.662127 | 10.337873 | 10.041570 | 9.958430 | 45 | 19 |
| 42 | 30 | 9.620626 | 10.379374 | 9.662210 | 10.337790 | 10.041584 | 9.958416 | 30 | 18 |
| 43 | 45 | 9.620695 | 10.379305 | 9.662293 | 10.337707 | 10.041599 | 9.958401 | 15 | 17 |
| 44 | 41 | 9.620763 | 10.379237 | 9.662376 | 10.337624 | 10.041613 | 9.958387 | 19 | 16 |
| 45 | 15 | 9.620832 | 10.379168 | 9.662460 | 10.337540 | 10.041628 | 9.958372 | 45 | 15 |
| 46 | 30 | 9.620901 | 10.379099 | 9.662543 | 10.337457 | 10.041642 | 9.958358 | 30 | 14 |
| 47 | 45 | 9.620969 | 10.379031 | 9.662626 | 10.337374 | 10.041657 | 9.958343 | 15 | 13 |
| 48 | 42 | 9.621038 | 10.378962 | 9.662709 | 10.337291 | 10.041671 | 9.958329 | 18 | 12 |
| 49 | 15 | 9.621107 | 10.378893 | 9.662792 | 10.337208 | 10.041686 | 9.958314 | 45 | 11 |
| 50 | 30 | 9.621175 | 10.378825 | 9.662876 | 10.337124 | 10.041700 | 9.958300 | 30 | 10 |
| 51 | 45 | 9.621244 | 10.378756 | 9 662959 | 10.337041 | 10.041715 | 9.958285 | 15 | 9 |
| 52 | 43 | 9.621313 | 10.378687 | 9.663042 | 10.336958 | 10.041729 | 9.958271 | 17 | 8 |
| 53 | 15 | 9.621381 | 10.378619 | 9.663125 | 10.336875 | 10.041744 | 9.958256 | 45 | 7 |
| 54 | 30 | 9.621450 | 10.378550 | 9.663208 | 10 336792 | 10.041758 | 9.958242 | 30 | 6 |
| 55 | 45 | 9.621518 | 10.378482 | 9.663291 | 10.336709 | 10.041773 | 9.958227 | 15 | 5 |
| 56 | 44 | 9.621587 | 10.378413 | 9.663374 | 10.336626 | 10.041788 | 9.958212 | 16 | 4 |
| 57 | 15 | 9.621656 | 10.378344 | 9.663458 | 10.336542 | 10.041802 | 9.958198 | 45 | 3 |
| 58 | 30 | 9.621724 | 10.378276 | 9.663541 | 10.336459 | 10.041817 | 9.958183 | 30 | 2 |
| 59 | 45 | 9.621793 | 10.378207 | 9.663624 | 10.336376 | 10.041831 | 9.958169 | 15 | 1 |
| 60 | 45 | 9.621861 | 10.378139 | 9.663707 | 10.336293 | 10.041846 | 9.958154 | 15 | 0 |
| sec | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine | ″ ′ | sec. |

| 1h 39m. | | LOG. SINES, &c. (t.) | | | | | 24 deg | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.621861 | 10.378139 | 9.663707 | 10.336293 | 10.041846 | 9.958154 | 15 | 60 |
| 1 | 15 | 9.621930 | 10.378070 | 9.663790 | 10.336210 | 10.041860 | 9.958140 | 45 | 59 |
| 2 | 30 | 9.621998 | 10.378002 | 9.663873 | 10.336127 | 10.041875 | 9.958125 | 30 | 58 |
| 3 | 45 | 9.622067 | 10.377933 | 9.663956 | 10.336044 | 10.041889 | 9.958111 | 15 | 57 |
| 4 | 46 | 9.622135 | 10.377865 | 9.664039 | 10.335961 | 10.041904 | 9.958096 | 14 | 56 |
| 5 | 15 | 9.622204 | 10.377796 | 9.664122 | 10.335878 | 10.041919 | 9.958081 | 45 | 55 |
| 6 | 30 | 9.622272 | 10.377728 | 9.664205 | 10.335795 | 10.041933 | 9.958067 | 30 | 54 |
| 7 | 45 | 9.622340 | 10.377660 | 9.664288 | 10.335712 | 10 041948 | 9.958052 | 15 | 53 |
| 8 | 47 | 9.622409 | 10.377591 | 9.664371 | 10.335629 | 10.041962 | 9.958038 | 13 | 52 |
| 9 | 15 | 9.622477 | 10.377523 | 9.664454 | 10.335546 | 10.041977 | 9.958023 | 45 | 51 |
| 10 | 30 | 9.622546 | 10.377454 | 9.664537 | 10.335463 | 10.041991 | 9.958009 | 30 | 50 |
| 11 | 45 | 9.622614 | 10.377386 | 9.664620 | 10.335380 | 10.042006 | 9.957994 | 15 | 49 |
| 12 | 48 | 9.622682 | 10.377318 | 9.664703 | 10.335297 | 10.042021 | 9.957979 | 12 | 48 |
| 13 | 15 | 9.622751 | 10.377249 | 9.664786 | 10.335214 | 10.042035 | 9.957965 | 45 | 47 |
| 14 | 30 | 9.622819 | 10.377181 | 9.664869 | 10.335131 | 10.042050 | 9.957950 | 30 | 46 |
| 15 | 45 | 9.622887 | 10.377113 | 9.664952 | 10.335048 | 10.042064 | 9.957936 | 15 | 45 |
| 16 | 49 | 9.622956 | 10.377044 | 9.665035 | 10.334965 | 10.042079 | 9.957921 | 11 | 44 |
| 17 | 15 | 9.623024 | 10.376976 | 9.665117 | 10.334883 | 10.042094 | 9.957906 | 45 | 43 |
| 18 | 30 | 9.623092 | 10.376908 | 9.665200 | 10.334800 | 10.042108 | 9.957892 | 30 | 42 |
| 19 | 45 | 9.623160 | 10.376840 | 9.665283 | 10.334717 | 10.042123 | 9.957877 | 15 | 41 |
| 20 | 50 | 9.623229 | 10.376771 | 9.665366 | 10.334634 | 10.042137 | 9.957863 | 10 | 40 |
| 21 | 15 | 9.623297 | 10.376703 | 9.665449 | 10.334551 | 10.042152 | 9.957848 | 45 | 39 |
| 22 | 30 | 9.623365 | 10.376635 | 9.665532 | 10.334468 | 10.042167 | 9.957833 | 30 | 38 |
| 23 | 45 | 9.623433 | 10.376567 | 9.665615 | 10.334385 | 10.042181 | 9.957819 | 15 | 37 |
| 24 | 51 | 9.623502 | 10.376498 | 9.665697 | 10.334303 | 10.042196 | 9.957804 | 9 | 36 |
| 25 | 15 | 9.623570 | 10.376430 | 9.665780 | 10.334220 | 10.042211 | 9.957789 | 45 | 35 |
| 26 | 30 | 9.623638 | 10.376362 | 9.665863 | 10.334137 | 10.042225 | 9.957775 | 30 | 34 |
| 27 | 45 | 9.623706 | 10.376294 | 9.665946 | 10.334054 | 10.042240 | 9.957760 | 15 | 33 |
| 28 | 52 | 9.623774 | 10.376226 | 9.666029 | 10.333971 | 10.042254 | 9.957746 | 8 | 32 |
| 29 | 15 | 9.623842 | 10.376158 | 9.666111 | 10.333889 | 10.042269 | 9.957731 | 45 | 31 |
| 30 | 30 | 9.623911 | 10.376089 | 9.666194 | 10.333806 | 10.042284 | 9.957716 | 30 | 30 |
| 31 | 45 | 9.623979 | 10.376021 | 9.666277 | 10.333723 | 10.042298 | 9.957702 | 15 | 29 |
| 32 | 53 | 9.624047 | 10.375953 | 9.666360 | 10.333640 | 10.042313 | 9.957687 | 7 | 28 |
| 33 | 15 | 9.624115 | 10.375885 | 9.666442 | 10.333558 | 10.042328 | 9.957672 | 45 | 27 |
| 34 | 30 | 9.624183 | 10.375817 | 9.666525 | 10.333475 | 10.042342 | 9.957658 | 30 | 26 |
| 35 | 45 | 9.624251 | 10.375749 | 9.666608 | 10.333392 | 10.042357 | 9.957643 | 15 | 25 |
| 36 | 54 | 9.624319 | 10.375681 | 9.666691 | 10.333309 | 10.042372 | 9.957628 | 6 | 24 |
| 37 | 15 | 9.624387 | 10.375613 | 9.666773 | 10.333227 | 10.042386 | 9.957614 | 45 | 23 |
| 38 | 30 | 9.624455 | 10.375545 | 9.666856 | 10.333144 | 10.042401 | 9.957599 | 30 | 22 |
| 39 | 45 | 9.624523 | 10.375477 | 9.666939 | 10.333061 | 10.042416 | 9.957584 | 15 | 21 |
| 40 | 55 | 9.624591 | 10.375409 | 9.667021 | 10.332979 | 10.042430 | 9.957570 | 5 | 20 |
| 41 | 15 | 9.624659 | 10.375341 | 9.667104 | 10.332896 | 10.042445 | 9.957555 | 45 | 19 |
| 42 | 30 | 9.624727 | 10.375273 | 9.667187 | 10.332813 | 10.042460 | 9.957540 | 30 | 18 |
| 43 | 45 | 9.624795 | 10.375205 | 9.667269 | 10.332731 | 10.042474 | 9.957526 | 15 | 17 |
| 44 | 56 | 9.624863 | 10.375137 | 9.667352 | 10.332648 | 10.042489 | 9.957511 | 4 | 16 |
| 45 | 15 | 9.624931 | 10.375069 | 9.667435 | 10.332565 | 10.042504 | 9.957496 | 45 | 15 |
| 46 | 30 | 9.624999 | 10.375001 | 9.667517 | 10.332483 | 10.042518 | 9.957482 | 30 | 14 |
| 47 | 45 | 9.625067 | 10.374933 | 9.667600 | 10.332400 | 10.042533 | 9.957467 | 15 | 13 |
| 48 | 57 | 9.625135 | 10.374865 | 9.667682 | 10.332318 | 10.042548 | 9.957452 | 3 | 12 |
| 49 | 15 | 9.625202 | 10.374798 | 9.667765 | 10.332235 | 10.042563 | 9.957437 | 45 | 11 |
| 50 | 30 | 9.625270 | 10.374730 | 9.667847 | 10.332153 | 10.042577 | 9.957423 | 30 | 10 |
| 51 | 45 | 9.625338 | 10.374662 | 9.667930 | 10.332070 | 10.042592 | 9.957408 | 15 | 9 |
| 52 | 58 | 9.625406 | 10.374594 | 9.668013 | 10.331987 | 10.042607 | 9.957393 | 2 | 8 |
| 53 | 15 | 9.625474 | 10.374526 | 9.668095 | 10.331905 | 10.042621 | 9.957379 | 45 | 7 |
| 54 | 30 | 9.625542 | 10.374458 | 9.668178 | 10.331822 | 10.042636 | 9.957364 | 30 | 6 |
| 55 | 45 | 9.625609 | 10.374391 | 9.668260 | 10.331740 | 10.042651 | 9.957349 | 15 | 5 |
| 56 | 59 | 9.625677 | 10.374323 | 9.668343 | 10.331657 | 10 042665 | 9.957335 | 1 | 4 |
| 57 | 15 | 9.625745 | 10.374255 | 9.668425 | 10.331575 | 10.042680 | 9.957320 | 45 | 3 |
| 58 | 30 | 9.625813 | 10.374187 | 9.668508 | 10.331492 | 10.042695 | 9.957305 | 30 | 2 |
| 59 | 45 | 9.625880 | 10.374120 | 9.668590 | 10.331410 | 10.042710 | 9.957290 | 15 | 1 |
| 60 | 60 | 9.625948 | 10.374052 | 9.668672 | 10.331328 | 10.042724 | 9.957276 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 20m. | | | | LOG. SINES, &c. | | | | 65 deg. | |

| 1h 40m. | | | LOG. SINES, &c. (t.) | | | | 25 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.625948 | 10.374052 | 9.668672 | 10.331328 | 10.042724 | 9.957276 | 60 | 60 |
| 1 | 15 | 9.626016 | 10.373984 | 9.668755 | 10.331245 | 10.042739 | 9.957261 | 45 | 59 |
| 2 | 30 | 9.626084 | 10.373916 | 9.668837 | 10.331163 | 10.042754 | 9.957246 | 30 | 58 |
| 3 | 45 | 9.626151 | 10.373849 | 9.668920 | 10.331080 | 10.042769 | 9.957231 | 15 | 57 |
| 4 | 1 | 9.626219 | 10.373781 | 9.669002 | 10.330998 | 10.042783 | 9.957217 | 59 | 56 |
| 5 | 15 | 9.626287 | 10.373713 | 9.669085 | 10.330915 | 10.042798 | 9.957202 | 45 | 55 |
| 6 | 30 | 9.626354 | 10.373646 | 9.669167 | 10.330833 | 10.042813 | 9.957187 | 30 | 54 |
| 7 | 45 | 9.626422 | 10.373578 | 9.669249 | 10.330751 | 10.042827 | 9.957173 | 15 | 53 |
| 8 | 2 | 9.626490 | 10.373510 | 9.669332 | 10.330668 | 10.042842 | 9.957158 | 58 | 52 |
| 9 | 15 | 9.626557 | 10.373443 | 9.669414 | 10.330586 | 10.042857 | 9.957143 | 45 | 51 |
| 10 | 30 | 9.626625 | 10.373375 | 9.669497 | 10.330503 | 10.042872 | 9.957128 | 30 | 50 |
| 11 | 45 | 9.626692 | 10.373308 | 9.669579 | 10.330421 | 10.042887 | 9.957113 | 15 | 49 |
| 12 | 3 | 9.626760 | 10.373240 | 9.669661 | 10.330339 | 10.042901 | 9.957099 | 57 | 48 |
| 13 | 15 | 9.626828 | 10.373172 | 9.669744 | 10.330256 | 10 042916 | 9.957084 | 45 | 47 |
| 14 | 30 | 9.626895 | 10.373105 | 9.669826 | 10.330174 | 10.042931 | 9.957069 | 30 | 46 |
| 15 | 45 | 9.626963 | 10.373037 | 9.669908 | 10.330092 | 10.042946 | 9.957054 | 15 | 45 |
| 16 | 4 | 9.627030 | 10.372970 | 9.669991 | 10.330009 | 10.042960 | 9.957040 | 56 | 44 |
| 17 | 15 | 9.627098 | 10.372902 | 9.670073 | 10.329927 | 10.042975 | 9.957025 | 45 | 43 |
| 18 | 30 | 9.627165 | 10.372835 | 9.670155 | 10.329845 | 10.042990 | 9.957010 | 30 | 42 |
| 19 | 45 | 9.627233 | 10.372767 | 9.670237 | 10.329763 | 10.043005 | 9.956995 | 15 | 41 |
| 20 | 5 | 9.627300 | 10.372700 | 9.670320 | 10.329680 | 10.043019 | 9.956981 | 55 | 40 |
| 21 | 15 | 9.627368 | 10.372632 | 9.670402 | 10.329598 | 10.043034 | 9.956966 | 45 | 39 |
| 22 | 30 | 9.627435 | 10.372565 | 9.670484 | 10.329516 | 10.043049 | 9.956951 | 30 | 38 |
| 23 | 45 | 9.627503 | 10.372497 | 9.670566 | 10.329434 | 10.043064 | 9.956936 | 15 | 37 |
| 24 | 6 | 9.627570 | 10.372430 | 9.670649 | 10.329351 | 10.043079 | 9.956921 | 54 | 36 |
| 25 | 15 | 9.627637 | 10.372363 | 9.670731 | 10.329269 | 10.043093 | 9.956907 | 45 | 35 |
| 26 | 30 | 9.627705 | 10.372295 | 9.670813 | 10.329187 | 10.043108 | 9.956892 | 30 | 34 |
| 27 | 45 | 9.627772 | 10.372228 | 9.670895 | 10.329105 | 10.043123 | 9.956877 | 15 | 33 |
| 28 | 7 | 9.627840 | 10.372160 | 9.670977 | 10.329023 | 10.043138 | 9.956862 | 53 | 32 |
| 29 | 15 | 9.627907 | 10.372093 | 9.671060 | 10.328940 | 10.043153 | 9.956847 | 45 | 31 |
| 30 | 30 | 9.627974 | 10 372026 | 9.671142 | 10.328858 | 10.043167 | 9.956833 | 30 | 30 |
| 31 | 45 | 9.628042 | 10.371958 | 9.671224 | 10.328776 | 10.043182 | 9.956818 | 15 | 29 |
| 32 | 8 | 9.628109 | 10.371891 | 9.671306 | 10.328694 | 10.043197 | 9.956803 | 52 | 28 |
| 33 | 15 | 9.628176 | 10.371824 | 9.671388 | 10.328612 | 10.043212 | 9.956788 | 45 | 27 |
| 34 | 30 | 9.628244 | 10.371756 | 9.671470 | 10.328530 | 10.043227 | 9.956773 | 30 | 26 |
| 35 | 45 | 9.628311 | 10.371689 | 9.671552 | 10.328448 | 10.043242 | 9.956758 | 15 | 25 |
| 36 | 9 | 9.628378 | 10.371622 | 9.671634 | 10.328366 | 10.043256 | 9.956744 | 51 | 24 |
| 37 | 15 | 9.628445 | 10.371555 | 9.671717 | 10.328283 | 10.043271 | 9.956729 | 45 | 23 |
| 38 | 30 | 9.628513 | 10.371487 | 9.671799 | 10.328201 | 10.043286 | 9.956714 | 30 | 22 |
| 39 | 45 | 9.628580 | 10.371420 | 9.671881 | 10.328119 | 10.043301 | 9.956699 | 15 | 21 |
| 40 | 10 | 9.628647 | 10.371353 | 9.671963 | 10.328037 | 10.043316 | 9.956684 | 50 | 20 |
| 41 | 15 | 9.628714 | 10.371286 | 9.672045 | 10.327955 | 10.043331 | 9.956669 | 45 | 19 |
| 42 | 30 | 9.628782 | 10.371218 | 9.672127 | 10.327873 | 10.043345 | 9.956655 | 30 | 18 |
| 43 | 45 | 9.628849 | 10.371151 | 9.672209 | 10.327791 | 10.043360 | 9.956640 | 15 | 17 |
| 44 | 11 | 9.628916 | 10.371084 | 9.672291 | 10.327709 | 10.043375 | 9.956625 | 49 | 16 |
| 45 | 15 | 9.628983 | 10.371017 | 9.672373 | 10.327627 | 10.043390 | 9.956610 | 45 | 15 |
| 46 | 30 | 9.629050 | 10.370950 | 9.672455 | 10.327545 | 10.043405 | 9.956595 | 30 | 14 |
| 47 | 45 | 9.629117 | 10.370883 | 9.672537 | 10.327463 | 10.043420 | 9.956580 | 15 | 13 |
| 48 | 12 | 9.629184 | 10.370816 | 9.672619 | 10.327381 | 10.043434 | 9.956566 | 48 | 12 |
| 49 | 15 | 9.629252 | 10.370748 | 9.672701 | 10.327299 | 10.043449 | 9.956551 | 45 | 11 |
| 50 | 30 | 9.629319 | 10.370681 | 9.672783 | 10.327217 | 10.043464 | 9.956536 | 30 | 10 |
| 51 | 45 | 9.629386 | 10.370614 | 9.672865 | 10.327135 | 10.043479 | 9.956521 | 15 | 9 |
| 52 | 13 | 9.629453 | 10.370547 | 9.672947 | 10.327053 | 10.043494 | 9.956506 | 47 | 8 |
| 53 | 15 | 9.629520 | 10.370480 | 9.673029 | 10.326971 | 10.043509 | 9.956491 | 45 | 7 |
| 54 | 30 | 9.629587 | 10.370413 | 9.673111 | 10.326889 | 10.043524 | 9.956476 | 30 | 6 |
| 55 | 45 | 9.629654 | 10.370346 | 9.673193 | 10.326807 | 10.043539 | 9.956461 | 15 | 5 |
| 56 | 14 | 9.629721 | 10.370279 | 9.673274 | 10.326726 | 10.043553 | 9.956447 | 46 | 4 |
| 57 | 15 | 9.629788 | 10.670212 | 9.673356 | 10.326644 | 10.043568 | 9.956432 | 45 | 3 |
| 58 | 30 | 9.629855 | 10.370145 | 9.673438 | 10.326562 | 10.043583 | 9.956417 | 30 | 2 |
| 59 | 45 | 9.629922 | 10.370078 | 9.673520 | 10.326480 | 10.043598 | 9.956402 | 15 | 1 |
| 60 | 15 | 9.629989 | 10.370011 | 9.673602 | 10.326398 | 10.043613 | 9.956387 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 1h 41m. | | | LOG. SINES, &c. (t.) | | | | 25 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.629989 | 10.370011 | 9.673602 | 10.326398 | 10.043613 | 9.956387 | 45 | 60 |
| 1 | 15 | 9.630056 | 10.369944 | 9.673684 | 10.326316 | 10.043628 | 9.956372 | 45 | 59 |
| 2 | 30 | 9.630123 | 10.369877 | 9.673766 | 10.326234 | 10.043643 | 9.956357 | 30 | 58 |
| 3 | 45 | 9.630190 | 10.369810 | 9.673847 | 10.326153 | 10.043658 | 9.956342 | 15 | 57 |
| 4 | 16 | 9.630257 | 10.369743 | 9.673929 | 10.326071 | 10.043673 | 9.956327 | 44 | 56 |
| 5 | 15 | 9.630324 | 10.369676 | 9.674011 | 10.325989 | 10.043688 | 9.956312 | 45 | 55 |
| 6 | 30 | 9.630391 | 10.369609 | 9.674093 | 10.325907 | 10.043702 | 9.956298 | 30 | 54 |
| 7 | 45 | 9.630457 | 10.369543 | 9.674175 | 10.325825 | 10.043717 | 9.956283 | 15 | 53 |
| 8 | 17 | 9.630524 | 10.369476 | 9.674257 | 10.325743 | 10.043732 | 9.956268 | 43 | 52 |
| 9 | 15 | 9.630591 | 10.369409 | 9.674338 | 10.325662 | 10.043747 | 9.956253 | 45 | 51 |
| 10 | 30 | 9.630658 | 10.369342 | 9.674420 | 10.325580 | 10.043762 | 9 956238 | 30 | 50 |
| 11 | 45 | 9.630725 | 10.369275 | 9.674502 | 10.325498 | 10.043777 | 9.956223 | 15 | 49 |
| 12 | 18 | 9.630792 | 10.369208 | 9.674584 | 10.325416 | 10.043792 | 9.956208 | 42 | 48 |
| 13 | 15 | 9.630858 | 10.369142 | 9.674665 | 10.325335 | 10.043807 | 9.956193 | 45 | 47 |
| 14 | 30 | 9.630925 | 10.369075 | 9.674747 | 10.325253 | 10.043822 | 9.956178 | 30 | 46 |
| 15 | 45 | 9.630992 | 10.369008 | 9.674829 | 10.325171 | 10.043837 | 9.956163 | 15 | 45 |
| 16 | 19 | 9.631059 | 10.368941 | 9.674910 | 10.325090 | 10.043852 | 9.956148 | 41 | 44 |
| 17 | 15 | 9.631126 | 10.368874 | 9.674992 | 10.325008 | 10.043867 | 9.956133 | 45 | 43 |
| 18 | 30 | 9.631192 | 10.368808 | 9.675074 | 10.324926 | 10.043882 | 9.956118 | 30 | 42 |
| 19 | 45 | 9.631259 | 10.368741 | 9.675156 | 10.324844 | 10.043897 | 9.956103 | 15 | 41 |
| 20 | 20 | 9.631326 | 10.368674 | 9.675237 | 10.324763 | 10.043911 | 9.956089 | 40 | 40 |
| 21 | 15 | 9.631392 | 10.368608 | 9.675319 | 10.324681 | 10.043926 | 9.956074 | 45 | 39 |
| 22 | 30 | 9.631459 | 10.368541 | 9.675401 | 10.324599 | 10.043941 | 9.956059 | 30 | 38 |
| 23 | 45 | 9.631526 | 10.368474 | 9.675482 | 10.324518 | 10.043956 | 9.956044 | 15 | 37 |
| 24 | 21 | 9.631593 | 10.368407 | 9.675564 | 10.324436 | 10.043971 | 9.956029 | 39 | 36 |
| 25 | 15 | 9.631659 | 10.368341 | 9.675645 | 10.324355 | 10.043986 | 9.956014 | 45 | 35 |
| 26 | 30 | 9.631726 | 10.368274 | 9.675727 | 10.324273 | 10.044001 | 9.955999 | 30 | 34 |
| 27 | 45 | 9.631792 | 10.368208 | 9.675809 | 10 324191 | 10.044016 | 9.955984 | 15 | 33 |
| 28 | 22 | 9.631859 | 10.368141 | 9.675890 | 10.324110 | 10.044031 | 9.955969 | 38 | 32 |
| 29 | 15 | 9.631926 | 10.368074 | 9.675972 | 10.324028 | 10.044046 | 9.955954 | 45 | 31 |
| 30 | 30 | 9.631992 | 10.368008 | 9.676053 | 10.323947 | 10.044061 | 9.955939 | 30 | 30 |
| 31 | 45 | 9.632059 | 10.367941 | 9.676135 | 10.323865 | 10.044076 | 9.955924 | 15 | 29 |
| 32 | 23 | 9.632125 | 10.367875 | 9.676216 | 10.323784 | 10.044091 | 9.955909 | 37 | 28 |
| 33 | 15 | 9.632192 | 10.367808 | 9.676298 | 10.323702 | 10.044106 | 9.955894 | 45 | 27 |
| 34 | 30 | 9.632259 | 10.367741 | 9.676380 | 10.323620 | 10.044121 | 9.955879 | 30 | 26 |
| 35 | 45 | 9.632325 | 10.367675 | 9.676461 | 10.323539 | 10.044136 | 9.955864 | 15 | 25 |
| 36 | 24 | 9 632392 | 10.367608 | 9.676543 | 10.323457 | 10.044151 | 9.955849 | 36 | 24 |
| 37 | 15 | 9.632458 | 10.367542 | 9.676624 | 10.323376 | 10.044166 | 9.955834 | 45 | 23 |
| 38 | 30 | 9.632525 | 10.367475 | 9.676706 | 10.323294 | 10.044181 | 9.955819 | 30 | 22 |
| 39 | 45 | 9.632591 | 10.367409 | 9.676787 | 10.323213 | 10.044196 | 9.955804 | 15 | 21 |
| 40 | 25 | 9.632658 | 10.367342 | 9.676869 | 10.323131 | 10.044211 | 9.955789 | 35 | 20 |
| 41 | 15 | 9.632724 | 10.367276 | 9.676950 | 10.323050 | 10.044226 | 9.955774 | 45 | 19 |
| 42 | 30 | 9.632790 | 10.367210 | 9.677031 | 10.322969 | 10.044241 | 9.955759 | 30 | 18 |
| 43 | 45 | 9.632857 | 10.367143 | 9.677113 | 10.322887 | 10.044256 | 9.955744 | 15 | 17 |
| 44 | 26 | 9.632923 | 10.367077 | 9.677194 | 10.322806 | 10.044271 | 9.955729 | 34 | 16 |
| 45 | 15 | 9.632990 | 10.367010 | 9.677276 | 10.322724 | 10.044286 | 9.955714 | 45 | 15 |
| 46 | 30 | 9.633056 | 10.366944 | 9.677357 | 10.322643 | 10.044301 | 9.955699 | 30 | 14 |
| 47 | 45 | 9.633122 | 10.366878 | 9.677439 | 10.322561 | 10.044316 | 9.955684 | 15 | 13 |
| 48 | 27 | 9.633189 | 10.366811 | 9.677520 | 10.322480 | 10.044331 | 9 955669 | 33 | 12 |
| 49 | 15 | 9.633255 | 10.366745 | 9.677601 | 10.322399 | 10 044346 | 9.955654 | 45 | 11 |
| 50 | 30 | 9.633322 | 10.366678 | 9.677683 | 10.322317 | 10.044361 | 9.955639 | 30 | 10 |
| 51 | 45 | 9.633388 | 10.366612 | 9.677764 | 10.322236 | 10.044376 | 9.955624 | 15 | 9 |
| 52 | 28 | 9.633454 | 10.366546 | 9.677846 | 10.322154 | 10.044391 | 9.955609 | 32 | 8 |
| 53 | 15 | 9.633520 | 10.366480 | 9.677927 | 10 322073 | 10.044406 | 9.955594 | 45 | 7 |
| 54 | 30 | 9.633587 | 10.366413 | 9.678008 | 10.321992 | 10.044421 | 9.955579 | 30 | 6 |
| 55 | 45 | 9.633653 | 10.366347 | 9.678090 | 10.321910 | 10.044437 | 9.955563 | 15 | 5 |
| 56 | 29 | 9.633719 | 10.366281 | 9.678171 | 10.321829 | 10.044452 | 9.955548 | 31 | 4 |
| 57 | 15 | 9.633786 | 10.366214 | 9.678252 | 10.321748 | 10.044467 | 9.955533 | 45 | 3 |
| 58 | 30 | 9.633852 | 10.366148 | 9.678333 | 10.321667 | 10.044482 | 9.955518 | 30 | 2 |
| 59 | 45 | 9.633918 | 10.366082 | 9.678415 | 10.321585 | 10.044497 | 9.955503 | 15 | 1 |
| 60 | 30 | 9.633984 | 10.366016 | 9.678496 | 10.321504 | 10.044512 | 9.955488 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 18m. | | | LOG. SINES, &c. | | | | 64 deg. | | |

| $1^h\ 42^m$. | | LOG. SINES, &c. (t.) | | | | | 25 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.633984 | 10.366016 | 9.678496 | 10.321504 | 10.044512 | 9.955488 | 30 | 60 |
| 1 | 15 | 9.634051 | 10.365949 | 9.678577 | 10.321423 | 10.044527 | 9.955473 | 45 | 59 |
| 2 | 30 | 9.634117 | 10 365883 | 9.678659 | 10.321341 | 10.044542 | 9.955458 | 30 | 58 |
| 3 | 45 | 9.634183 | 10.365817 | 9.678740 | 10.321260 | 10.044557 | 9.955443 | 15 | 57 |
| 4 | 31 | 9.634249 | 10.365751 | 9.678821 | 10.321179 | 10.044572 | 9.955428 | 29 | 56 |
| 5 | 15 | 9.634315 | 10.365685 | 9.678902 | 10.321098 | 10.044587 | 9.955413 | 45 | 55 |
| 6 | 30 | 9.634381 | 10.365619 | 9.678984 | 10.321016 | 10.044602 | 9.955398 | 30 | 54 |
| 7 | 45 | 9.634447 | 10.365553 | 9.679065 | 10.320935 | 10.044617 | 9.955383 | 15 | 53 |
| 8 | 32 | 9.634514 | 10.365486 | 9.679146 | 10.320854 | 10.044632 | 9.955368 | 28 | 52 |
| 9 | 15 | 9.634580 | 10.365420 | 9.679227 | 10.320773 | 10.044647 | 9.955353 | 45 | 51 |
| 10 | 30 | 9.634646 | 10.365354 | 9.679308 | 10.320692 | 10.044663 | 9.955337 | 30 | 50 |
| 11 | 45 | 9.634712 | 10.365288 | 9.679390 | 10.320610 | 10.044678 | 9.955322 | 15 | 49 |
| 12 | 33 | 9.634778 | 10.365222 | 9.679471 | 10.320529 | 10.044693 | 9.955307 | 27 | 48 |
| 13 | 15 | 9.634844 | 10.365156 | 9.679552 | 10.320448 | 10.044708 | 9.955292 | 45 | 47 |
| 14 | 30 | 9.634910 | 10.365090 | 9.679633 | 10.320367 | 10.044723 | 9.955277 | 30 | 46 |
| 15 | 45 | 9.634976 | 10.365024 | 9.679714 | 10.320286 | 10.044738 | 9.955262 | 15 | 45 |
| 16 | 34 | 9.635042 | 10.364958 | 9.679795 | 10.320205 | 10.044753 | 9.955247 | 26 | 44 |
| 17 | 15 | 9.635108 | 10.364892 | 9.679876 | 10.320124 | 10.044768 | 9.955232 | 45 | 43 |
| 18 | 30 | 9.635174 | 10.364826 | 9.679958 | 10.320042 | 10.044783 | 9.955217 | 30 | 42 |
| 19 | 45 | 9.635240 | 10.364760 | 9.680039 | 10.319961 | 10.044799 | 9.955201 | 15 | 41 |
| 20 | 35 | 9.635306 | 10.364694 | 9.680120 | 10.319880 | 10.044814 | 9.955186 | 25 | 40 |
| 21 | 15 | 9.635372 | 10.364628 | 9.680201 | 10.319799 | 10.044829 | 9.955171 | 45 | 39 |
| 22 | 30 | 9.635438 | 10.364562 | 9.680282 | 10.319718 | 10.044844 | 9.955156 | 30 | 38 |
| 23 | 45 | 9.635504 | 10.364496 | 9.680363 | 10.319637 | 10.044859 | 9.955141 | 15 | 37 |
| 24 | 36 | 9.635570 | 10.364430 | 9.680444 | 10.319556 | 10.044874 | 9.955126 | 24 | 36 |
| 25 | 15 | 9.635636 | 10.364364 | 9.680525 | 10.319475 | 10.044889 | 9.955111 | 45 | 35 |
| 26 | 30 | 9.635702 | 10.364298 | 9.680606 | 10.319394 | 10.044904 | 9.955096 | 30 | 34 |
| 27 | 45 | 9.635768 | 10.364232 | 9.680687 | 10.319313 | 10.044920 | 9.955080 | 15 | 33 |
| 28 | 37 | 9.635833 | 10.364167 | 9.680768 | 10.319232 | 10.044935 | 9.955065 | 23 | 32 |
| 29 | 15 | 9.635899 | 10.364101 | 9.680849 | 10.319151 | 10.044950 | 9.955050 | 45 | 31 |
| 30 | 30 | 9.635965 | 10.364035 | 9.680930 | 10.319070 | 10.044965 | 9.955035 | 30 | 30 |
| 31 | 45 | 9.636031 | 10.363969 | 9.681011 | 10.318989 | 10.044980 | 9.955020 | 15 | 29 |
| 32 | 38 | 9.636097 | 10.363903 | 9.681092 | 10.318906 | 10.044995 | 9.955005 | 22 | 28 |
| 33 | 15 | 9.636163 | 10.363837 | 9.681173 | 10.318827 | 10.045010 | 9.954990 | 45 | 27 |
| 34 | 30 | 9.636228 | 10.363772 | 9.681254 | 10.318746 | 10.045026 | 9.954974 | 30 | 26 |
| 35 | 45 | 9.636294 | 10.363706 | 9.681335 | 10.318665 | 10.045041 | 9.954959 | 15 | 25 |
| 36 | 39 | 9.636360 | 10.363640 | 9.681416 | 10.318584 | 10.045056 | 9.954944 | 21 | 24 |
| 37 | 15 | 9.636426 | 10.363574 | 9.681497 | 10.318503 | 10.045071 | 9.954929 | 45 | 23 |
| 38 | 30 | 9.636492 | 10.363508 | 9.681578 | 10.318422 | 10.045086 | 9.954914 | 30 | 22 |
| 39 | 45 | 9.636557 | 10.363443 | 9.681659 | 10.318341 | 10.045101 | 9.954899 | 15 | 21 |
| 40 | 40 | 9.636623 | 10.363377 | 9.681740 | 10.318260 | 10.045117 | 9.954883 | 20 | 20 |
| 41 | 15 | 9.636689 | 10.363311 | 9.681820 | 10.318180 | 10.045132 | 9.954868 | 45 | 19 |
| 42 | 30 | 9.636754 | 10.363246 | 9.681901 | 10.318099 | 10.045147 | 9.954853 | 30 | 18 |
| 43 | 45 | 9.636820 | 10.363180 | 9.681982 | 10.318018 | 10.045162 | 9.954838 | 15 | 17 |
| 44 | 41 | 9.636886 | 10.363114 | 9.682063 | 10.317937 | 10.045177 | 9.954823 | 19 | 16 |
| 45 | 15 | 9.636951 | 10.363049 | 9.682144 | 10.317856 | 10.045193 | 9.954807 | 45 | 15 |
| 46 | 30 | 9.637017 | 10.362983 | 9.682225 | 10.317775 | 10.045208 | 9.954792 | 30 | 14 |
| 47 | 45 | 9.637083 | 10.362917 | 9.682306 | 10.317694 | 10.045223 | 9.954777 | 15 | 13 |
| 48 | 42 | 9.637148 | 10.362852 | 9.682386 | 10.317614 | 10.045238 | 9.954762 | 18 | 12 |
| 49 | 15 | 9.637214 | 10.362786 | 9.682467 | 10.317533 | 10.045253 | 9.954747 | 45 | 11 |
| 50 | 30 | 9.637280 | 10.362720 | 9.682548 | 10.317452 | 10.045269 | 9.954731 | 30 | 10 |
| 51 | 45 | 9.637345 | 10.362655 | 9.682629 | 10.317371 | 10.045284 | 9.954716 | 15 | 9 |
| 52 | 43 | 9.637411 | 10.362589 | 9.682710 | 10.317290 | 10.045299 | 9.954701 | 17 | 8 |
| 53 | 15 | 9.637476 | 10.362524 | 9.682790 | 10.317210 | 10.045314 | 9.954686 | 45 | 7 |
| 54 | 30 | 9.637542 | 10.362458 | 9.682871 | 10.317129 | 10.045329 | 9.954671 | 30 | 6 |
| 55 | 45 | 9.637607 | 10.362393 | 9.682952 | 10.317048 | 10.045345 | 9.954655 | 15 | 5 |
| 56 | 44 | 9.637673 | 10.362327 | 9.683033 | 10.316967 | 10.045360 | 9.954640 | 16 | 4 |
| 57 | 15 | 9.637739 | 10.362261 | 9.683114 | 10.316886 | 10.045375 | 9.954625 | 45 | 3 |
| 58 | 30 | 9.637804 | 10.362196 | 9.683194 | 10.316806 | 10.045390 | 9.954610 | 30 | 2 |
| 59 | 45 | 9.637870 | 10.362130 | 9.683275 | 10.316725 | 10.045406 | 9.954594 | 15 | 1 |
| 60 | 45 | 9.637935 | 10.362065 | 9.683356 | 10.316644 | 10.045421 | 9.954579 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| $4^h\ 17^m$. | | LOG. SINES, &c. | | | | | 64 deg. | | |

| 1h 43m. | | | LOG. SINES, &c. (t.) | | | | 25 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.637935 | 10.362065 | 9.683356 | 10.316644 | 10.045421 | 9.954579 | 15 | 60 |
| 1 | 15 | 9.638000 | 10.362000 | 9.683436 | 10.316564 | 10.045436 | 9.954564 | 45 | 59 |
| 2 | 30 | 9.638066 | 10.361934 | 9.683517 | 10.316483 | 10.045451 | 9.954549 | 30 | 58 |
| 3 | 45 | 9.638131 | 10.361869 | 9.683598 | 10.316402 | 10.045466 | 9.954534 | 15 | 57 |
| 4 | 46 | 9.638197 | 10.361803 | 9.683678 | 10.316322 | 10.045482 | 9.954518 | 14 | 56 |
| 5 | 15 | 9.638262 | 10.361738 | 9.683759 | 10.316241 | 10.045497 | 9.954503 | 45 | 55 |
| 6 | 30 | 9.638328 | 10.361672 | 9.683840 | 10.316160 | 10.045512 | 9.954488 | 30 | 54 |
| 7 | 45 | 9.638393 | 10.361607 | 9.683920 | 10.316080 | 10.045527 | 9.954473 | 15 | 53 |
| 8 | 47 | 9.638458 | 10.361542 | 9.684001 | 10.315999 | 10.045543 | 9.954457 | 13 | 52 |
| 9 | 15 | 9.638524 | 10.361476 | 9.684082 | 10.315918 | 10.045558 | 9.954442 | 45 | 51 |
| 10 | 30 | 9.638589 | 10.361411 | 9.684162 | 10.315838 | 10.045573 | 9.954427 | 30 | 50 |
| 11 | 45 | 9.638655 | 10.361345 | 9.684243 | 10.315757 | 10.045588 | 9.954412 | 15 | 49 |
| 12 | 48 | 9.638720 | 10.361280 | 9.684324 | 10.315676 | 10.045604 | 9.954396 | 12 | 48 |
| 13 | 15 | 9.638785 | 10.361215 | 9.684404 | 10.315596 | 10.045619 | 9.954381 | 45 | 47 |
| 14 | 30 | 9.638851 | 10.361149 | 9.684485 | 10.315515 | 10.045634 | 9.954366 | 30 | 46 |
| 15 | 45 | 9.638916 | 10.361084 | 9.684565 | 10.315435 | 10.045650 | 9.954350 | 15 | 45 |
| 16 | 49 | 9.638981 | 10.361019 | 9.684646 | 10.315354 | 10.045665 | 9.954335 | 11 | 44 |
| 17 | 15 | 9.639046 | 10.360954 | 9.684726 | 10.315274 | 10.045680 | 9.954320 | 45 | 43 |
| 18 | 30 | 9.639112 | 10.360888 | 9.684807 | 10.315193 | 10.045695 | 9.954305 | 30 | 42 |
| 19 | 45 | 9.639177 | 10.360823 | 9.684888 | 10.315112 | 10.045711 | 9.954289 | 15 | 41 |
| 20 | 50 | 9.639242 | 10.360758 | 9.684968 | 10.315032 | 10.045726 | 9.954274 | 10 | 40 |
| 21 | 15 | 9.639307 | 10.360693 | 9.685049 | 10.314951 | 10.045741 | 9.954259 | 45 | 39 |
| 22 | 30 | 9.639373 | 10.360627 | 9.685129 | 10.314871 | 10.045757 | 9.954243 | 30 | 38 |
| 23 | 45 | 9.639438 | 10.360562 | 9.685210 | 10.314790 | 10.045772 | 9 954228 | 15 | 37 |
| 24 | 51 | 9.639503 | 10.360497 | 9.685290 | 10.314710 | 10.045787 | 9.954213 | 9 | 36 |
| 25 | 15 | 9.639568 | 10.360432 | 9.685371 | 10 314629 | 10.045802 | 9.954198 | 45 | 35 |
| 26 | 30 | 9.639633 | 10.360367 | 9.685451 | 10.314549 | 10.045818 | 9.954182 | 30 | 34 |
| 27 | 45 | 9.639698 | 10.360302 | 9.685532 | 10.314468 | 10.045833 | 9.954167 | 15 | 33 |
| 28 | 52 | 9.639764 | 10.360236 | 9.685612 | 10.314388 | 10.045848 | 9.954152 | 8 | 32 |
| 29 | 15 | 9.639829 | 10.360171 | 9.685692 | 10.314308 | 10.045864 | 9.954136 | 45 | 31 |
| 30 | 30 | 9.639894 | 10.360106 | 9.685773 | 10.314227 | 10.045879 | 9.954121 | 30 | 30 |
| 31 | 45 | 9.639959 | 10.360041 | 9.685853 | 10.314147 | 10.045894 | 9.954106 | 15 | 29 |
| 32 | 53 | 9.640024 | 10.359976 | 9.685934 | 10.314066 | 10.045910 | 9.954090 | 7 | 28 |
| 33 | 15 | 9.640089 | 10.359911 | 9.686014 | 10.313986 | 10.045925 | 9.954075 | 45 | 27 |
| 34 | 30 | 9.640154 | 10.359846 | 9.686095 | 10.313905 | 10.045940 | 9.954060 | 30 | 26 |
| 35 | 45 | 9.640219 | 10.359781 | 9.686175 | 10.313825 | 10.045956 | 9.954044 | 15 | 25 |
| 36 | 54 | 9.640284 | 10.359716 | 9.686255 | 10.313745 | 10.045971 | 9.954029 | 6 | 24 |
| 37 | 15 | 9.640349 | 10.359651 | 9.686336 | 10.313664 | 10.045986 | 9.954014 | 45 | 23 |
| 38 | 30 | 9.640414 | 10.359586 | 9.686416 | 10.313584 | 10.046002 | 9.953998 | 30 | 22 |
| 39 | 45 | 9.640479 | 10.359521 | 9.686496 | 10.313504 | 10.046017 | 9.953983 | 15 | 21 |
| 40 | 55 | 9.640544 | 10.359456 | 9.686577 | 10.313423 | 10.046032 | 9.953968 | 5 | 20 |
| 41 | 15 | 9.640609 | 10.359391 | 9.686657 | 10.313343 | 10.046048 | 9.953952 | 45 | 19 |
| 42 | 30 | 9.640674 | 10.359326 | 9.686737 | 10.313263 | 10.046063 | 9.953937 | 30 | 18 |
| 43 | 45 | 9.640739 | 10.359261 | 9.686818 | 10.313182 | 10.046078 | 9.953922 | 15 | 17 |
| 44 | 56 | 9.640804 | 10.359196 | 9.686898 | 10.313102 | 10.046094 | 9 953906 | 4 | 16 |
| 45 | 15 | 9.640869 | 10.359131 | 9.686978 | 10.313022 | 10.046109 | 9.953891 | 45 | 15 |
| 46 | 30 | 9.640934 | 10.359066 | 9.687059 | 10.312941 | 10.046124 | 9.953876 | 30 | 14 |
| 47 | 45 | 9.640999 | 10.359001 | 9.687139 | 10.312861 | 10.046140 | 9.953860 | 15 | 13 |
| 48 | 57 | 9.641064 | 10.358936 | 9.687219 | 10.312781 | 10.046155 | 9.953845 | 3 | 12 |
| 49 | 15 | 9.641129 | 10.358871 | 9.687299 | 10.312701 | 10.046171 | 9.953829 | 45 | 11 |
| 50 | 30 | 9.641194 | 10.358806 | 9.687380 | 10.312620 | 10.046186 | 9.953814 | 30 | 10 |
| 51 | 45 | 9.641259 | 10.358741 | 9.687460 | 10.312540 | 10.046201 | 9.953799 | 15 | 9 |
| 52 | 58 | 9.641323 | 10.358677 | 9.687540 | 10.312460 | 10.046217 | 9.953783 | 2 | 8 |
| 53 | 15 | 9.641388 | 10.358612 | 9.687620 | 10.312380 | 10.046232 | 9.953768 | 45 | 7 |
| 54 | 30 | 9.641453 | 10.358547 | 9.687701 | 10.312299 | 10.046247 | 9.953753 | 30 | 6 |
| 55 | 45 | 9.641518 | 10.358482 | 9.687781 | 10.312219 | 10.046263 | 9.953737 | 15 | 5 |
| 56 | 59 | 9.641583 | 10.358417 | 9.687861 | 10.312139 | 10.046278 | 9.953722 | 1 | 4 |
| 57 | 15 | 9.641648 | 10.358352 | 9.687941 | 10.312059 | 10.046294 | 9.953706 | 45 | 3 |
| 58 | 30 | 9 641712 | 10.358288 | 9.688021 | 10.311979 | 10.046309 | 9 953691 | 30 | 2 |
| 59 | 45 | 9.641777 | 10.358223 | 9.688102 | 10.311898 | 10.046324 | 9.953676 | 15 | 1 |
| 60 | 60 | 9.641842 | 10.358158 | 9.688182 | 10.311818 | 10.046340 | 9.953660 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 16m. | | | LOG. SINES, &c. | | | | 64 deg. | | |

| 1h 44m. | | | LOG. SINES, &c. (t.) | | | | | 26 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.641842 | 10.358158 | 9.688182 | 10.311818 | 10.046340 | 9.953660 | 60 | 60 |
| 1 | 15 | 9.641907 | 10.358093 | 9.688262 | 10.311738 | 10.046355 | 9.953645 | 45 | 59 |
| 2 | 30 | 9.641971 | 10.358029 | 9.688342 | 10.311658 | 10.046371 | 9.953629 | 30 | 58 |
| 3 | 45 | 9.642036 | 10.357964 | 9.688422 | 10.311578 | 10.046386 | 9.953614 | 15 | 57 |
| 4 | 1 | 9.642101 | 10.357899 | 9.688502 | 10.311498 | 10.046402 | 9.953598 | 59 | 56 |
| 5 | 15 | 9.642166 | 10.357834 | 9.688582 | 10.311418 | 10.046417 | 9.953583 | 45 | 55 |
| 6 | 30 | 9.642230 | 10.357770 | 9.688663 | 10.311337 | 10.046432 | 9.953568 | 30 | 54 |
| 7 | 45 | 9.642295 | 10.357705 | 9.688743 | 10.311257 | 10.046448 | 9.953552 | 15 | 53 |
| 8 | 2 | 9.642360 | 10.357640 | 9.688823 | 10.311177 | 10.046463 | 9.953537 | 58 | 52 |
| 9 | 15 | 9.642424 | 10.357576 | 9.688903 | 10.311097 | 10.046479 | 9.953521 | 45 | 51 |
| 10 | 30 | 9.642489 | 10.357511 | 9.688983 | 10.311017 | 10.046494 | 9.953506 | 30 | 50 |
| 11 | 45 | 9.642553 | 10.357447 | 9.689063 | 10.310937 | 10.046509 | 9.953491 | 15 | 49 |
| 12 | 3 | 9.642618 | 10.357382 | 9.689143 | 10.310857 | 10.046525 | 9.953475 | 57 | 48 |
| 13 | 15 | 9.642683 | 10.357317 | 9.689223 | 10.310777 | 10.046540 | 9.953460 | 45 | 47 |
| 14 | 30 | 9.642747 | 10.357253 | 9.689303 | 10.310697 | 10.046556 | 9.953444 | 30 | 46 |
| 15 | 45 | 9.642812 | 10.357188 | 9.689383 | 10.310617 | 10.046571 | 9.953429 | 15 | 45 |
| 16 | 4 | 9.642876 | 10.357124 | 9.689463 | 10.310537 | 10.046587 | 9.953413 | 56 | 44 |
| 17 | 15 | 9.642941 | 10.357059 | 9.689543 | 10.310457 | 10.046602 | 9.953398 | 45 | 43 |
| 18 | 30 | 9.643006 | 10.356994 | 9.689623 | 10.310377 | 10.046618 | 9.953382 | 30 | 42 |
| 19 | 45 | 9.643070 | 10.356930 | 9.689703 | 10.310297 | 10.046633 | 9.953367 | 15 | 41 |
| 20 | 5 | 9.643135 | 10.356865 | 9.689783 | 10.310217 | 10.046649 | 9.953351 | 55 | 40 |
| 21 | 15 | 9.643199 | 10.356801 | 9.689863 | 10.310137 | 10.046664 | 9.953336 | 45 | 39 |
| 22 | 30 | 9.643264 | 10.356736 | 9.689943 | 10.310057 | 10.046679 | 9.953321 | 30 | 38 |
| 23 | 45 | 9.643328 | 10.356672 | 9.690023 | 10.309977 | 10.046695 | 9.953305 | 15 | 37 |
| 24 | 6 | 9.643393 | 10.356607 | 9.690103 | 10.309897 | 10.046710 | 9.953290 | 54 | 36 |
| 25 | 15 | 9.643457 | 10.356543 | 9.690183 | 10.309817 | 10.046726 | 9.953274 | 45 | 35 |
| 26 | 30 | 9.643521 | 10.356479 | 9.690263 | 10.309737 | 10.046741 | 9.953259 | 30 | 34 |
| 27 | 45 | 9.643586 | 10.356414 | 9.690343 | 10.309657 | 10.046757 | 9.953243 | 15 | 33 |
| 28 | 7 | 9.643650 | 10.356350 | 9.690423 | 10.309577 | 10.046772 | 9.953228 | 53 | 32 |
| 29 | 15 | 9.643715 | 10.356285 | 9.690502 | 10.309498 | 10.046788 | 9.953212 | 45 | 31 |
| 30 | 30 | 9.643779 | 10.356221 | 9.690582 | 10.309418 | 10.046803 | 9.953197 | 30 | 30 |
| 31 | 45 | 9.643844 | 10.356156 | 9.690662 | 10.309338 | 10.046819 | 9.953181 | 15 | 29 |
| 32 | 8 | 9.643908 | 10.356092 | 9.690742 | 10.309258 | 10.046834 | 9.953166 | 52 | 28 |
| 33 | 15 | 9.643972 | 10.356028 | 9.690822 | 10.309178 | 10.046850 | 9.953150 | 45 | 27 |
| 34 | 30 | 9.644037 | 10.355963 | 9.690902 | 10.309098 | 10.046865 | 9.953135 | 30 | 26 |
| 35 | 45 | 9.644101 | 10.355899 | 9.690982 | 10.309018 | 10.046881 | 9.953119 | 15 | 25 |
| 36 | 9 | 9.644165 | 10.355835 | 9.691062 | 10.308938 | 10.046896 | 9.953104 | 51 | 24 |
| 37 | 15 | 9.644230 | 10.355770 | 9.691141 | 10.308859 | 10.046912 | 9.953088 | 45 | 23 |
| 38 | 30 | 9.644294 | 10.355706 | 9.691221 | 10.308779 | 10.046927 | 9.953073 | 30 | 22 |
| 39 | 45 | 9.644358 | 10.355642 | 9.691301 | 10.308699 | 10.046943 | 9.953057 | 15 | 21 |
| 40 | 10 | 9.644423 | 10.355577 | 9.691381 | 10.308619 | 10.046958 | 9.953042 | 50 | 20 |
| 41 | 15 | 9.644487 | 10.355513 | 9.691461 | 10.308539 | 10.046974 | 9.953026 | 45 | 19 |
| 42 | 30 | 9.644551 | 10.355449 | 9.691540 | 10.308460 | 10.046989 | 9.953011 | 30 | 18 |
| 43 | 45 | 9.644615 | 10.355385 | 9.691620 | 10.308380 | 10.047005 | 9.952995 | 15 | 17 |
| 44 | 11 | 9.644680 | 10.355320 | 9.691700 | 10.308300 | 10.047020 | 9.952980 | 49 | 16 |
| 45 | 15 | 9.644744 | 10.355256 | 9.691780 | 10.308220 | 10.047036 | 9.952964 | 45 | 15 |
| 46 | 30 | 9.644808 | 10.355192 | 9.691859 | 10.308141 | 10.047051 | 9.952949 | 30 | 14 |
| 47 | 45 | 9.644872 | 10.355128 | 9.691939 | 10.308061 | 10.047067 | 9.952933 | 15 | 13 |
| 48 | 12 | 9.644936 | 10.355064 | 9.692019 | 10.307981 | 10.047083 | 9.952917 | 48 | 12 |
| 49 | 15 | 9.645001 | 10.354999 | 9.692099 | 10.307901 | 10.047098 | 9.952902 | 45 | 11 |
| 50 | 30 | 9.645065 | 10.354935 | 9.692178 | 10.307822 | 10.047114 | 9.952886 | 30 | 10 |
| 51 | 45 | 9.645129 | 10.354871 | 9.692258 | 10.307742 | 10.047129 | 9.952871 | 15 | 9 |
| 52 | 13 | 9.645193 | 10.354807 | 9.692338 | 10.307662 | 10.047145 | 9.952855 | 47 | 8 |
| 53 | 15 | 9.645257 | 10.354743 | 9.692417 | 10.307583 | 10.047160 | 9.952840 | 45 | 7 |
| 54 | 30 | 9.645321 | 10.354679 | 9.692497 | 10.307503 | 10.047176 | 9.952824 | 30 | 6 |
| 55 | 45 | 9.645385 | 10.354615 | 9.692577 | 10.307423 | 10.047191 | 9.952809 | 15 | 5 |
| 56 | 14 | 9.645450 | 10.354550 | 9.692656 | 10.307344 | 10.047207 | 9.952793 | 46 | 4 |
| 57 | 15 | 9.645514 | 10.354486 | 9.692736 | 10.307264 | 10.047223 | 9.952777 | 45 | 3 |
| 58 | 30 | 9.645578 | 10.354422 | 9.692816 | 10.307184 | 10.047238 | 9.952762 | 30 | 2 |
| 59 | 45 | 9.645642 | 10.354358 | 9.692895 | 10.307105 | 10.047254 | 9.952746 | 15 | 1 |
| 60 | 15 | 9.645706 | 10.354294 | 9.692975 | 10.307025 | 10.047269 | 9.952731 | 45 | 0 |
| sec. | ′ ″ | co-sine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 15m. | | | LOG. SINES, &c. | | | | | 63 deg. | |

| $1^h\ 45^m$. | | | LOG. SINES, &c. (t.) | | | | 26 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.645706 | 10.354294 | 9.692975 | 10.307025 | 10.047269 | 9.952731 | 45 | 60 |
| 1 | 15 | 9.645770 | 10.354230 | 9.693055 | 10.306945 | 10.047285 | 9.952715 | 45 | 59 |
| 2 | 30 | 9.645834 | 10.354166 | 9.693134 | 10.306866 | 10.047300 | 9.952700 | 30 | 58 |
| 3 | 45 | 9.645898 | 10.354102 | 9.693214 | 10.306786 | 10.047316 | 9.952684 | 15 | 57 |
| 4 | 16 | 9.645962 | 10.354038 | 9.693293 | 10.306707 | 10.047332 | 9.952668 | 44 | 56 |
| 5 | 15 | 9.646026 | 10.353974 | 9.693373 | 10.306627 | 10.047347 | 9.952653 | 45 | 55 |
| 6 | 30 | 9.646090 | 10.353910 | 9.693453 | 10.306547 | 10.047363 | 9.952637 | 30 | 54 |
| 7 | 45 | 9.646154 | 10.353846 | 9.693532 | 10.306468 | 10.047378 | 9.952622 | 15 | 53 |
| 8 | 17 | 9.646218 | 10.353782 | 9.693612 | 10.306388 | 10.047394 | 9.952606 | 43 | 52 |
| 9 | 15 | 9.646282 | 10.353718 | 9.693691 | 10.306309 | 10.047410 | 9.952590 | 45 | 51 |
| 10 | 30 | 9.646346 | 10.353654 | 9.693771 | 10.306229 | 10.047425 | 9.952575 | 30 | 50 |
| 11 | 45 | 9.646410 | 10.353590 | 9.693850 | 10.306150 | 10.047441 | 9.952559 | 15 | 49 |
| 12 | 18 | 9.646473 | 10.353527 | 9.693930 | 10.306070 | 10.047456 | 9.952544 | 42 | 48 |
| 13 | 15 | 9.646537 | 10.353463 | 9.694009 | 10.305991 | 10.047472 | 9.952528 | 45 | 47 |
| 14 | 30 | 9.646601 | 10.353399 | 9.694089 | 10.305911 | 10.047488 | 9.952512 | 30 | 46 |
| 15 | 45 | 9.646665 | 10.353335 | 9.694168 | 10.305832 | 10.047503 | 9.952497 | 15 | 45 |
| 16 | 19 | 9.646729 | 10.353271 | 9.694248 | 10.305752 | 10.047519 | 9.952481 | 41 | 44 |
| 17 | 15 | 9.646793 | 10.353207 | 9.694327 | 10.305673 | 10.047534 | 9.952466 | 45 | 43 |
| 18 | 30 | 9.646857 | 10.353143 | 9.694407 | 10.305593 | 10.047550 | 9.952450 | 30 | 42 |
| 19 | 45 | 9.646920 | 10.353080 | 9.694486 | 10.305514 | 10.047566 | 9.952434 | 15 | 41 |
| 20 | 20 | 9.646984 | 10.353016 | 9.694566 | 10.305434 | 10.047581 | 9.952419 | 40 | 40 |
| 21 | 15 | 9.647048 | 10.352952 | 9.694645 | 10.305355 | 10.047597 | 9.952403 | 45 | 39 |
| 22 | 30 | 9.647112 | 10.352888 | 9.694724 | 10.305276 | 10.047613 | 9.952387 | 30 | 38 |
| 23 | 45 | 9.647176 | 10.352824 | 9.694804 | 10.305196 | 10.047628 | 9.952372 | 15 | 37 |
| 24 | 21 | 9.647239 | 10.352761 | 9.694883 | 10.305117 | 10.047644 | 9.952356 | 39 | 36 |
| 25 | 15 | 9.647303 | 10.352697 | 9.694963 | 10.305037 | 10.047659 | 9.952341 | 45 | 35 |
| 26 | 30 | 9.647367 | 10.352633 | 9.695042 | 10.304958 | 10.047675 | 9.952325 | 30 | 34 |
| 27 | 45 | 9.647431 | 10.352569 | 9.695121 | 10.304879 | 10.047691 | 9.952309 | 15 | 33 |
| 28 | 22 | 9.647494 | 10.352506 | 9.695201 | 10.304799 | 10.047706 | 9.952294 | 38 | 32 |
| 29 | 15 | 9.647558 | 10.352442 | 9.695280 | 10.304720 | 10.047722 | 9.952278 | 45 | 31 |
| 30 | 30 | 9.647622 | 10.352378 | 9.695360 | 10.304640 | 10.047738 | 9.952262 | 30 | 30 |
| 31 | 45 | 9.647686 | 10.352314 | 9.695439 | 10.304561 | 10.047753 | 9.952247 | 15 | 29 |
| 32 | 23 | 9.647749 | 10.352251 | 9.695518 | 10.304482 | 10.047769 | 9.952231 | 37 | 28 |
| 33 | 15 | 9.647813 | 10.352187 | 9.695598 | 10.304402 | 10.047785 | 9.952215 | 45 | 27 |
| 34 | 30 | 9.647877 | 10.352123 | 9.695677 | 10.304323 | 10.047800 | 9.952200 | 30 | 26 |
| 35 | 45 | 9.647940 | 10.352060 | 9.695756 | 10.304244 | 10.047816 | 9.952184 | 15 | 25 |
| 36 | 24 | 9.648004 | 10.351996 | 9.695835 | 10.304165 | 10.047832 | 9.952168 | 36 | 24 |
| 37 | 15 | 9.648067 | 10.351933 | 9.695915 | 10.304085 | 10.047847 | 9.952153 | 45 | 23 |
| 38 | 30 | 9.648131 | 10.351869 | 9.695994 | 10.304006 | 10.047863 | 9.952137 | 30 | 22 |
| 39 | 45 | 9.648195 | 10.351805 | 9.696073 | 10.303927 | 10.047879 | 9.952121 | 15 | 21 |
| 40 | 25 | 9.648258 | 10.351742 | 9.696153 | 10.303847 | 10.047895 | 9.952105 | 35 | 20 |
| 41 | 15 | 9.648322 | 10.351678 | 9.696232 | 10.303768 | 10.047910 | 9.952090 | 45 | 19 |
| 42 | 30 | 9.648385 | 10.351615 | 9.696311 | 10.303689 | 10.047926 | 9.952074 | 30 | 18 |
| 43 | 45 | 9.648449 | 10.351551 | 9.696390 | 10.303610 | 10.047942 | 9.952058 | 15 | 17 |
| 44 | 26 | 9.648512 | 10.351488 | 9.696470 | 10.303530 | 10.047957 | 9.952043 | 34 | 16 |
| 45 | 15 | 9.648576 | 10.351424 | 9.696549 | 10.303451 | 10.047973 | 9.952027 | 45 | 15 |
| 46 | 30 | 9.648639 | 10.351361 | 9.696628 | 10.303372 | 10.047989 | 9.952011 | 30 | 14 |
| 47 | 45 | 9.648703 | 10.351297 | 9.696707 | 10.303293 | 10.048004 | 9.951996 | 15 | 13 |
| 48 | 27 | 9.648766 | 10.351234 | 9.696786 | 10.303214 | 10.048020 | 9.951980 | 33 | 12 |
| 49 | 15 | 9.648830 | 10.351170 | 9.696866 | 10.303134 | 10.048036 | 9.951964 | 45 | 11 |
| 50 | 30 | 9.648893 | 10.351107 | 9.696945 | 10.303055 | 10.048052 | 9.951948 | 30 | 10 |
| 51 | 45 | 9.648957 | 10.351043 | 9.697024 | 10.302976 | 10.048067 | 9.951933 | 15 | 9 |
| 52 | 28 | 9.649020 | 10.350980 | 9.697103 | 10.302897 | 10.048083 | 9.951917 | 32 | 8 |
| 53 | 15 | 9.649084 | 10.350916 | 9.697182 | 10.302818 | 10.048099 | 9.951901 | 45 | 7 |
| 54 | 30 | 9.649147 | 10.350853 | 9.697261 | 10.302739 | 10.048114 | 9.951886 | 30 | 6 |
| 55 | 45 | 9.649211 | 10.350789 | 9.697341 | 10.302659 | 10.048130 | 9.951870 | 15 | 5 |
| 56 | 29 | 9.649274 | 10.350726 | 9.697420 | 10.302580 | 10.048146 | 9.951854 | 31 | 4 |
| 57 | 15 | 9.649337 | 10.350663 | 9.697499 | 10.302501 | 10.048162 | 9.951838 | 45 | 3 |
| 58 | 30 | 9.649401 | 10.350599 | 9.697578 | 10.302422 | 10.048177 | 9.951823 | 30 | 2 |
| 59 | 45 | 9.649464 | 10.350536 | 9.697657 | 10.302343 | 10.048193 | 9.951807 | 15 | 1 |
| 60 | 30 | 9.649527 | 10.350473 | 9.697736 | 10.302264 | 10.048209 | 9.951791 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| $4^h\ 14^m$. | | | LOG. SINES, &c. | | | | 63 deg. | | |

| | 1h 46m. | | LOG. SINES, &c. (t.) | | | | 26 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| ″ | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.649527 | 10.350473 | 9.697736 | 10.302264 | 10.048209 | 9.951791 | 30 | 60 |
| 1 | 15 | 9.649591 | 10.350409 | 9.697815 | 10.302185 | 10.048225 | 9.951775 | 45 | 59 |
| 2 | 30 | 9.649654 | 10.350346 | 9.697894 | 10.302106 | 10.048240 | 9.951760 | 30 | 58 |
| 3 | 45 | 9.649717 | 10.350283 | 9.697973 | 10.302027 | 10.048256 | 9.951744 | 15 | 57 |
| 4 | 31 | 9.649781 | 10.350219 | 9.698053 | 10.301947 | 10.048272 | 9.951728 | 29 | 56 |
| 5 | 15 | 9.649844 | 10.350156 | 9.698132 | 10.301868 | 10.048288 | 9.951712 | 45 | 55 |
| 6 | 30 | 9.649907 | 10.350093 | 9.698211 | 10.301789 | 10.048303 | 9.951697 | 30 | 54 |
| 7 | 45 | 9.649971 | 10.350029 | 9.698290 | 10.301710 | 10.048319 | 9.951681 | 15 | 53 |
| 8 | 32 | 9.650034 | 10.349966 | 9.698369 | 10.301631 | 10.048335 | 9.951665 | 28 | 52 |
| 9 | 15 | 9.650097 | 10.349903 | 9.698448 | 10.301552 | 10.048351 | 9.951649 | 45 | 51 |
| 10 | 30 | 9.650160 | 10.349840 | 9.698527 | 10.301473 | 10.048366 | 9.951634 | 30 | 50 |
| 11 | 45 | 9.650223 | 10.349777 | 9.698606 | 10.301394 | 10.048382 | 9.951618 | 15 | 49 |
| 12 | 33 | 9.650287 | 10.349713 | 9.698685 | 10.301315 | 10.048398 | 9.951602 | 27 | 48 |
| 13 | 15 | 9.650350 | 10.349650 | 9.698764 | 10.301236 | 10.048414 | 9.951586 | 45 | 47 |
| 14 | 30 | 9.650413 | 10.349587 | 9.698843 | 10.301157 | 10.048430 | 9.951570 | 30 | 46 |
| 15 | 45 | 9.650476 | 10.349524 | 9.698922 | 10.301078 | 10.048445 | 9.951555 | 15 | 45 |
| 16 | 34 | 9.650539 | 10.349461 | 9.699001 | 10.300999 | 10.048461 | 9.951539 | 26 | 44 |
| 17 | 15 | 9.650603 | 10.349397 | 9.699080 | 10.300920 | 10.048477 | 9.951523 | 45 | 43 |
| 18 | 30 | 9.650666 | 10.349334 | 9.699158 | 10.300842 | 10.048493 | 9.951507 | 30 | 42 |
| 19 | 45 | 9.650729 | 10.349271 | 9.699237 | 10.300763 | 10.048509 | 9.951491 | 15 | 41 |
| 20 | 35 | 9.650792 | 10.349208 | 9.699316 | 10.300684 | 10.048524 | 9.951476 | 25 | 40 |
| 21 | 15 | 9.650855 | 10.349145 | 9.699395 | 10.300605 | 10.048540 | 9.951460 | 45 | 39 |
| 22 | 30 | 9.650918 | 10.349082 | 9.699474 | 10.300526 | 10.048556 | 9.951444 | 30 | 38 |
| 23 | 45 | 9.650981 | 10.349019 | 9.699553 | 10.300447 | 10.048572 | 9.951428 | 15 | 37 |
| 24 | 36 | 9.651044 | 10.348956 | 9.699632 | 10.300368 | 10.048588 | 9.951412 | 24 | 36 |
| 25 | 15 | 9.651107 | 10.348893 | 9.699711 | 10.300289 | 10.048603 | 9.951397 | 45 | 35 |
| 26 | 30 | 9.651170 | 10.348830 | 9.699790 | 10.300210 | 10.048619 | 9.951381 | 30 | 34 |
| 27 | 45 | 9.651234 | 10.348766 | 9.699869 | 10.300131 | 10.048635 | 9.951365 | 15 | 33 |
| 28 | 37 | 9.651297 | 10.348703 | 9.699947 | 10.300053 | 10.048651 | 9.951349 | 23 | 32 |
| 29 | 15 | 9.651360 | 10.348640 | 9.700026 | 10.299974 | 10 048667 | 9.951333 | 46 | 31 |
| 30 | 30 | 9.651423 | 10.348577 | 9.700105 | 10.299895 | 10.048683 | 9.951317 | 30 | 30 |
| 31 | 45 | 9.651486 | 10.348514 | 9.700184 | 10.299816 | 10.048698 | 9.951302 | 15 | 29 |
| 32 | 38 | 9.651549 | 10.348451 | 9.700263 | 10.299737 | 10.048714 | 9.951286 | 22 | 28 |
| 33 | 15 | 9.651612 | 10.348388 | 9.700342 | 10.299658 | 10.048730 | 9.951270 | 45 | 27 |
| 34 | 30 | 9.651674 | 10.348326 | 9.700420 | 10.299580 | 10.048746 | 9.951254 | 30 | 26 |
| 35 | 45 | 9.651737 | 10.348263 | 9.700499 | 10.299501 | 10.048762 | 9.951238 | 15 | 25 |
| 36 | 39 | 9.651800 | 10.348200 | 9.700578 | 10.299422 | 10.048778 | 9.951222 | 21 | 24 |
| 37 | 15 | 9.651863 | 10.348137 | 9.700657 | 10.299343 | 10.048793 | 9.951207 | 45 | 23 |
| 38 | 30 | 9.651926 | 10.348074 | 9.700735 | 10.299265 | 10.048809 | 9.951191 | 30 | 22 |
| 39 | 45 | 9.651989 | 10.348011 | 9.700814 | 10.299186 | 10.048825 | 9.951175 | 15 | 21 |
| 40 | 40 | 9.652052 | 10.347948 | 9.700893 | 10.299107 | 10.048841 | 9.951159 | 20 | 20 |
| 41 | 15 | 9.652115 | 10.347885 | 9.700972 | 10.299028 | 10.048857 | 9.951143 | 45 | 19 |
| 42 | 30 | 9.652178 | 10.347822 | 9.701050 | 10.298950 | 10.048873 | 9.951127 | 30 | 18 |
| 43 | 45 | 9.652241 | 10.347759 | 9.701129 | 10.298871 | 10.048889 | 9.951111 | 15 | 17 |
| 44 | 41 | 9.652303 | 10.347697 | 9.701208 | 10.298792 | 10.048904 | 9.951096 | 19 | 16 |
| 45 | 15 | 9.652366 | 10.347634 | 9.701287 | 10.298713 | 10.048920 | 9.951080 | 45 | 15 |
| 46 | 30 | 9.652429 | 10.347571 | 9.701365 | 10.298635 | 10.048936 | 9.951064 | 30 | 14 |
| 47 | 45 | 9.652492 | 10.347508 | 9.701444 | 10.298556 | 10.048952 | 9.951048 | 15 | 13 |
| 48 | 42 | 9.652555 | 10.347445 | 9.701523 | 10.298477 | 10.048968 | 9.951032 | 18 | 12 |
| 49 | 15 | 9.652618 | 10.347382 | 9.701601 | 10.298399 | 10.048984 | 9.951016 | 45 | 11 |
| 50 | 30 | 9.652680 | 10.347320 | 9.701680 | 10.298320 | 10.049000 | 9.951000 | 30 | 10 |
| 51 | 45 | 9.652743 | 10.347257 | 9.701759 | 10.298241 | 10.049016 | 9.950984 | 15 | 9 |
| 52 | 43 | 9.652806 | 10.347194 | 9.701837 | 10.298163 | 10.049032 | 9.950968 | 17 | 8 |
| 53 | 15 | 9.652869 | 10.347131 | 9.701916 | 10.298084 | 10.049047 | 9.950953 | 45 | 7 |
| 54 | 30 | 9.652931 | 10.347069 | 9.701995 | 10.298005 | 10.049063 | 9.950937 | 30 | 6 |
| 55 | 45 | 9.652994 | 10.347006 | 9.702073 | 10.297927 | 10.049079 | 9.950921 | 15 | 5 |
| 56 | 44 | 9.653057 | 10.346943 | 9.702152 | 10.297848 | 10.049095 | 9 950905 | 16 | 4 |
| 57 | 15 | 9.653119 | 10.346881 | 9.702230 | 10.297770 | 10.049111 | 9.950889 | 45 | 3 |
| 58 | 30 | 9.653182 | 10.346818 | 9.702309 | 10.297691 | 10.049127 | 9.950873 | 30 | 2 |
| 59 | 45 | 9.653245 | 10.346755 | 9.702388 | 10.297612 | 10.049143 | 9.950857 | 15 | 1 |
| 60 | 45 | 9.653307 | 10.346693 | 9.702466 | 10.297534 | 10.049159 | 9.950841 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 13m. | | LOG. SINES, &c. | | | | 63 deg. | | |

| 1h 47m. | | | LOG. SINES, &c. (t.) | | | | 26 deg | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.653307 | 10.346693 | 9.702466 | 10.297534 | 10.049159 | 9.950841 | 15 | 60 |
| 1 | 15 | 9.653370 | 10.346630 | 9.702545 | 10.297455 | 10.049175 | 9.950825 | 45 | 59 |
| 2 | 30 | 9.653433 | 10.346567 | 9.702623 | 10.297377 | 10.049191 | 9.950809 | 30 | 58 |
| 3 | 45 | 9.653496 | 10.346505 | 9.702702 | 10.297298 | 10.049207 | 9.950793 | 15 | 57 |
| 4 | 46 | 9.653558 | 10.346442 | 9.702780 | 10.297220 | 10.049223 | 9.950777 | 14 | 56 |
| 5 | 15 | 9.653621 | 10.346379 | 9.702859 | 10.297141 | 10.049238 | 9.950762 | 45 | 55 |
| 6 | 30 | 9.653683 | 10.346317 | 9.702938 | 10.297062 | 10.049254 | 9.950746 | 30 | 54 |
| 7 | 45 | 9.653746 | 10.346254 | 9.703016 | 10.296984 | 10.049270 | 9.950730 | 15 | 53 |
| 8 | 47 | 9.653808 | 10.346192 | 9.703095 | 10.296905 | 10.049286 | 9.950714 | 13 | 52 |
| 9 | 15 | 9.653871 | 10.346129 | 9.703173 | 10.296827 | 10.049302 | 9.950698 | 45 | 51 |
| 10 | 30 | 9.653933 | 10.346067 | 9.703252 | 10.296748 | 10.049318 | 9.950682 | 30 | 50 |
| 11 | 45 | 9.653996 | 10.346004 | 9.703330 | 10.296670 | 10.049334 | 9.950666 | 15 | 49 |
| 12 | 48 | 9.654059 | 10.345941 | 9.703409 | 10.296591 | 10.049350 | 9.950650 | 12 | 48 |
| 13 | 15 | 9.654121 | 10.345879 | 9.703487 | 10.296513 | 10.049366 | 9.950634 | 45 | 47 |
| 14 | 30 | 9.654184 | 10.345816 | 9.703566 | 10.296434 | 10.049382 | 9.950618 | 30 | 46 |
| 15 | 45 | 9.654246 | 10.345754 | 9.703644 | 10.296356 | 10.049398 | 9.950602 | 15 | 45 |
| 16 | 49 | 9.654309 | 10.345691 | 9.703722 | 10.296278 | 10.049414 | 9.950586 | 11 | 44 |
| 17 | 15 | 9.654371 | 10.345629 | 9.703801 | 10.296199 | 10.049430 | 9.950570 | 45 | 43 |
| 18 | 30 | 9.654433 | 10.345567 | 9.703879 | 10.296121 | 10.049446 | 9.950554 | 30 | 42 |
| 19 | 45 | 9.654496 | 10.345504 | 9.703958 | 10.296042 | 10.049462 | 9.950538 | 15 | 41 |
| 20 | 50 | 9.654558 | 10.345442 | 9.704036 | 10.295964 | 10.049478 | 9.950522 | 10 | 40 |
| 21 | 15 | 9.654621 | 10.345379 | 9.704115 | 10.295885 | 10.049494 | 9.950506 | 45 | 39 |
| 22 | 30 | 9.654683 | 10.345317 | 9.704193 | 10.295807 | 10.049510 | 9.950490 | 30 | 38 |
| 23 | 45 | 9.654746 | 10.345254 | 9.704271 | 10.295729 | 10.049526 | 9.950474 | 15 | 37 |
| 24 | 51 | 9.654808 | 10.345192 | 9.704350 | 10.295650 | 10.049542 | 9.950458 | 9 | 36 |
| 25 | 15 | 9.654870 | 10.345130 | 9.704428 | 10.295572 | 10.049558 | 9.950442 | 45 | 35 |
| 26 | 30 | 9.654933 | 10.345067 | 9.704506 | 10.295494 | 10.049574 | 9.950426 | 30 | 34 |
| 27 | 45 | 9.654995 | 10.345005 | 9.704585 | 10.295415 | 10.049590 | 9.950410 | 15 | 33 |
| 28 | 52 | 9.655057 | 10.344943 | 9.704663 | 10.295337 | 10.049606 | 9.950394 | 8 | 32 |
| 29 | 15 | 9.655120 | 10.344880 | 9.704741 | 10.295259 | 10.049622 | 9.950378 | 45 | 31 |
| 30 | 30 | 9.655182 | 10.344818 | 9.704820 | 10.295180 | 10.049638 | 9.950362 | 30 | 30 |
| 31 | 45 | 9.655244 | 10.344756 | 9.704898 | 10.295102 | 10.049654 | 9.950346 | 15 | 29 |
| 32 | 53 | 9.655307 | 10.344693 | 9.704976 | 10.295024 | 10.049670 | 9.950330 | 7 | 28 |
| 33 | 15 | 9.655369 | 10.344631 | 9.705055 | 10.294945 | 10.049686 | 9.950314 | 45 | 27 |
| 34 | 30 | 9.655431 | 10.344569 | 9.705133 | 10.294867 | 10.049702 | 9.950298 | 30 | 26 |
| 35 | 45 | 9.655494 | 10.344506 | 9.705211 | 10.294789 | 10.049718 | 9.950282 | 15 | 25 |
| 36 | 54 | 9.655556 | 10.344444 | 9.705290 | 10.294710 | 10.049734 | 9.950266 | 6 | 24 |
| 37 | 15 | 9.655618 | 10.344382 | 9.705368 | 10.294632 | 10.049750 | 9.950250 | 45 | 23 |
| 38 | 30 | 9.655680 | 10.344320 | 9.705446 | 10.294554 | 10.049766 | 9.950234 | 30 | 22 |
| 39 | 45 | 9.655743 | 10.344257 | 9.705524 | 10.294476 | 10.049782 | 9.950218 | 15 | 21 |
| 40 | 55 | 9.655805 | 10.344195 | 9.705603 | 10.294397 | 10.049798 | 9.950202 | 5 | 20 |
| 41 | 15 | 9.655867 | 10.344133 | 9.705681 | 10.294319 | 10.049814 | 9.950186 | 45 | 19 |
| 42 | 30 | 9.655929 | 10.344071 | 9.705759 | 10.294241 | 10.049830 | 9.950170 | 30 | 18 |
| 43 | 45 | 9.655991 | 10.344009 | 9.705837 | 10.294163 | 10.049846 | 9.950154 | 15 | 17 |
| 44 | 56 | 9.656054 | 10.343946 | 9.705916 | 10.294084 | 10.049862 | 9.950138 | 4 | 16 |
| 45 | 15 | 9.656116 | 10.343884 | 9.705994 | 10.294006 | 10.049878 | 9.950122 | 45 | 15 |
| 46 | 30 | 9.656178 | 10.343822 | 9.706072 | 10.293928 | 10.049894 | 9.950106 | 30 | 14 |
| 47 | 45 | 9.656240 | 10.343760 | 9.706150 | 10.293850 | 10.049910 | 9.950090 | 15 | 13 |
| 48 | 57 | 9.656302 | 10.343698 | 9.706228 | 10.293772 | 10.049926 | 9.950074 | 3 | 12 |
| 49 | 15 | 9.656364 | 10.343636 | 9.706306 | 10.293694 | 10.049942 | 9.950058 | 45 | 11 |
| 50 | 30 | 9.656426 | 10.343574 | 9.706385 | 10.293615 | 10.049958 | 9.950042 | 30 | 10 |
| 51 | 45 | 9.656488 | 10.343512 | 9.706463 | 10.293537 | 10.049974 | 9.950026 | 15 | 9 |
| 52 | 58 | 9.656550 | 10.343450 | 9.706541 | 10.293459 | 10.049991 | 9.950009 | 2 | 8 |
| 53 | 15 | 9.656613 | 10.343387 | 9.706619 | 10.293381 | 10.050007 | 9.949993 | 45 | 7 |
| 54 | 30 | 9.656675 | 10.343325 | 9.706697 | 10.293303 | 10.050023 | 9.949977 | 30 | 6 |
| 55 | 45 | 9.656737 | 10.343263 | 9.706775 | 10.293225 | 10.050039 | 9.949961 | 15 | 5 |
| 56 | 59 | 9.656799 | 10.343201 | 9.706853 | 10.293147 | 10.050055 | 9.949945 | 1 | 4 |
| 57 | 15 | 9.656861 | 10.343139 | 9.706932 | 10.293068 | 10.050071 | 9.949929 | 45 | 3 |
| 58 | 30 | 9.656923 | 10.343077 | 9.707010 | 10.292990 | 10.050087 | 9.949913 | 30 | 2 |
| 59 | 45 | 9.656985 | 10.343015 | 9.707088 | 10.292912 | 10.050103 | 9.949897 | 15 | 1 |
| 60 | 60 | 9.657047 | 10.342953 | 9.707166 | 10.292834 | 10.050119 | 9.949881 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 12m. | | | LOG. SINES, &c. | | | | 63 deg. | | |

| 1 · 48m. | | | LOG. SINES, &c. (t.) | | | | 27 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.657047 | 10.342953 | 9.707166 | 10.292834 | 10.050119 | 9.949881 | 60 | 60 |
| 1 | 15 | 9.657109 | 10.342891 | 9.707244 | 10.292756 | 10.050135 | 9.949865 | 45 | 59 |
| 2 | 30 | 9.657171 | 10.342829 | 9.707322 | 10.292678 | 10.050151 | 9.949849 | 30 | 58 |
| 3 | 45 | 9.657233 | 10.342767 | 9.707400 | 10.292600 | 10.050167 | 9.949833 | 15 | 57 |
| 4 | 1 | 9.657295 | 10.342705 | 9.707478 | 10.292522 | 10.050184 | 9.949816 | 59 | 56 |
| 5 | 15 | 9.657356 | 10.342644 | 9.707556 | 10.292444 | 10.050200 | 9.949800 | 45 | 55 |
| 6 | 30 | 9.657418 | 10.342582 | 9.707634 | 10.292366 | 10.050216 | 9.949784 | 30 | 54 |
| 7 | 45 | 9.657480 | 10.342520 | 9.707712 | 10.292288 | 10.050232 | 9.949768 | 15 | 53 |
| 8 | 2 | 9.657542 | 10.342458 | 9.707790 | 10.292210 | 10.050248 | 9.949752 | 58 | 52 |
| 9 | 15 | 9.657604 | 10.342396 | 9.707868 | 10.292132 | 10.050264 | 9.949736 | 45 | 51 |
| 10 | 30 | 9.657666 | 10.342334 | 9.707946 | 10.292054 | 10.050280 | 9.949720 | 30 | 50 |
| 11 | 45 | 9.657728 | 10.342272 | 9.708024 | 10.291976 | 10.050296 | 9.949704 | 15 | 49 |
| 12 | 3 | 9.657790 | 10.342210 | 9.708102 | 10.291898 | 10.050312 | 9.949688 | 57 | 48 |
| 13 | 15 | 9.657852 | 10.342148 | 9.708180 | 10.291820 | 10.050329 | 9.949671 | 45 | 47 |
| 14 | 30 | 9.657913 | 10.342087 | 9.708258 | 10.291742 | 10 050345 | 9.949655 | 30 | 46 |
| 15 | 45 | 9.657975 | 10.342025 | 9.708336 | 10.291664 | 10.050361 | 9.949639 | 15 | 45 |
| 16 | 4 | 9.658037 | 10.341963 | 9.708414 | 10.291586 | 10.050377 | 9.949623 | 56 | 44 |
| 17 | 15 | 9.658099 | 10.341901 | 9.708492 | 10.291508 | 10.050393 | 9.949607 | 45 | 43 |
| 18 | 30 | 9.658161 | 10.341839 | 9.708570 | 10.291430 | 10.050409 | 9.949591 | 30 | 42 |
| 19 | 45 | 9.658222 | 10.341778 | 9.708648 | 10.291352 | 10.050425 | 9.949575 | 15 | 41 |
| 20 | 5 | 9.658284 | 10.341716 | 9.708726 | 10.291274 | 10.050442 | 9.949558 | 55 | 40 |
| 21 | 15 | 9.658346 | 10.341654 | 9.708804 | 10.291196 | 10.050458 | 9.949542 | 45 | 39 |
| 22 | 30 | 9.658408 | 10.341592 | 9.708882 | 10.291118 | 10.050474 | 9.949526 | 30 | 38 |
| 23 | 45 | 9.658469 | 10.341531 | 9.708959 | 10.291041 | 10.050490 | 9.949510 | 15 | 37 |
| 24 | 6 | 9.658531 | 10.341469 | 9.709037 | 10.290963 | 10.050506 | 9.949494 | 54 | 36 |
| 25 | 15 | 9.658593 | 10.341407 | 9.709115 | 10.290885 | 10.050522 | 9.949478 | 45 | 35 |
| 26 | 30 | 9.658655 | 10.341345 | 9.709193 | 10.290807 | 10.050539 | 9.949461 | 30 | 34 |
| 27 | 45 | 9.658716 | 10.341284 | 9.709271 | 10.290729 | 10.050555 | 9.949445 | 15 | 33 |
| 28 | 7 | 9.658778 | 10.341222 | 9.709349 | 10.290651 | 10.050571 | 9.949429 | 53 | 32 |
| 29 | 15 | 9.658840 | 10.341160 | 9.709427 | 10.290573 | 10.050587 | 9 949413 | 45 | 31 |
| 30 | 30 | 9.658901 | 10.341099 | 9.709504 | 10.290496 | 10.050603 | 9.949397 | 30 | 30 |
| 31 | 45 | 9.658963 | 10.341037 | 9.709582 | 10.290418 | 10.050619 | 9.949381 | 15 | 29 |
| 32 | 8 | 9.659025 | 10.340975 | 9.709660 | 10.290340 | 10.050636 | 9.949364 | 52 | 28 |
| 33 | 15 | 9.659086 | 10.340914 | 9.709738 | 10.290262 | 10.050652 | 9.949348 | 45 | 27 |
| 34 | 30 | 9.659148 | 10 340852 | 9.709816 | 10.290184 | 10.050668 | 9.949332 | 30 | 26 |
| 35 | 45 | 9.659209 | 10.340791 | 9.709893 | 10.290107 | 10.050684 | 9.949316 | 15 | 25 |
| 36 | 9 | 9.659271 | 10.340729 | 9.709971 | 10.290029 | 10.050700 | 9.949300 | 51 | 24 |
| 37 | 15 | 9.659333 | 10.340667 | 9.710049 | 10.289951 | 10.050717 | 9.949283 | 45 | 23 |
| 38 | 30 | 9.659394 | 10.340606 | 9.710127 | 10.289873 | 10.050733 | 9.949267 | 30 | 22 |
| 39 | 45 | 9.659456 | 10.340544 | 9.710205 | 10.289795 | 10.050749 | 9.949251 | 15 | 21 |
| 40 | 10 | 9.659517 | 10.340483 | 9.710282 | 10.289718 | 10.050765 | 9.949235 | 50 | 20 |
| 41 | 15 | 9.659579 | 10.340421 | 9.710360 | 10.289640 | 10.050781 | 9.949219 | 45 | 19 |
| 42 | 30 | 9.659640 | 10.340360 | 9.710438 | 10.289562 | 10.050798 | 9.949202 | 30 | 18 |
| 43 | 45 | 9.659702 | 10.340298 | 9.710516 | 10.289484 | 10.050814 | 9 949186 | 15 | 17 |
| 44 | 11 | 9.659763 | 10.340237 | 9.710593 | 10.289407 | 10.050830 | 9.949170 | 49 | 16 |
| 45 | 15 | 9.659825 | 10.340175 | 9.710671 | 10.289329 | 10.050846 | 9.949154 | 45 | 15 |
| 46 | 30 | 9.659886 | 10.340114 | 9.710749 | 10.289251 | 10.050862 | 9.949138 | 30 | 14 |
| 47 | 45 | 9.659948 | 10.340052 | 9.710826 | 10.289174 | 10 050879 | 9.949121 | 15 | 13 |
| 48 | 12 | 9.660009 | 10.339991 | 9.710904 | 10.289096 | 10.050895 | 9.949105 | 48 | 12 |
| 49 | 15 | 9.660071 | 10.339929 | 9.710982 | 10.289018 | 10.050911 | 9.949089 | 45 | 11 |
| 50 | 30 | 9.660132 | 10.339868 | 9.711059 | 10.288941 | 10.050927 | 9.949073 | 30 | 10 |
| 51 | 45 | 9.660194 | 10.339806 | 9.711137 | 10.288863 | 10.050944 | 9.949056 | 15 | 9 |
| 52 | 13 | 9.660255 | 10.339745 | 9.711215 | 10.288785 | 10 050960 | 9.949040 | 47 | 8 |
| 53 | 15 | 9.660316 | 10 339684 | 9.711292 | 10.288708 | 10.050976 | 9.949024 | 45 | 7 |
| 54 | 30 | 9.660378 | 10 339622 | 9.711370 | 10.288630 | 10.050992 | 9.949008 | 30 | 6 |
| 55 | 45 | 9.660439 | 10 339561 | 9.711448 | 10.288552 | 10.051009 | 9.948991 | 15 | 5 |
| 56 | 14 | 9.660500 | 10.339500 | 9.711525 | 10.288475 | 10.051025 | 9.948975 | 46 | 4 |
| 57 | 15 | 9.660562 | 10.339438 | 9.711603 | 10.288397 | 10.051041 | 9.948959 | 45 | 3 |
| 58 | 30 | 9.660623 | 10.339377 | 9.711681 | 10.288319 | 10.051057 | 9.948943 | 30 | 2 |
| 59 | 45 | 9.660685 | 10.339315 | 9.711758 | 10.288242 | 10.051074 | 9.948926 | 15 | 1 |
| 60 | 15 | 9.660746 | 10.339254 | 9.711836 | 10.288164 | 10.051090 | 9.948910 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4m 11m. | | | LOG. SINES, &c. | | | | 62 deg. | | |

| 1h 49m. | | | LOG. SINES, &c. (t.) | | | | 27 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.660746 | 10.339254 | 9.711836 | 10.288164 | 10.051090 | 9.948910 | 45 | 60 |
| 1 | 15 | 9.660807 | 10.339193 | 9.711913 | 10.288087 | 10.051106 | 9.948894 | 45 | 59 |
| 2 | 30 | 9.660868 | 10.339132 | 9.711991 | 10.288009 | 10.051122 | 9.948878 | 30 | 58 |
| 3 | 45 | 9.660930 | 10.339070 | 9.712068 | 10.287932 | 10.051139 | 9.948861 | 15 | 57 |
| 4 | 16 | 9.660991 | 10.339009 | 9.712146 | 10.287854 | 10.051155 | 9.948845 | 44 | 56 |
| 5 | 15 | 9.661052 | 10.338948 | 9.712224 | 10.287776 | 10.051171 | 9.948829 | 45 | 55 |
| 6 | 30 | 9.661114 | 10.338886 | 9.712301 | 10.287699 | 10.051188 | 9.948812 | 30 | 54 |
| 7 | 45 | 9.661175 | 10.338825 | 9.712379 | 10.287621 | 10.051204 | 9.948796 | 15 | 53 |
| 8 | 17 | 9.661236 | 10.338764 | 9.712456 | 10.287544 | 10.051220 | 9.948780 | 43 | 52 |
| 9 | 15 | 9.661297 | 10.338703 | 9.712534 | 10.287466 | 10.051236 | 9.948764 | 45 | 51 |
| 10 | 30 | 9.661359 | 10.338641 | 9.712611 | 10.287389 | 10.051253 | 9.948747 | 30 | 50 |
| 11 | 45 | 9.661420 | 10.338580 | 9.712689 | 10.287311 | 10.051269 | 9.948731 | 15 | 49 |
| 12 | 18 | 9.661481 | 10.338519 | 9.712766 | 10.287234 | 10.051285 | 9.948715 | 42 | 48 |
| 13 | 15 | 9.661542 | 10.338458 | 9.712844 | 10.287156 | 10.051302 | 9.948698 | 45 | 47 |
| 14 | 30 | 9.661603 | 10.338397 | 9.712921 | 10.287079 | 10.051318 | 9.948682 | 30 | 46 |
| 15 | 45 | 9.661664 | 10.338336 | 9.712999 | 10.287001 | 10.051334 | 9.948666 | 15 | 45 |
| 16 | 19 | 9.661726 | 10.338274 | 9.713076 | 10.286924 | 10.051351 | 9.948649 | 41 | 44 |
| 17 | 15 | 9.661787 | 10.338213 | 9.713154 | 10.286846 | 10.051367 | 9.948633 | 45 | 43 |
| 18 | 30 | 9.661848 | 10.338152 | 9.713231 | 10.286769 | 10.051383 | 9.948617 | 30 | 42 |
| 19 | 45 | 9.661909 | 10.338091 | 9.713308 | 10.286692 | 10.051399 | 9.948601 | 15 | 41 |
| 20 | 20 | 9.661970 | 10.338030 | 9.713386 | 10.286614 | 10.051416 | 9.948584 | 40 | 40 |
| 21 | 15 | 9.662031 | 10.337969 | 9.713463 | 10.286537 | 10.051432 | 9.948568 | 45 | 39 |
| 22 | 30 | 9.662092 | 10.337908 | 9.713541 | 10.286459 | 10.051448 | 9.948552 | 30 | 38 |
| 23 | 45 | 9.662153 | 10.337847 | 9.713618 | 10.286382 | 10.051465 | 9.948535 | 15 | 37 |
| 24 | 21 | 9.662214 | 10.337786 | 9.713696 | 10.286304 | 10.051481 | 9.948519 | 39 | 36 |
| 25 | 15 | 9.662275 | 10.337725 | 9.713773 | 10.286227 | 10.051497 | 9.948503 | 45 | 35 |
| 26 | 30 | 9.662337 | 10.337663 | 9.713850 | 10.286150 | 10.051514 | 9.948486 | 30 | 34 |
| 27 | 45 | 9.662398 | 10.337602 | 9.713928 | 10.286072 | 10.051530 | 9.948470 | 15 | 33 |
| 28 | 22 | 9.662459 | 10.337541 | 9.714005 | 10.285995 | 10.051547 | 9.948453 | 38 | 32 |
| 29 | 15 | 9.662520 | 10.337480 | 9.714082 | 10.285918 | 10.051563 | 9.948437 | 45 | 31 |
| 30 | 30 | 9.662581 | 10.337419 | 9.714160 | 10.285840 | 10.051579 | 9.948421 | 30 | 30 |
| 31 | 45 | 9.662642 | 10.337358 | 9.714237 | 10.285763 | 10.051596 | 9.948404 | 15 | 29 |
| 32 | 23 | 9.662703 | 10.337297 | 9.714314 | 10.285686 | 10.051612 | 9.948388 | 37 | 28 |
| 33 | 15 | 9.662764 | 10.337236 | 9.714392 | 10.285608 | 10.051628 | 9.948372 | 45 | 27 |
| 34 | 30 | 9.662824 | 10.337176 | 9.714469 | 10.285531 | 10.051645 | 9.948355 | 30 | 26 |
| 35 | 45 | 9.662885 | 10.337115 | 9.714546 | 10.285454 | 10.051661 | 9.948339 | 15 | 25 |
| 36 | 24 | 9.662946 | 10.337054 | 9.714624 | 10.285376 | 10.051677 | 9.948323 | 36 | 24 |
| 37 | 15 | 9.663007 | 10.336993 | 9.714701 | 10.285299 | 10.051694 | 9.948306 | 45 | 23 |
| 38 | 30 | 9.663068 | 10.336932 | 9.714778 | 10.285222 | 10.051710 | 9.948290 | 30 | 22 |
| 39 | 45 | 9.663129 | 10.336871 | 9.714856 | 10.285144 | 10.051727 | 9.948273 | 15 | 21 |
| 40 | 25 | 9.663190 | 10.336810 | 9.714983 | 10.285067 | 10.051743 | 9.948257 | 35 | 20 |
| 41 | 15 | 9.663251 | 10.336749 | 9.715010 | 10.284990 | 10.051759 | 9.948241 | 45 | 19 |
| 42 | 30 | 9.663312 | 10.336688 | 9.715087 | 10.284913 | 10.051776 | 9.948224 | 30 | 18 |
| 43 | 45 | 9.663373 | 10.336627 | 9.715165 | 10.284835 | 10.051792 | 9.948208 | 15 | 17 |
| 44 | 26 | 9.663433 | 10.336567 | 9.715242 | 10.284758 | 10.051808 | 9.948192 | 34 | 16 |
| 45 | 15 | 9.663494 | 10.336506 | 9.715319 | 10.284681 | 10.051825 | 9.948175 | 45 | 15 |
| 46 | 30 | 9.663555 | 10.336445 | 9.715396 | 10.284604 | 10.051841 | 9.948159 | 30 | 14 |
| 47 | 45 | 9.663616 | 10.336384 | 9.715474 | 10.284526 | 10.051858 | 9.948142 | 15 | 13 |
| 48 | 27 | 9.663677 | 10.336323 | 9.715551 | 10.284449 | 10.051874 | 9.948126 | 33 | 12 |
| 49 | 15 | 9.663738 | 10.336262 | 9.715628 | 10.284372 | 10.051890 | 9.948110 | 45 | 11 |
| 50 | 30 | 9.663798 | 10.336202 | 9.715705 | 10.284295 | 10.051907 | 9.948093 | 30 | 10 |
| 51 | 45 | 9.663859 | 10.336141 | 9.715782 | 10.284218 | 10.051923 | 9.948077 | 15 | 9 |
| 52 | 28 | 9.663920 | 10.336080 | 9.715859 | 10.284141 | 10.051940 | 9.948060 | 32 | 8 |
| 53 | 15 | 9.663981 | 10.336019 | 9.715937 | 10.284063 | 10.051956 | 9.948044 | 45 | 7 |
| 54 | 30 | 9.664041 | 10.335959 | 9.716014 | 10.283986 | 10.051973 | 9.948027 | 30 | 6 |
| 55 | 45 | 9.664102 | 10.335898 | 9.716091 | 10.283909 | 10.051989 | 9.948011 | 15 | 5 |
| 56 | 29 | 9.664163 | 10.335837 | 9.716168 | 10.283832 | 10.052005 | 9.947995 | 31 | 4 |
| 57 | 15 | 9.664223 | 10.335777 | 9.716245 | 10.283755 | 10.052022 | 9.947978 | 45 | 3 |
| 58 | 30 | 9.664284 | 10.335716 | 9.716322 | 10.283678 | 10.052038 | 9.947962 | 30 | 2 |
| 59 | 45 | 9.664345 | 10.335655 | 9.716400 | 10.283600 | 10.052055 | 9.947945 | 15 | 1 |
| 60 | 30 | 9.664406 | 10.335594 | 9.716477 | 10.283523 | 10.052071 | 9.947929 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine | ″ ′ | sec. |
| 4h 10m. | | | LOG. SINES, &c. | | | | 62 deg. | | |

| 1h 50m. | | | | LOG. SINES, &c. (t.) | | | | 27 deg. | | |
|---|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.664406 | 10.335594 | 9.716477 | 10.283523 | 10.052071 | 9.947929 | 30 | 60 |
| 1 | 15 | 9.664466 | 10.335534 | 9.716554 | 10.283446 | 10.052088 | 9.947912 | 45 | 59 |
| 2 | 30 | 9.664527 | 10.335473 | 9.716631 | 10.283369 | 10.052104 | 9.947896 | 30 | 58 |
| 3 | 45 | 9.664588 | 10.335412 | 9.716708 | 10.283292 | 10.052120 | 9.947880 | 15 | 57 |
| 4 | 31 | 9.664648 | 10.335352 | 9.716785 | 10.283215 | 10.052137 | 9.947863 | 29 | 56 |
| 5 | 15 | 9.664709 | 10.335291 | 9.716862 | 10.283138 | 10.052153 | 9.947847 | 45 | 55 |
| 6 | 30 | 9.664769 | 10.335231 | 9.716939 | 10.283061 | 10.052170 | 9.947830 | 30 | 54 |
| 7 | 45 | 9.664830 | 10.335170 | 9.717016 | 10.282984 | 10.052186 | 9.947814 | 15 | 53 |
| 8 | 32 | 9.664891 | 10.335109 | 9.717093 | 10.282907 | 10.052203 | 9.947797 | 28 | 52 |
| 9 | 15 | 9.664951 | 10.335049 | 9.717170 | 10.282830 | 10.052219 | 9.947781 | 45 | 51 |
| 10 | 30 | 9.665012 | 10.334988 | 9.717247 | 10.282753 | 10.052236 | 9.947764 | 30 | 50 |
| 11 | 45 | 9.665072 | 10.334928 | 9.717324 | 10.282676 | 10.052252 | 9.947748 | 15 | 49 |
| 12 | 33 | 9.665133 | 10.334867 | 9.717401 | 10.282599 | 10.052269 | 9.947731 | 27 | 48 |
| 13 | 15 | 9.665193 | 10.334807 | 9.717478 | 10.282522 | 10.052285 | 9.947715 | 45 | 47 |
| 14 | 30 | 9.665254 | 10.334746 | 9.717555 | 10.282445 | 10.052302 | 9.947698 | 30 | 46 |
| 15 | 45 | 9.665314 | 10.334686 | 9.717632 | 10.282368 | 10.052318 | 9.947682 | 15 | 45 |
| 16 | 34 | 9.665375 | 10.334625 | 9.717709 | 10.282291 | 10.052335 | 9.947665 | 26 | 44 |
| 17 | 15 | 9.665435 | 10.334565 | 9.717786 | 10.282214 | 10.052351 | 9.947649 | 45 | 43 |
| 18 | 30 | 9.665496 | 10.334504 | 9.717863 | 10.282137 | 10.052368 | 9.947632 | 30 | 42 |
| 19 | 45 | 9.665556 | 10.334444 | 9.717940 | 10.282060 | 10.052384 | 9.947616 | 15 | 41 |
| 20 | 35 | 9.665617 | 10.334383 | 9.718017 | 10.281983 | 10.052401 | 9.947599 | 25 | 40 |
| 21 | 15 | 9.665677 | 10.334323 | 9.718094 | 10.281906 | 10.052417 | 9.947583 | 45 | 39 |
| 22 | 30 | 9.665738 | 10.334262 | 9.718171 | 10.281829 | 10.052434 | 9.947566 | 30 | 38 |
| 23 | 45 | 9.665798 | 10.334202 | 9.718248 | 10.281752 | 10.052450 | 9.947550 | 15 | 37 |
| 24 | 36 | 9.665859 | 10.334141 | 9.718325 | 10.281675 | 10.052467 | 9.947533 | 24 | 36 |
| 25 | 15 | 9.665919 | 10.334081 | 9.718402 | 10.281598 | 10.052483 | 9.947517 | 45 | 35 |
| 26 | 30 | 9.665979 | 10.334021 | 9.718479 | 10.281521 | 10.052500 | 9.947500 | 30 | 34 |
| 27 | 45 | 9.666040 | 10.333960 | 9.718556 | 10.281444 | 10.052516 | 9.947484 | 15 | 33 |
| 28 | 37 | 9.666100 | 10.333900 | 9.718633 | 10.281367 | 10.052533 | 9.947467 | 23 | 32 |
| 29 | 15 | 9.666160 | 10.333840 | 9.718710 | 10.281290 | 10.052549 | 9.947451 | 45 | 31 |
| 30 | 30 | 9.666221 | 10.333779 | 9.718786 | 10.281214 | 10.052566 | 9.947434 | 30 | 30 |
| 31 | 45 | 9.666281 | 10.333719 | 9.718863 | 10.281137 | 10.052582 | 9.947418 | 15 | 29 |
| 32 | 38 | 9.666341 | 10.333659 | 9.718940 | 10.281060 | 10.052599 | 9.947401 | 22 | 28 |
| 33 | 15 | 9.666402 | 10.333598 | 9.719017 | 10.280983 | 10.052615 | 9.947385 | 45 | 27 |
| 34 | 30 | 9.666462 | 10.333538 | 9.719094 | 10.280906 | 10.052632 | 9.947368 | 30 | 26 |
| 35 | 45 | 9.666522 | 10.333478 | 9.719171 | 10.280829 | 10.052648 | 9.947352 | 15 | 25 |
| 36 | 39 | 9.666583 | 10.333417 | 9.719248 | 10.280752 | 10.052665 | 9.947335 | 21 | 24 |
| 37 | 15 | 9.666643 | 10.333357 | 9.719324 | 10.280676 | 10.052681 | 9.947319 | 45 | 23 |
| 38 | 30 | 9.666703 | 10.333297 | 9.719401 | 10.280599 | 10.052698 | 9.947302 | 30 | 22 |
| 39 | 45 | 9.666764 | 10.333236 | 9.719478 | 10.280522 | 10.052715 | 9.947285 | 15 | 21 |
| 40 | 40 | 9.666824 | 10.333176 | 9.719555 | 10.280445 | 10.052731 | 9.947269 | 20 | 20 |
| 41 | 15 | 9.666884 | 10.333116 | 9.719632 | 10.280368 | 10.052748 | 9.947252 | 45 | 19 |
| 42 | 30 | 9.666944 | 10.333056 | 9.719708 | 10.280292 | 10.052764 | 9.947236 | 30 | 18 |
| 43 | 45 | 9.667004 | 10.332996 | 9.719785 | 10.280215 | 10.052781 | 9.947219 | 15 | 17 |
| 44 | 41 | 9.667065 | 10.332935 | 9.719862 | 10.280138 | 10.052797 | 9.947203 | 19 | 16 |
| 45 | 15 | 9.667125 | 10.332875 | 9.719939 | 10.280061 | 10.052814 | 9.947186 | 45 | 15 |
| 46 | 30 | 9.667185 | 10.332815 | 9.720015 | 10.279985 | 10.052831 | 9.947169 | 30 | 14 |
| 47 | 45 | 9.667245 | 10.332755 | 9.720092 | 10.279908 | 10.052847 | 9.947153 | 15 | 13 |
| 48 | 42 | 9.667305 | 10.332695 | 9.720169 | 10.279831 | 10.052864 | 9.947136 | 18 | 12 |
| 49 | 15 | 9.667366 | 10.332634 | 9.720246 | 10.279754 | 10.052880 | 9.947120 | 45 | 11 |
| 50 | 30 | 9.667426 | 10.332574 | 9.720322 | 10.279678 | 10.052897 | 9.947103 | 30 | 10 |
| 51 | 45 | 9.667486 | 10.332514 | 9.720399 | 10.279601 | 10.052913 | 9.947087 | 15 | 9 |
| 52 | 43 | 9.667546 | 10.332454 | 9.720476 | 10.279524 | 10.052930 | 9.947070 | 17 | 8 |
| 53 | 15 | 9.667606 | 10.332394 | 9.720553 | 10.279447 | 10.052947 | 9.947053 | 45 | 7 |
| 54 | 30 | 9.667666 | 10.332334 | 9.720629 | 10.279371 | 10.052963 | 9.947037 | 30 | 6 |
| 55 | 45 | 9.667726 | 10.332274 | 9.720706 | 10.279294 | 10.052980 | 9.947020 | 15 | 5 |
| 56 | 44 | 9.667786 | 10.332214 | 9.720783 | 10.279217 | 10.052996 | 9.947004 | 16 | 4 |
| 57 | 15 | 9.667846 | 10.332154 | 9.720859 | 10.279141 | 10.053013 | 9.946987 | 45 | 3 |
| 58 | 30 | 9.667906 | 10.332094 | 9.720936 | 10.279064 | 10.053030 | 9.946970 | 30 | 2 |
| 59 | 45 | 9.667966 | 10.332034 | 9.721013 | 10.278987 | 10.053046 | 9.946954 | 15 | 1 |
| 60 | 45 | 9.668026 | 10.331974 | 9.721089 | 10.278911 | 10.053063 | 9.946937 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 9m. | | | | LOG. SINES, &c. | | | | 62 deg. | | |

| 1h 51m. | | | LOG. SINES, &c. (t.) | | | | 27 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.668026 | 10.331974 | 9.721089 | 10.278911 | 10.053063 | 9.946937 | 15 | 60 |
| 1 | 15 | 9.668086 | 10.331914 | 9.721166 | 10.278834 | 10.053079 | 9.946921 | 45 | 59 |
| 2 | 30 | 9 668147 | 10.331853 | 9.721243 | 10.278757 | 10.053096 | 9.946904 | 30 | 58 |
| 3 | 45 | 9.668207 | 10.331793 | 9.721319 | 10.278681 | 10.053113 | 9.946887 | 15 | 57 |
| 4 | 46 | 9.668266 | 10.331734 | 9.721396 | 10.278604 | 10.053129 | 9.946871 | 14 | 56 |
| 5 | 15 | 9.668326 | 10.331674 | 9.721472 | 10.278528 | 10.053146 | 9.946854 | 45 | 55 |
| 6 | 30 | 9.668386 | 10.331614 | 9.721549 | 10.278451 | 10.053163 | 9.946837 | 30 | 54 |
| 7 | 45 | 9.668446 | 10.331554 | 9.721626 | 10.278374 | 10.053179 | 9.946821 | 15 | 53 |
| 8 | 47 | 9.668506 | 10.331494 | 9.721702 | 10.278298 | 10.053196 | 9.946804 | 13 | 52 |
| 9 | 15 | 9.668566 | 10.331434 | 9.721779 | 10.278221 | 10.053213 | 9.946787 | 45 | 51 |
| 10 | 30 | 9.668626 | 10.331374 | 9.721855 | 10.278145 | 10.053229 | 9.946771 | 30 | 50 |
| 11 | 45 | 9.668686 | 10.331314 | 9.721932 | 10.278068 | 10.053246 | 9.946754 | 15 | 49 |
| 12 | 48 | 9.668746 | 10.331254 | 9.722008 | 10.277992 | 10.053262 | 9.946738 | 12 | 48 |
| 13 | 15 | 9.668806 | 10.331194 | 9.722085 | 10.277915 | 10.053279 | 9.946721 | 45 | 47 |
| 14 | 30 | 9.668866 | 10.331134 | 9.722162 | 10.277838 | 10.053296 | 9.946704 | 30 | 46 |
| 15 | 45 | 9.668926 | 10.331074 | 9.722238 | 10.277762 | 10.053312 | 9.946688 | 15 | 45 |
| 16 | 49 | 9.668986 | 10.331014 | 9.722315 | 10.277685 | 10.053329 | 9.946671 | 11 | 44 |
| 17 | 15 | 9.669045 | 10.330955 | 9.722391 | 10.277609 | 10.053346 | 9.946654 | 45 | 43 |
| 18 | 30 | 9.669105 | 10.330895 | 9.722468 | 10.277532 | 10.053362 | 9.946638 | 30 | 42 |
| 19 | 45 | 9.669165 | 10.330835 | 9.722544 | 10.277456 | 10.053379 | 9.946621 | 15 | 41 |
| 20 | 50 | 9.669225 | 10.330775 | 9.722621 | 10.277379 | 10.053396 | 9.946604 | 10 | 40 |
| 21 | 15 | 9.669285 | 10.330715 | 9.722697 | 10.277303 | 10.053412 | 9.946588 | 45 | 39 |
| 22 | 30 | 9.669345 | 10.330655 | 9.722774 | 10.277226 | 10.053429 | 9.946571 | 30 | 38 |
| 23 | 45 | 9.669404 | 10.330596 | 9.722850 | 10.277150 | 10.053446 | 9.946554 | 15 | 37 |
| 24 | 51 | 9.669464 | 10.330536 | 9.722927 | 10.277073 | 10.053462 | 9.946538 | 9 | 36 |
| 25 | 15 | 9.669524 | 10.330476 | 9.723003 | 10.276997 | 10.053479 | 9.946521 | 45 | 35 |
| 26 | 30 | 9.669584 | 10.330416 | 9.723079 | 10.276921 | 10.053496 | 9.946504 | 30 | 34 |
| 27 | 45 | 9.669643 | 10.330357 | 9.723156 | 10.276844 | 10.053513 | 9.946487 | 15 | 33 |
| 28 | 52 | 9.669703 | 10.330297 | 9.723232 | 10.276768 | 10.053529 | 9.946471 | 8 | 32 |
| 29 | 15 | 9.669763 | 10.330237 | 9.723309 | 10.276691 | 10.053546 | 9.946454 | 45 | 31 |
| 30 | 30 | 9.669823 | 10.330177 | 9.723385 | 10.276615 | 10.053563 | 9.946437 | 30 | 30 |
| 31 | 45 | 9.669882 | 10.330118 | 9.723462 | 10.276538 | 10.053579 | 9.946421 | 15 | 29 |
| 32 | 53 | 9.669942 | 10.330058 | 9.723538 | 10.276462 | 10.053596 | 9.946404 | 7 | 28 |
| 33 | 15 | 9.670002 | 10.329998 | 9.723614 | 10.276386 | 10.053613 | 9.946387 | 45 | 27 |
| 34 | 30 | 9.670061 | 10.329939 | 9.723691 | 10.276309 | 10.053630 | 9.946370 | 30 | 26 |
| 35 | 45 | 9.670121 | 10.329879 | 9.723767 | 10.276233 | 10.053646 | 9.946354 | 15 | 25 |
| 36 | 54 | 9.670181 | 10 329819 | 9.723844 | 10.276156 | 10.053663 | 9.946337 | 6 | 24 |
| 37 | 15 | 9.670240 | 10.329760 | 9.723920 | 10.276080 | 10.053680 | 9.946320 | 45 | 23 |
| 38 | 30 | 9.670300 | 10.329700 | 9.723996 | 10.276004 | 10.053696 | 9.946304 | 30 | 22 |
| 39 | 45 | 9.670360 | 10.329640 | 9.724073 | 10.275927 | 10.053713 | 9.946287 | 15 | 21 |
| 40 | 55 | 9.670419 | 10.329581 | 9.724149 | 10.275851 | 10.053730 | 9.946270 | 5 | 20 |
| 41 | 15 | 9.670479 | 10.329521 | 9.724225 | 10.275775 | 10.053747 | 9.946253 | 45 | 19 |
| 42 | 30 | 9.670538 | 10.329462 | 9.724302 | 10.275698 | 10.053763 | 9.946237 | 30 | 18 |
| 43 | 45 | 9.670598 | 10.329402 | 9.724378 | 10.275622 | 10.053780 | 9.946220 | 15 | 17 |
| 44 | 56 | 9.670658 | 10.329342 | 9.724454 | 10.275546 | 10.053797 | 9.946203 | 4 | 16 |
| 45 | 15 | 9.670717 | 10.329283 | 9.724531 | 10.275469 | 10.053814 | 9.946186 | 45 | 15 |
| 46 | 30 | 9.670777 | 10.329223 | 9.724607 | 10.275393 | 10.053830 | 9.946170 | 30 | 14 |
| 47 | 45 | 9.670836 | 10.329164 | 9.724683 | 10.275317 | 10.053847 | 9.946153 | 15 | 13 |
| 48 | 57 | 9.670896 | 10.329104 | 9.724759 | 10.275241 | 10.053864 | 9.946136 | 3 | 12 |
| 49 | 15 | 9.670955 | 10.329045 | 9.724836 | 10.275164 | 10.053881 | 9.946119 | 45 | 11 |
| 50 | 30 | 9.671015 | 10.328985 | 9.724912 | 10.275088 | 10.053897 | 9.946103 | 30 | 10 |
| 51 | 45 | 9.671074 | 10.328926 | 9.724988 | 10.275012 | 10.053914 | 9.946086 | 15 | 9 |
| 52 | 58 | 9.671134 | 10.328866 | 9.725065 | 10.274935 | 10.053931 | 9.946069 | 2 | 8 |
| 53 | 15 | 9.671193 | 10.328807 | 9.725141 | 10.274859 | 10.053948 | 9.946052 | 45 | 7 |
| 54 | 30 | 9.671253 | 10.328747 | 9.725217 | 10.274783 | 10.053964 | 9.946036 | 30 | 6 |
| 55 | 45 | 9.671312 | 10.328688 | 9.725293 | 10.274707 | 10.053981 | 9.946019 | 15 | 5 |
| 56 | 59 | 9.671372 | 10.328628 | 9.725369 | 10 274631 | 10.053998 | 9 946002 | 1 | 4 |
| 57 | 15 | 9.671431 | 10.328569 | 9.725446 | 10.274554 | 10.054015 | 9.945985 | 45 | 3 |
| 58 | 30 | 9.671490 | 10.328510 | 9.725522 | 10.274478 | 10.054032 | 9.945968 | 30 | 2 |
| 59 | 45 | 9.671550 | 10.328450 | 9.725598 | 10.274402 | 10.054048 | 9.945952 | 15 | 1 |
| 60 | 60 | 9 671609 | 10.328391 | 9.725674 | 10.274326 | 10.054065 | 9.945935 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 4h 8m. | | | LOG. SINES, &c. | | | | 62 deg. | | |
|---|---|---|---|---|---|---|---|---|---|

| 1h 52m. | | | LOG. SINES, &c. (t.) | | | | 28 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.671609 | 10.328391 | 9.725674 | 10.274326 | 10.054065 | 9.945935 | 60 | 60 |
| 1 | 15 | 9.671669 | 10.328331 | 9.725751 | 10.274249 | 10.054082 | 9.945918 | 45 | 59 |
| 2 | 30 | 9.671728 | 10.328272 | 9.725827 | 10.274173 | 10.054099 | 9.945901 | 30 | 58 |
| 3 | 45 | 9.671787 | 10.328213 | 9.725903 | 10.274097 | 10.054116 | 9.945884 | 15 | 57 |
| 4 | 1 | 9.671847 | 10.328153 | 9.725979 | 10.274021 | 10.054132 | 9.945868 | 59 | 56 |
| 5 | 15 | 9.671906 | 10.328094 | 9.726055 | 10.273945 | 10.054149 | 9.945851 | 45 | 55 |
| 6 | 30 | 9.671965 | 10.328035 | 9.726131 | 10.273869 | 10.054166 | 9.945834 | 30 | 54 |
| 7 | 45 | 9.672025 | 10.327975 | 9.726207 | 10.273793 | 10.054183 | 9.945817 | 15 | 53 |
| 8 | 2 | 9.672084 | 10.327916 | 9.726284 | 10.273716 | 10.054200 | 9.945800 | 58 | 52 |
| 9 | 15 | 9.672143 | 10.327857 | 9.726360 | 10.273640 | 10.054216 | 9.945784 | 45 | 51 |
| 10 | 30 | 9.672203 | 10.327797 | 9.726436 | 10.273564 | 10.054233 | 9.945767 | 30 | 50 |
| 11 | 45 | 9.672262 | 10.327738 | 9.726512 | 10.273488 | 10.054250 | 9.945750 | 15 | 49 |
| 12 | 3 | 9.672321 | 10.327679 | 9.726588 | 10.273412 | 10.054267 | 9.945733 | 57 | 48 |
| 13 | 15 | 9.672381 | 10.327619 | 9.726664 | 10.273336 | 10.054284 | 9.945716 | 45 | 47 |
| 14 | 30 | 9.672440 | 10.327560 | 9.726740 | 10.273260 | 10.054301 | 9.945699 | 30 | 46 |
| 15 | 45 | 9.672499 | 10.327501 | 9.726816 | 10.273184 | 10.054317 | 9.945683 | 15 | 45 |
| 16 | 4 | 9.672558 | 10.327442 | 9.726892 | 10.273108 | 10.054334 | 9.945666 | 56 | 44 |
| 17 | 15 | 9.672618 | 10.327382 | 9.726968 | 10.273032 | 10.054351 | 9.945649 | 45 | 43 |
| 18 | 30 | 9.672677 | 10.327323 | 9.727045 | 10.272955 | 10.054368 | 9.945632 | 30 | 42 |
| 19 | 45 | 9.672736 | 10.327264 | 9.727121 | 10.272879 | 10.054385 | 9.945615 | 15 | 41 |
| 20 | 5 | 9.672795 | 10.327205 | 9.727197 | 10.272803 | 10.054402 | 9.945598 | 55 | 40 |
| 21 | 15 | 9.672854 | 10.327146 | 9.727273 | 10.272727 | 10.054418 | 9.945582 | 45 | 39 |
| 22 | 30 | 9.672913 | 10.327087 | 9.727349 | 10.272651 | 10.054435 | 9.945565 | 30 | 38 |
| 23 | 45 | 9.672973 | 10.327027 | 9.727425 | 10.272575 | 10.054452 | 9.945548 | 15 | 37 |
| 24 | 6 | 9.673032 | 10.326968 | 9.727501 | 10.272499 | 10.054469 | 9.945531 | 54 | 36 |
| 25 | 15 | 9.673091 | 10.326909 | 9.727577 | 10.272423 | 10.054486 | 9.945514 | 45 | 35 |
| 26 | 30 | 9.673150 | 10.326850 | 9.727653 | 10.272347 | 10.054503 | 9.945497 | 30 | 34 |
| 27 | 45 | 9.673209 | 10.326791 | 9.727729 | 10.272271 | 10.054520 | 9.945480 | 15 | 33 |
| 28 | 7 | 9.673268 | 10.326732 | 9.727805 | 10.272195 | 10.054536 | 9.945464 | 53 | 32 |
| 29 | 15 | 9.673327 | 10.326673 | 9.727881 | 10.272119 | 10.054553 | 9.945447 | 45 | 31 |
| 30 | 30 | 9.673387 | 10.326613 | 9.727957 | 10.272043 | 10.054570 | 9.945430 | 30 | 30 |
| 31 | 45 | 9.673446 | 10.326554 | 9.728033 | 10.271967 | 10.054587 | 9.945413 | 15 | 29 |
| 32 | 8 | 9.673505 | 10.326495 | 9.728109 | 10.271891 | 10.054604 | 9.945396 | 52 | 28 |
| 33 | 15 | 9.673564 | 10.326436 | 9.728185 | 10 271815 | 10.054621 | 9.945379 | 45 | 27 |
| 34 | 30 | 9.673623 | 10.326377 | 9.728261 | 10.271739 | 10.054638 | 9.945362 | 30 | 26 |
| 35 | 45 | 9.673682 | 10.326318 | 9.728336 | 10.271664 | 10.054655 | 9.945345 | 15 | 25 |
| 36 | 9 | 9.673741 | 10.326259 | 9.728412 | 10.271588 | 10.054672 | 9.945328 | 51 | 24 |
| 37 | 15 | 9.673800 | 10.326200 | 9.728488 | 10.271512 | 10.054688 | 9.945312 | 45 | 23 |
| 38 | 30 | 9.673859 | 10.326141 | 9.728564 | 10.271436 | 10.054705 | 9.945295 | 30 | 22 |
| 39 | 45 | 9.673918 | 10.326082 | 9.728640 | 10.271360 | 10.054722 | 9.945278 | 15 | 21 |
| 40 | 10 | 9.673977 | 10.326023 | 9.728716 | 10.271284 | 10.054739 | 9.945261 | 50 | 20 |
| 41 | 15 | 9.674036 | 10.325964 | 9.728792 | 10.271208 | 10.054756 | 9.945244 | 45 | 19 |
| 42 | 30 | 9.674095 | 10.325905 | 9.728868 | 10.271132 | 10.054773 | 9.945227 | 30 | 18 |
| 43 | 45 | 9.674154 | 10 325846 | 9.728944 | 10.271056 | 10.054790 | 9.945210 | 15 | 17 |
| 44 | 11 | 9.674213 | 10.325787 | 9.729020 | 10.270980 | 10.054807 | 9.945193 | 49 | 16 |
| 45 | 15 | 9.674272 | 10.325728 | 9.729095 | 10.270905 | 10.054824 | 9.945176 | 45 | 15 |
| 46 | 30 | 9.674331 | 10.325669 | 9.729171 | 10.270829 | 10.054841 | 9.945159 | 30 | 14 |
| 47 | 45 | 9.674390 | 10.325610 | 9.729247 | 10.270753 | 10.054858 | 9.945142 | 15 | 13 |
| 48 | 12 | 9.674448 | 10.325552 | 9.729323 | 10.270677 | 10.054875 | 9.945125 | 48 | 12 |
| 49 | 15 | 9.674507 | 10.325493 | 9.729399 | 10.270601 | 10.054892 | 9.945108 | 45 | 11 |
| 50 | 30 | 9.674566 | 10.325434 | 9.729475 | 10.270525 | 10.054908 | 9.945092 | 30 | 10 |
| 51 | 45 | 9.674625 | 10.325375 | 9.729550 | 10.270450 | 10.054925 | 9.945075 | 15 | 9 |
| 52 | 13 | 9.674684 | 10.325316 | 9.729626 | 10.270374 | 10.054942 | 9.945058 | 47 | 8 |
| 53 | 15 | 9.674743 | 10.325257 | 9.729702 | 10.270298 | 10.054959 | 9.945041 | 45 | 7 |
| 54 | 30 | 9.674802 | 10.325198 | 9.729778 | 10.270222 | 10.054976 | 9.945024 | 30 | 6 |
| 55 | 45 | 9.674860 | 10.325140 | 9.729854 | 10.270146 | 10.054993 | 9.945007 | 15 | 5 |
| 56 | 14 | 9.674919 | 10.325081 | 9.729929 | 10.270071 | 10.055010 | 9.944990 | 46 | 4 |
| 57 | 15 | 9.674978 | 10.325022 | 9.730005 | 10.269995 | 10.055027 | 9.944973 | 45 | 3 |
| 58 | 30 | 9.675037 | 10.324963 | 9.730081 | 10.269919 | 10.055044 | 9.944956 | 30 | 2 |
| 59 | 45 | 9.675096 | 10.324904 | 9.730157 | 10.269843 | 10.055061 | 9.944939 | 15 | 1 |
| 60 | 15 | 9.675155 | 10.324845 | 9.730232 | 10.269768 | 10.055078 | 9.944922 | 45 | 0 |
| sec. | ′ ″ | cosine | secant | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 7m. | | | LOG. SINES. &c. | | | | 61 deg. | | |

| 1h 53m. | | LOG. SINES, &c. (t.) | | | | | 28 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.675155 | 10.324845 | 9.730232 | 10.269768 | 10.055078 | 9.944922 | 45 | 60 |
| 1 | 15 | 9.675213 | 10.324787 | 9.730308 | 10.269692 | 10.055095 | 9.944905 | 45 | 59 |
| 2 | 30 | 9.675272 | 10.324728 | 9.730384 | 10.269616 | 10.055112 | 9.944888 | 30 | 58 |
| 3 | 45 | 9.675331 | 10.324669 | 9.730460 | 10.269540 | 10.055129 | 9.944871 | 15 | 57 |
| 4 | 16 | 9.675390 | 10.324610 | 9.730535 | 10.269465 | 10.055146 | 9.944854 | 44 | 56 |
| 5 | 15 | 9.675448 | 10.324552 | 9.730611 | 10.269389 | 10.055163 | 9.944837 | 45 | 55 |
| 6 | 30 | 9.675507 | 10.324493 | 9.730687 | 10.269313 | 10.055180 | 9.944820 | 30 | 54 |
| 7 | 45 | 9.675566 | 10.324434 | 9.730763 | 10.269237 | 10.055197 | 9.944803 | 15 | 53 |
| 8 | 17 | 9.675624 | 10.324376 | 9 730838 | 10.269162 | 10.055214 | 9.944786 | 43 | 52 |
| 9 | 15 | 9.675683 | 10.324317 | 9.730914 | 10.269086 | 10.055231 | 9.944769 | 45 | 51 |
| 10 | 30 | 9.675742 | 10.324258 | 9.730990 | 10.269010 | 10.055248 | 9.944752 | 30 | 50 |
| 11 | 45 | 9.675800 | 10.324200 | 9.731065 | 10.268935 | 10.055265 | 9.944735 | 15 | 49 |
| 12 | 18 | 9.675859 | 10.324141 | 9.731141 | 10.268859 | 10.055282 | 9.944718 | 42 | 48 |
| 13 | 15 | 9.675918 | 10.324082 | 9.731217 | 10.268783 | 10.055299 | 9.944701 | 45 | 47 |
| 14 | 30 | 9.675976 | 10.324024 | 9.731292 | 10.268708 | 10.055316 | 9.944684 | 30 | 46 |
| 15 | 45 | 9.676035 | 10.323965 | 9.731368 | 10.268632 | 10.055333 | 9.944667 | 15 | 45 |
| 16 | 19 | 9.676094 | 10.323906 | 9.731444 | 10.268556 | 10.055350 | 9.944650 | 41 | 44 |
| 17 | 15 | 9.676152 | 10.323848 | 9.731519 | 10.268481 | 10.055367 | 9.944633 | 45 | 43 |
| 18 | 30 | 9.676211 | 10.323789 | 9.731595 | 10.268405 | 10.055384 | 9.944616 | 30 | 42 |
| 19 | 45 | 9.676269 | 10.323731 | 9.731670 | 10.268330 | 10.055401 | 9.944599 | 15 | 41 |
| 20 | 20 | 9.676328 | 10.323672 | 9.731746 | 10.268254 | 10.055418 | 9.944582 | 40 | 40 |
| 21 | 15 | 9.676387 | 10.323613 | 9.731822 | 10.268178 | 10.055435 | 9.944565 | 45 | 39 |
| 22 | 30 | 9.676445 | 10.323555 | 9.731897 | 10.268103 | 10.055452 | 9.944548 | 30 | 38 |
| 23 | 45 | 9.676504 | 10.323496 | 9.731973 | 10.268027 | 10.055469 | 9.944531 | 15 | 37 |
| 24 | 21 | 9.676562 | 10.323438 | 9.732048 | 10.267952 | 10.055486 | 9.944514 | 39 | 36 |
| 25 | 15 | 9.676621 | 10.323379 | 9.732124 | 10.267876 | 10.055503 | 9.944497 | 45 | 35 |
| 26 | 30 | 9 676679 | 10.323321 | 9.732199 | 10.267801 | 10.055520 | 9.944480 | 30 | 34 |
| 27 | 45 | 9.676738 | 10.323262 | 9.732275 | 10.267725 | 10.055537 | 9.944463 | 15 | 33 |
| 28 | 22 | 9.676796 | 10.323204 | 9.732351 | 10.267649 | 10.055554 | 9.944446 | 38 | 32 |
| 29 | 15 | 9.676855 | 10.323145 | 9.732426 | 10.267574 | 10.055571 | 9.944429 | 45 | 31 |
| 30 | 30 | 9.676913 | 10.323087 | 9.732502 | 10.267498 | 10.055588 | 9.944412 | 30 | 30 |
| 31 | 45 | 9.676972 | 10.323028 | 9 732577 | 10.267423 | 10.055606 | 9.944394 | 15 | 29 |
| 32 | 23 | 9.677030 | 10.322970 | 9.732653 | 10.267347 | 10.055623 | 9.944377 | 37 | 28 |
| 33 | 15 | 9.677089 | 10.322911 | 9.732728 | 10.267272 | 10.055640 | 9.944360 | 45 | 27 |
| 34 | 30 | 9.677147 | 10.322853 | 9.732804 | 10.267196 | 10.055657 | 9.944343 | 30 | 26 |
| 35 | 45 | 9.677205 | 10.322795 | 9.732879 | 10.267121 | 10.055674 | 9.944326 | 15 | 25 |
| 36 | 24 | 9.677264 | 10.322736 | 9.732955 | 10.267045 | 10.055691 | 9.944309 | 36 | 24 |
| 37 | 15 | 9.677322 | 10.322678 | 9.733030 | 10.266970 | 10.055708 | 9.944292 | 45 | 23 |
| 38 | 30 | 9.677381 | 10.322619 | 9.733106 | 10.266894 | 10.055725 | 9.944275 | 30 | 22 |
| 39 | 45 | 9.677439 | 10.322561 | 9.733181 | 10.266819 | 10.055742 | 9.944258 | 15 | 21 |
| 40 | 25 | 9.677497 | 10.322503 | 9.733257 | 10.266743 | 10.055759 | 9.944241 | 35 | 20 |
| 41 | 15 | 9.677556 | 10.322444 | 9.733332 | 10.266668 | 10.055776 | 9.944224 | 45 | 19 |
| 42 | 30 | 9.677614 | 10.322386 | 9.733407 | 10.266593 | 10.055793 | 9.944207 | 30 | 18 |
| 43 | 45 | 9.677673 | 10.322327 | 9.733483 | 10.266517 | 10.055810 | 9.944190 | 15 | 17 |
| 44 | 26 | 9.677731 | 10.322269 | 9.733558 | 10.266442 | 10.055828 | 9.944172 | 34 | 16 |
| 45 | 15 | 9.677789 | 10.322211 | 9.733634 | 10.266366 | 10.055845 | 9.944155 | 45 | 15 |
| 46 | 30 | 9.677848 | 10.322152 | 9.733709 | 10.266291 | 10.055862 | 9.944138 | 30 | 14 |
| 47 | 45 | 9.677906 | 10.322094 | 9.733785 | 10.266215 | 10.055879 | 9.944121 | 15 | 13 |
| 48 | 27 | 9.677964 | 10.322036 | 9.733860 | 10.266140 | 10.055896 | 9.944104 | 33 | 12 |
| 49 | 15 | 9.678022 | 10.321978 | 9.733935 | 10.266065 | 10.055913 | 9.944087 | 45 | 11 |
| 50 | 30 | 9.678081 | 10.321919 | 9.734011 | 10.265989 | 10.055930 | 9.944070 | 30 | 10 |
| 51 | 45 | 9.678139 | 10.321861 | 9.734086 | 10.265914 | 10.055947 | 9.944053 | 15 | 9 |
| 52 | 28 | 9.678197 | 10.321803 | 9.734162 | 10.265838 | 10.055964 | 9.944036 | 32 | 8 |
| 53 | 15 | 9.678255 | 10.321745 | 9.734237 | 10.265763 | 10.055982 | 9.944018 | 45 | 7 |
| 54 | 30 | 9.678314 | 10.321686 | 9.734312 | 10.265688 | 10.055999 | 9.944001 | 30 | 6 |
| 55 | 45 | 9.678372 | 10.321628 | 9.734388 | 10.265612 | 10.056016 | 9.943984 | 15 | 5 |
| 56 | 29 | 9.678430 | 10.321570 | 9.734463 | 10.265537 | 10.056033 | 9.943967 | 31 | 4 |
| 57 | 15 | 9.678488 | 10.321512 | 9.734538 | 10.265462 | 10.056050 | 9.943950 | 45 | 3 |
| 58 | 30 | 9.678546 | 10.321454 | 9.734614 | 10.265386 | 10.056067 | 9.943933 | 30 | 2 |
| 59 | 45 | 9.678605 | 10.321395 | 9.734689 | 10.265311 | 10.056084 | 9.943916 | 15 | 1 |
| 60 | 30 | 9.678663 | 10.321337 | 9.734764 | 10.265236 | 10.056102 | 9.943898 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 6m. | | | LOG. SINES, &c | | | | | 61 deg. | |

| 1h 54m. | | | LOG. SINES, &c. (t.) | | | | 28 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.678663 | 10.321337 | 9.734764 | 10.265236 | 10.056102 | 9.943898 | 30 | 60 |
| 1 | 15 | 9.678721 | 10.321279 | 9.734840 | 10.265160 | 10.056119 | 9.943881 | 45 | 59 |
| 2 | 30 | 9.678779 | 10.321221 | 9.734915 | 10.265085 | 10.056136 | 9.943864 | 30 | 58 |
| 3 | 45 | 9.678837 | 10.321163 | 9.734990 | 10.265010 | 10.056153 | 9.943847 | 15 | 57 |
| 4 | 31 | 9.678895 | 10.321105 | 9.735066 | 10.264934 | 10.056170 | 9.943830 | 29 | 56 |
| 5 | 15 | 9.678954 | 10.321046 | 9.735141 | 10.264859 | 10.056187 | 9.943813 | 45 | 55 |
| 6 | 30 | 9.679012 | 10.320988 | 9.735216 | 10.264784 | 10.056204 | 9.943796 | 30 | 54 |
| 7 | 45 | 9.679070 | 10.320930 | 9.735291 | 10.264709 | 10.056222 | 9.943778 | 15 | 53 |
| 8 | 32 | 9.679128 | 10.320872 | 9.735367 | 10.264633 | 10.056239 | 9.943761 | 28 | 52 |
| 9 | 15 | 9.679186 | 10.320814 | 9.735442 | 10.264558 | 10.056256 | 9.943744 | 45 | 51 |
| 10 | 30 | 9.679244 | 10.320756 | 9.735517 | 10.264483 | 10.056273 | 9.943727 | 30 | 50 |
| 11 | 45 | 9.679302 | 10.320698 | 9.735592 | 10.264408 | 10.056290 | 9.943710 | 15 | 49 |
| 12 | 33 | 9.679360 | 10.320640 | 9.735668 | 10.264332 | 10.056308 | 9.943692 | 27 | 48 |
| 13 | 15 | 9.679418 | 10.320582 | 9.735743 | 10.264257 | 10.056325 | 9.943675 | 45 | 47 |
| 14 | 30 | 9.679476 | 10.320524 | 9.735818 | 10.264182 | 10.056342 | 9.943658 | 30 | 46 |
| 15 | 45 | 9.679534 | 10.320466 | 9.735893 | 10.264107 | 10.056359 | 9.943641 | 15 | 45 |
| 16 | 34 | 9.679592 | 10.320408 | 9.735968 | 10.264032 | 10.056376 | 9.943624 | 26 | 44 |
| 17 | 15 | 9.679650 | 10.320350 | 9.736044 | 10.263956 | 10.056393 | 9.943607 | 45 | 43 |
| 18 | 30 | 9.679708 | 10.320292 | 9.736119 | 10.263881 | 10.056411 | 9.943589 | 30 | 42 |
| 19 | 45 | 9.679766 | 10.320234 | 9.736194 | 10.263806 | 10.056428 | 9.943572 | 15 | 41 |
| 20 | 35 | 9.679824 | 10.320176 | 9.736269 | 10.263731 | 10.056445 | 9.943555 | 25 | 40 |
| 21 | 15 | 9.679882 | 10.320118 | 9.736344 | 10.263656 | 10.056462 | 9.943538 | 45 | 39 |
| 22 | 30 | 9.679940 | 10.320060 | 9.736420 | 10.263580 | 10.056480 | 9.943520 | 30 | 38 |
| 23 | 45 | 9.679998 | 10.320002 | 9.736495 | 10.263505 | 10.056497 | 9.943503 | 15 | 37 |
| 24 | 36 | 9.680056 | 10.319944 | 9.736570 | 10.263430 | 10.056514 | 9.943486 | 24 | 36 |
| 25 | 15 | 9.680114 | 10.319886 | 9.736645 | 10.263355 | 10.056531 | 9.943469 | 45 | 35 |
| 26 | 30 | 9.680172 | 10.319828 | 9.736720 | 10.263280 | 10.056548 | 9.943452 | 30 | 34 |
| 27 | 45 | 9.680230 | 10.319770 | 9.736795 | 10.263205 | 10.056566 | 9.943434 | 15 | 33 |
| 28 | 37 | 9.680288 | 10.319712 | 9.736870 | 10.263130 | 10.056583 | 9.943417 | 23 | 32 |
| 29 | 15 | 9.680345 | 10.319655 | 9.736946 | 10.263054 | 10.056600 | 9.943400 | 45 | 31 |
| 30 | 30 | 9.680403 | 10.319597 | 9.737021 | 10.262979 | 10.056617 | 9.943383 | 30 | 30 |
| 31 | 45 | 9.680461 | 10.319539 | 9.737096 | 10.262904 | 10.056635 | 9.943365 | 15 | 29 |
| 32 | 38 | 9.680519 | 10.319481 | 9.737171 | 10.262829 | 10.056652 | 9.943348 | 22 | 28 |
| 33 | 15 | 9.680577 | 10.319423 | 9.737246 | 10.262754 | 10.056669 | 9.943331 | 45 | 27 |
| 34 | 30 | 9.680635 | 10.319365 | 9.737321 | 10.262679 | 10.056686 | 9.943314 | 30 | 26 |
| 35 | 45 | 9.680693 | 10.319307 | 9.737396 | 10.262604 | 10.056704 | 9.943296 | 15 | 25 |
| 36 | 39 | 9.680750 | 10.319250 | 9.737471 | 10.262529 | 10.056721 | 9.943279 | 21 | 24 |
| 37 | 15 | 9.680808 | 10.319192 | 9.737546 | 10.262454 | 10.056738 | 9.943262 | 45 | 23 |
| 38 | 30 | 9.680866 | 10.319134 | 9.737621 | 10.262379 | 10.056755 | 9.943245 | 30 | 22 |
| 39 | 45 | 9.680924 | 10.319076 | 9.737696 | 10.262304 | 10.056773 | 9.943227 | 15 | 21 |
| 40 | 40 | 9.680982 | 10.319018 | 9.737771 | 10.262229 | 10.056790 | 9.943210 | 20 | 20 |
| 41 | 15 | 9.681039 | 10.318961 | 9.737846 | 10.262154 | 10.056807 | 9.943193 | 45 | 19 |
| 42 | 30 | 9.681097 | 10.318903 | 9.737921 | 10.262079 | 10.056824 | 9.943176 | 30 | 18 |
| 43 | 45 | 9.681155 | 10.318845 | 9.737996 | 10.262004 | 10.056842 | 9.943158 | 15 | 17 |
| 44 | 41 | 9.681213 | 10.318787 | 9.738071 | 10.261929 | 10.056859 | 9.943141 | 19 | 16 |
| 45 | 15 | 9.681270 | 10.318730 | 9.738146 | 10.261854 | 10.056876 | 9.943124 | 45 | 15 |
| 46 | 30 | 9.681328 | 10.318672 | 9.738221 | 10.261779 | 10.056894 | 9.943106 | 30 | 14 |
| 47 | 45 | 9.681386 | 10.318614 | 9.738296 | 10.261704 | 10.056911 | 9.943089 | 15 | 13 |
| 48 | 42 | 9.681443 | 10.318557 | 9.738371 | 10.261629 | 10.056928 | 9.943072 | 18 | 12 |
| 49 | 15 | 9.681501 | 10.318499 | 9.738446 | 10.261554 | 10.056945 | 9.943055 | 45 | 11 |
| 50 | 30 | 9.681559 | 10.318441 | 9.738521 | 10.261479 | 10.056963 | 9.943037 | 30 | 10 |
| 51 | 45 | 9.681616 | 10.318384 | 9.738596 | 10.261404 | 10.056980 | 9.943020 | 15 | 9 |
| 52 | 43 | 9.681674 | 10.318326 | 9.738671 | 10.261329 | 10.056997 | 9.943003 | 17 | 8 |
| 53 | 15 | 9.681732 | 10.318268 | 9.738746 | 10.261254 | 10.057015 | 9.942985 | 45 | 7 |
| 54 | 30 | 9.681789 | 10.318211 | 9.738821 | 10.261179 | 10.057032 | 9.942968 | 30 | 6 |
| 55 | 45 | 9.681847 | 10.318153 | 9.738896 | 10.261104 | 10.057049 | 9.942951 | 15 | 5 |
| 56 | 44 | 9.681905 | 10.318095 | 9.738971 | 10.261029 | 10.057067 | 9.942933 | 16 | 4 |
| 57 | 15 | 9.681962 | 10.318038 | 9.739046 | 10.260954 | 10.057084 | 9.942916 | 45 | 3 |
| 58 | 30 | 9.682020 | 10.317980 | 9.739121 | 10.260879 | 10.057101 | 9.942899 | 30 | 2 |
| 59 | 45 | 9.682077 | 10.317923 | 9.739196 | 10.260804 | 10.057118 | 9.942882 | 15 | 1 |
| 60 | 45 | 9.682135 | 10.317865 | 9.739271 | 10.260729 | 10.057136 | 9.942864 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 5m. | | | LOG. SINES, &c. | | | | 61 deg. | | |

| ° | 1h 55m. | | LOG. SINES, &c. (t.) | | | | 28 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.682135 | 10.317865 | 9.739271 | 10.260729 | 10.057136 | 9.942864 | 15 | 60 |
| 1 | 15 | 9.682192 | 10.317808 | 9.739346 | 10.260654 | 10.057153 | 9.942847 | 45 | 59 |
| 2 | 30 | 9.682250 | 10.317750 | 9.739420 | 10.260580 | 10.057170 | 9.942830 | 30 | 58 |
| 3 | 45 | 9.682308 | 10.317692 | 9.739495 | 10.260505 | 10.057188 | 9.942812 | 15 | 57 |
| 4 | 46 | 9.682365 | 10.317635 | 9.739570 | 10.260430 | 10.057205 | 9.942795 | 14 | 56 |
| 5 | 15 | 9.682423 | 10.317577 | 9.739645 | 10.260355 | 10.057222 | 9.942778 | 45 | 55 |
| 6 | 30 | 9.682480 | 10.317520 | 9.739720 | 10.260280 | 10.057240 | 9.942760 | 30 | 54 |
| 7 | 45 | 9.682538 | 10.317462 | 9.739795 | 10.260205 | 10.057257 | 9.942743 | 15 | 53 |
| 8 | 47 | 9.682595 | 10.317405 | 9.739870 | 10.260130 | 10.057275 | 9.942725 | 13 | 52 |
| 9 | 15 | 9.682653 | 10.317347 | 9.739944 | 10.260056 | 10.057292 | 9.942708 | 45 | 51 |
| 10 | 30 | 9.682710 | 10.317290 | 9.740019 | 10.259981 | 10.057309 | 9.942691 | 30 | 50 |
| 11 | 45 | 9.682768 | 10.317232 | 9.740094 | 10.259906 | 10.057327 | 9.942673 | 15 | 49 |
| 12 | 48 | 9.682825 | 10.317175 | 9.740169 | 10.259831 | 10.057344 | 9.942656 | 12 | 48 |
| 13 | 15 | 9.682882 | 10.317118 | 9.740244 | 10.259756 | 10.057361 | 9.942639 | 45 | 47 |
| 14 | 30 | 9.682940 | 10.317060 | 9.740318 | 10.259682 | 10.057379 | 9.942621 | 30 | 46 |
| 15 | 45 | 9.682997 | 10.317003 | 9.740393 | 10.259607 | 10.057396 | 9.942604 | 15 | 45 |
| 16 | 49 | 9.683055 | 10.316945 | 9.740468 | 10.259532 | 10.057413 | 9.942587 | 11 | 44 |
| 17 | 15 | 9.683112 | 10.316888 | 9.740543 | 10.259457 | 10.057431 | 9.942569 | 45 | 43 |
| 18 | 30 | 9.683170 | 10.316830 | 9.740618 | 10.259382 | 10.057448 | 9.942552 | 30 | 42 |
| 19 | 45 | 9.683227 | 10.316773 | 9.740692 | 10.259308 | 10.057466 | 9.942534 | 15 | 41 |
| 20 | 50 | 9.683284 | 10.316716 | 9.740767 | 10.259233 | 10.057483 | 9.942517 | 10 | 40 |
| 21 | 15 | 9.683342 | 10.316658 | 9.740842 | 10.259158 | 10.057500 | 9.942500 | 45 | 39 |
| 22 | 30 | 9.683399 | 10.316601 | 9.740917 | 10.259083 | 10.057518 | 9.942482 | 30 | 38 |
| 23 | 45 | 9.683456 | 10.316544 | 9.740991 | 10.259009 | 10.057535 | 9.942465 | 15 | 37 |
| 24 | 51 | 9.683514 | 10.316486 | 9.741066 | 10.258934 | 10.057552 | 9.942448 | 9 | 36 |
| 25 | 15 | 9.683571 | 10.316429 | 9.741141 | 10.258859 | 10.057570 | 9.942430 | 45 | 35 |
| 26 | 30 | 9.683628 | 10.316372 | 9.741216 | 10.258784 | 10.057587 | 9.942413 | 30 | 34 |
| 27 | 45 | 9.683686 | 10.316314 | 9.741290 | 10.258710 | 10.057605 | 9.942395 | 15 | 33 |
| 28 | 52 | 9.683743 | 10.316257 | 9.741365 | 10.258635 | 10.057622 | 9.942378 | 8 | 32 |
| 29 | 15 | 9.683800 | 10.316200 | 9.741440 | 10.258560 | 10.057640 | 9.942360 | 45 | 31 |
| 30 | 30 | 9.683857 | 10.316143 | 9.741514 | 10.258486 | 10.057657 | 9.942343 | 30 | 30 |
| 31 | 45 | 9.683915 | 10.316085 | 9.741589 | 10.258411 | 10.057674 | 9.942326 | 15 | 29 |
| 32 | 53 | 9.683972 | 10.316028 | 9.741664 | 10.258336 | 10.057692 | 9.942308 | 7 | 28 |
| 33 | 15 | 9.684029 | 10.315971 | 9.741738 | 10.258262 | 10.057709 | 9.942291 | 45 | 27 |
| 34 | 30 | 9.684086 | 10.315914 | 9.741813 | 10.258187 | 10.057727 | 9.942273 | 30 | 26 |
| 35 | 45 | 9.684144 | 10.315856 | 9.741888 | 10.258112 | 10.057744 | 9.942256 | 15 | 25 |
| 36 | 54 | 9.684201 | 10.315799 | 9.741962 | 10.258038 | 10.057761 | 9.942239 | 6 | 24 |
| 37 | 15 | 9.684258 | 10.315742 | 9.742037 | 10.257963 | 10.057779 | 9.942221 | 45 | 23 |
| 38 | 30 | 9.684315 | 10.315685 | 9.742112 | 10.257888 | 10.057796 | 9.942204 | 30 | 22 |
| 39 | 45 | 9.684373 | 10.315627 | 9.742186 | 10.257814 | 10.057814 | 9.942186 | 15 | 21 |
| 40 | 55 | 9.684430 | 10.315570 | 9.742261 | 10.257739 | 10.057831 | 9.942169 | 5 | 20 |
| 41 | 15 | 9.684487 | 10.315513 | 9.742336 | 10.257664 | 10.057849 | 9.942151 | 45 | 19 |
| 42 | 30 | 9.684544 | 10.315456 | 9.742410 | 10.257590 | 10.057866 | 9.942134 | 30 | 18 |
| 43 | 45 | 9.684601 | 10.315399 | 9.742485 | 10.257515 | 10.057884 | 9.942116 | 15 | 17 |
| 44 | 56 | 9.684658 | 10.315342 | 9.742559 | 10.257441 | 10.057901 | 9.942099 | 4 | 16 |
| 45 | 15 | 9.684715 | 10.315285 | 9.742634 | 10.257366 | 10.057919 | 9.942081 | 45 | 15 |
| 46 | 30 | 9.684773 | 10.315227 | 9.742708 | 10.257292 | 10.057936 | 9.942064 | 30 | 14 |
| 47 | 45 | 9.684830 | 10.315170 | 9.742783 | 10.257217 | 10.057953 | 9.942047 | 15 | 13 |
| 48 | 57 | 9.684887 | 10.315113 | 9.742858 | 10.257142 | 10.057971 | 9.942029 | 3 | 12 |
| 49 | 15 | 9.684944 | 10.315056 | 9.742932 | 10.257068 | 10.057988 | 9.942012 | 45 | 11 |
| 50 | 30 | 9.685001 | 10.314999 | 9.743007 | 10.256993 | 10.058006 | 9.941994 | 30 | 10 |
| 51 | 45 | 9.685058 | 10.314942 | 9.743081 | 10.256919 | 10.058023 | 9.941977 | 15 | 9 |
| 52 | 58 | 9.685115 | 10.314885 | 9.743156 | 10.256844 | 10.058041 | 9.941959 | 2 | 8 |
| 53 | 15 | 9.685172 | 10.314828 | 9.743230 | 10.256770 | 10.058058 | 9.941942 | 45 | 7 |
| 54 | 30 | 9.685229 | 10.314771 | 9.743305 | 10.256695 | 10.058076 | 9.941924 | 30 | 6 |
| 55 | 45 | 9.685286 | 10 314714 | 9.743379 | 10.256621 | 10.058093 | 9.941907 | 15 | 5 |
| 56 | 59 | 9.685343 | 10.314657 | 9.743454 | 10.256546 | 10.058111 | 9.941889 | 1 | 4 |
| 57 | 15 | 9.685400 | 10.314600 | 9.743528 | 10.256472 | 10.058128 | 9.941872 | 45 | 3 |
| 58 | 30 | 9.685457 | 10.314543 | 9.743603 | 10.256397 | 10.058146 | 9.941854 | 30 | 2 |
| 59 | 45 | 9.685514 | 10.314486 | 9.743677 | 10.256323 | 10.058163 | 9.941837 | 15 | 1 |
| 60 | 60 | 9.685571 | 10.314429 | 9.743752 | 10.256248 | 10.058181 | 9.941819 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 1h 56m. | | LOG. SINES, &c. (t.) | | | | | 29 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.685571 | 10.314429 | 9.743752 | 10.256248 | 10.058181 | 9.941819 | 60 | 60 |
| 1 | 15 | 9.685628 | 10.314372 | 9.743826 | 10.256174 | 10.058198 | 9.941802 | 45 | 59 |
| 2 | 30 | 9.685685 | 10.314315 | 9.743901 | 10.256099 | 10.058216 | 9.941784 | 30 | 58 |
| 3 | 45 | 9.685742 | 10.314258 | 9.743975 | 10.256025 | 10.058233 | 9.941767 | 15 | 57 |
| 4 | 1 | 9.685799 | 10.314201 | 9.744050 | 10.255950 | 10.058251 | 9.941749 | 59 | 56 |
| 5 | 15 | 9.685856 | 10.314144 | 9.744124 | 10.255876 | 10.058268 | 9.941732 | 45 | 55 |
| 6 | 30 | 9.685913 | 10.314087 | 9.744199 | 10.255801 | 10.058286 | 9.941714 | 30 | 54 |
| 7 | 45 | 9.685970 | 10.314030 | 9.744273 | 10.255727 | 10.058303 | 9.941697 | 15 | 53 |
| 8 | 2 | 9.686027 | 10.313973 | 9.744348 | 10.255652 | 10.058321 | 9.941679 | 58 | 52 |
| 9 | 15 | 9.686084 | 10.313916 | 9.744422 | 10.255578 | 10.058338 | 9.941662 | 45 | 51 |
| 10 | 30 | 9.686140 | 10.313860 | 9.744496 | 10.255504 | 10.058356 | 9.941644 | 30 | 50 |
| 11 | 45 | 9.686197 | 10.313803 | 9.744571 | 10.255429 | 10.058374 | 9.941626 | 15 | 49 |
| 12 | 3 | 9.686254 | 10.313746 | 9.744645 | 10.255355 | 10.058391 | 9.941609 | 57 | 48 |
| 13 | 15 | 9.686311 | 10.313689 | 9.744720 | 10.255280 | 10.058409 | 9.941591 | 45 | 47 |
| 14 | 30 | 9.686368 | 10.313632 | 9.744794 | 10.255206 | 10.058426 | 9.941574 | 30 | 46 |
| 15 | 45 | 9.686425 | 10.313575 | 9.744868 | 10.255132 | 10.058444 | 9.941556 | 15 | 45 |
| 16 | 4 | 9.686482 | 10.313518 | 9.744943 | 10.255057 | 10.058461 | 9.941539 | 56 | 44 |
| 17 | 15 | 9.686538 | 10.313462 | 9.745017 | 10.254983 | 10.058479 | 9.941521 | 45 | 43 |
| 18 | 30 | 9.686595 | 10.313405 | 9.745092 | 10.254908 | 10.058496 | 9.941504 | 30 | 42 |
| 19 | 45 | 9.686652 | 10.313348 | 9.745166 | 10.254834 | 10.058514 | 9.941486 | 15 | 41 |
| 20 | 5 | 9.686709 | 10.313291 | 9.745240 | 10.254760 | 10.058532 | 9.941468 | 55 | 40 |
| 21 | 15 | 9.686766 | 10.313234 | 9.745315 | 10.254685 | 10.058549 | 9.941451 | 45 | 39 |
| 22 | 30 | 9.686822 | 10.313178 | 9.745389 | 10.254611 | 10.058567 | 9.941433 | 30 | 38 |
| 23 | 45 | 9.686879 | 10.313121 | 9.745463 | 10.254537 | 10.058584 | 9.941416 | 15 | 37 |
| 24 | 6 | 9.686936 | 10.313064 | 9.745538 | 10.254462 | 10.058602 | 9.941398 | 54 | 36 |
| 25 | 15 | 9.686993 | 10.313007 | 9.745612 | 10.254388 | 10.058619 | 9.941381 | 45 | 35 |
| 26 | 30 | 9.687049 | 10.312951 | 9.745686 | 10.254314 | 10.058637 | 9.941363 | 30 | 34 |
| 27 | 45 | 9.687106 | 10.312894 | 9.745761 | 10.254239 | 10.058655 | 9.941345 | 15 | 33 |
| 28 | 7 | 9.687163 | 10.312837 | 9.745835 | 10.254165 | 10 058672 | 9.941328 | 53 | 32 |
| 29 | 15 | 9.687219 | 10.312781 | 9.745909 | 10.254091 | 10.058690 | 9.941310 | 45 | 31 |
| 30 | 30 | 9.687276 | 10.312724 | 9.745983 | 10.254017 | 10.058707 | 9.941293 | 30 | 30 |
| 31 | 45 | 9.687333 | 10.312667 | 9.746058 | 10.253942 | 10.058725 | 9.941275 | 15 | 29 |
| 32 | 8 | 9.687389 | 10.312611 | 9.746132 | 10.253868 | 10.058743 | 9.941257 | 52 | 28 |
| 33 | 15 | 9.687446 | 10.312554 | 9.746206 | 10.253794 | 10.058760 | 9.941240 | 45 | 27 |
| 34 | 30 | 9.687503 | 10.312497 | 9.746280 | 10.253720 | 10.058778 | 9.941222 | 30 | 26 |
| 35 | 45 | 9.687559 | 10.312441 | 9.746355 | 10.253645 | 10.058795 | 9.941205 | 15 | 25 |
| 36 | 9 | 9.687616 | 10.312384 | 9.746429 | 10.253571 | 10.058813 | 9.941187 | 51 | 24 |
| 37 | 15 | 9.687673 | 10.312327 | 9.746503 | 10.253497 | 10.058831 | 9.941169 | 45 | 23 |
| 38 | 30 | 9.687729 | 10.312271 | 9.746577 | 10.253423 | 10.058848 | 9.941152 | 30 | 22 |
| 39 | 45 | 9.687786 | 10.312214 | 9.746652 | 10.253348 | 10.058866 | 9.941134 | 15 | 21 |
| 40 | 10 | 9.687842 | 10.312158 | 9.746726 | 10.253274 | 10.058883 | 9.941117 | 50 | 20 |
| 41 | 15 | 9.687899 | 10.312101 | 9.746800 | 10.253200 | 10.058901 | 9.941099 | 45 | 19 |
| 42 | 30 | 9.687956 | 10.312044 | 9.746874 | 10.253126 | 10.058919 | 9.941081 | 30 | 18 |
| 43 | 45 | 9.688012 | 10.311988 | 9.746948 | 10.253052 | 10.058936 | 9.941064 | 15 | 17 |
| 44 | 11 | 9.688069 | 10.311931 | 9.747023 | 10.252977 | 10.058954 | 9.941046 | 49 | 16 |
| 45 | 15 | 9.688125 | 10.311875 | 9.747097 | 10.252903 | 10.058972 | 9.941028 | 45 | 15 |
| 46 | 30 | 9.688182 | 10.311818 | 9.747171 | 10.252829 | 10.058989 | 9.941011 | 30 | 14 |
| 47 | 45 | 9.688238 | 10.311762 | 9.747245 | 10.252755 | 10.059007 | 9.940993 | 15 | 13 |
| 48 | 12 | 9.688295 | 10.311705 | 9.747319 | 10.252681 | 10.059025 | 9.940975 | 48 | 12 |
| 49 | 15 | 9.688351 | 10.311649 | 9.747394 | 10.252606 | 10.059042 | 9.940958 | 45 | 11 |
| 50 | 30 | 9.688408 | 10.311592 | 9.747468 | 10.252532 | 10.059060 | 9.940940 | 30 | 10 |
| 51 | 45 | 9.688464 | 10.311536 | 9.747542 | 10.252458 | 10.059078 | 9.940922 | 15 | 9 |
| 52 | 13 | 9.688521 | 10.311479 | 9.747616 | 10.252384 | 10.059095 | 9.940905 | 47 | 8 |
| 53 | 15 | 9.688577 | 10.311423 | 9.747690 | 10.252310 | 10.059113 | 9.940887 | 45 | 7 |
| 54 | 30 | 9.688634 | 10.311366 | 9.747764 | 10.252236 | 10.059131 | 9.940869 | 30 | 6 |
| 55 | 45 | 9.688690 | 10.311310 | 9.747838 | 10.252162 | 10.059148 | 9.940852 | 15 | 5 |
| 56 | 14 | 9.688747 | 10.311253 | 9.747912 | 10.252088 | 10.059166 | 9.940834 | 46 | 4 |
| 57 | 15 | 9 688803 | 10.311197 | 9.747987 | 10.252013 | 10.059184 | 9.940816 | 45 | 3 |
| 58 | 30 | 9.688859 | 10.311141 | 9.748061 | 10.251939 | 10.059201 | 9.940799 | 30 | 2 |
| 59 | 45 | 9.688916 | 10.311084 | 9.748135 | 10.251865 | 10.059219 | 9.940781 | 15 | 1 |
| 60 | 15 | 9.688972 | 10.311028 | 9.748209 | 10.251791 | 10.059237 | 9.940763 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 3m. | | | LOG. SINES, &c. | | | | 60 deg. | | |

| 1h 57m. | | LOG. SINES, &c. (t.) | | | | | 29 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec |
| 0 | 15 | 9.688972 | 10.311028 | 9.748209 | 10.251791 | 10.059237 | 9.940763 | 45 | 60 |
| 1 | 15 | 9.689029 | 10.310971 | 9.748283 | 10.251717 | 10.059254 | 9.940746 | 45 | 59 |
| 2 | 30 | 9.689085 | 10.310915 | 9.748357 | 10.251643 | 10.059272 | 9.940728 | 30 | 58 |
| 3 | 45 | 9.689141 | 10.310859 | 9.748431 | 10.251569 | 10.059290 | 9.940710 | 15 | 57 |
| 4 | 16 | 9.689198 | 10.310802 | 9.748505 | 10.251495 | 10.059307 | 9.940693 | 44 | 56 |
| 5 | 15 | 9.689254 | 10.310746 | 9.748579 | 10.251421 | 10.059325 | 9.940675 | 45 | 55 |
| 6 | 30 | 9.689310 | 10.310690 | 9.748653 | 10.251347 | 10.059343 | 9.940657 | 30 | 54 |
| 7 | 45 | 9.689367 | 10.310633 | 9.748727 | 10.251273 | 10.059360 | 9.940640 | 15 | 53 |
| 8 | 17 | 9.689423 | 10.310577 | 9.748801 | 10.251199 | 10.059378 | 9.940622 | 43 | 52 |
| 9 | 15 | 9.689479 | 10.310521 | 9.748875 | 10.251125 | 10.059396 | 9.940604 | 45 | 51 |
| 10 | 30 | 9.689536 | 10.310464 | 9.748949 | 10.251051 | 10.059414 | 9.940586 | 30 | 50 |
| 11 | 45 | 9.689592 | 10.310408 | 9.749023 | 10.250977 | 10.059431 | 9.940569 | 15 | 49 |
| 12 | 18 | 9.689648 | 10.310352 | 9.749097 | 10.250903 | 10.059449 | 9.940551 | 42 | 48 |
| 13 | 15 | 9.689705 | 10.310295 | 9.749171 | 10.250829 | 10.059467 | 9.940533 | 45 | 47 |
| 14 | 30 | 9.689761 | 10.310239 | 9.749245 | 10.250755 | 10.059485 | 9.940515 | 30 | 46 |
| 15 | 45 | 9.689817 | 10.310183 | 9.749319 | 10.250681 | 10.059502 | 9.940498 | 15 | 45 |
| 16 | 19 | 9.689873 | 10.310127 | 9.749393 | 10.250607 | 10.059520 | 9.940480 | 41 | 44 |
| 17 | 15 | 9.689930 | 10.310070 | 9.749467 | 10.250533 | 10.059538 | 9.940462 | 45 | 43 |
| 18 | 30 | 9.689986 | 10.310014 | 9.749541 | 10.250459 | 10.059555 | 9.940445 | 30 | 42 |
| 19 | 45 | 9.690042 | 10.309958 | 9.749615 | 10.250385 | 10.059573 | 9.940427 | 15 | 41 |
| 20 | 20 | 9.690098 | 10.309902 | 9.749689 | 10.250311 | 10.059591 | 9.940409 | 40 | 40 |
| 21 | 15 | 9.690154 | 10.309846 | 9.749763 | 10.250237 | 10.059609 | 9.940391 | 45 | 39 |
| 22 | 30 | 9.690211 | 10.309789 | 9.749837 | 10.250163 | 10.059626 | 9.940374 | 30 | 38 |
| 23 | 45 | 9.690267 | 10.309733 | 9.749911 | 10.250089 | 10.059644 | 9.940356 | 15 | 37 |
| 24 | 21 | 9.690323 | 10.309677 | 9.749985 | 10.250015 | 10.059662 | 9.940338 | 39 | 36 |
| 25 | 15 | 9.690379 | 10.309621 | 9.750059 | 10.249941 | 10.059680 | 9.940320 | 45 | 35 |
| 26 | 30 | 9.690435 | 10.309565 | 9.750133 | 10.249867 | 10.059697 | 9.940303 | 30 | 34 |
| 27 | 45 | 9.690491 | 10.309509 | 9.750207 | 10.249793 | 10.059715 | 9.940285 | 15 | 33 |
| 28 | 22 | 9.690548 | 10.309452 | 9.750281 | 10.249719 | 10.059733 | 9.940267 | 38 | 32 |
| 29 | 15 | 9.690604 | 10.309396 | 9.750354 | 10.249646 | 10.059751 | 9.940249 | 45 | 31 |
| 30 | 30 | 9.690660 | 10.309340 | 9.750428 | 10.249572 | 10.059769 | 9.940231 | 30 | 30 |
| 31 | 45 | 9.690716 | 10.309284 | 9.750502 | 10.249498 | 10.059786 | 9.940214 | 15 | 29 |
| 32 | 23 | 9.690772 | 10.309228 | 9.750576 | 10.249424 | 10.059804 | 9.940196 | 37 | 28 |
| 33 | 15 | 9.690828 | 10.309172 | 9.750650 | 10.249350 | 10.059822 | 9.940178 | 45 | 27 |
| 34 | 30 | 9.690884 | 10.309116 | 9.750724 | 10.249276 | 10.059840 | 9.940160 | 30 | 26 |
| 35 | 45 | 9.690940 | 10.309060 | 9.750798 | 10.249202 | 10.059858 | 9.940142 | 15 | 25 |
| 36 | 24 | 9.690996 | 10.309004 | 9.750872 | 10.249128 | 10.059875 | 9.940125 | 36 | 24 |
| 37 | 15 | 9.691052 | 10.308948 | 9.750945 | 10.249055 | 10.059893 | 9.940107 | 45 | 23 |
| 38 | 30 | 9.691108 | 10.308892 | 9.751019 | 10.248981 | 10.059911 | 9.940089 | 30 | 22 |
| 39 | 45 | 9.691164 | 10.308836 | 9.751093 | 10.248907 | 10.059929 | 9.940071 | 15 | 21 |
| 40 | 25 | 9.691220 | 10.308780 | 9.751167 | 10.248833 | 10.059947 | 9.940053 | 35 | 20 |
| 41 | 15 | 9.691276 | 10.308724 | 9.751241 | 10.248759 | 10.059964 | 9.940036 | 45 | 19 |
| 42 | 30 | 9.691332 | 10.308668 | 9.751315 | 10.248685 | 10.059982 | 9.940018 | 30 | 18 |
| 43 | 45 | 9.691388 | 10.308612 | 9.751388 | 10.248612 | 10.060000 | 9.940000 | 15 | 17 |
| 44 | 26 | 9.691444 | 10.308556 | 9.751462 | 10.248538 | 10.060018 | 9.939982 | 34 | 16 |
| 45 | 15 | 9.691500 | 10.308500 | 9.751536 | 10.248464 | 10.060036 | 9.939964 | 45 | 15 |
| 46 | 30 | 9.691556 | 10.308444 | 9.751610 | 10.248390 | 10.060053 | 9.939947 | 30 | 14 |
| 47 | 45 | 9.691612 | 10.308388 | 9.751683 | 10.248317 | 10.060071 | 9.939929 | 15 | 13 |
| 48 | 27 | 9.691668 | 10.308332 | 9.751757 | 10.248243 | 10.060089 | 9.939911 | 33 | 12 |
| 49 | 15 | 9.691724 | 10.308276 | 9.751831 | 10.248169 | 10.060107 | 9.939893 | 45 | 11 |
| 50 | 30 | 9.691780 | 10.308220 | 9.751905 | 10.248095 | 10.060125 | 9.939875 | 30 | 10 |
| 51 | 45 | 9.691836 | 10.308164 | 9.751979 | 10.248021 | 10.060143 | 9.939857 | 15 | 9 |
| 52 | 28 | 9.691892 | 10.308108 | 9.752052 | 10.247948 | 10.060160 | 9.939840 | 32 | 8 |
| 53 | 15 | 9.691948 | 10.308052 | 9.752126 | 10.247874 | 10.060178 | 9.939822 | 45 | 7 |
| 54 | 30 | 9.692004 | 10.307996 | 9.752200 | 10.247800 | 10.060196 | 9.939804 | 30 | 6 |
| 55 | 45 | 9.692060 | 10.307940 | 9.752273 | 10.247727 | 10.060214 | 9.939786 | 15 | 5 |
| 56 | 29 | 9.692115 | 10.307885 | 9.752347 | 10.247653 | 10.060232 | 9.939768 | 31 | 4 |
| 57 | 15 | 9.692171 | 10.307829 | 9.752421 | 10.247579 | 10.060250 | 9.939750 | 45 | 3 |
| 58 | 30 | 9.692227 | 10.307773 | 9.752495 | 10.247505 | 10.060268 | 9.939732 | 30 | 2 |
| 59 | 45 | 9.692283 | 10.307717 | 9.752568 | 10.247432 | 10.060285 | 9.939715 | 15 | 1 |
| 60 | 30 | 9.692339 | 10.307661 | 9.752642 | 10.247358 | 10.060303 | 9.939697 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 2m. | | LOG. SINES, &c. | | | | | 60 deg | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 1h 58m. | | LOG. SINES, &c. (t.) | | | | 29 deg. | | |
| 0 | 30 | 9.692339 | 10.307661 | 9.752642 | 10.247358 | 10.060303 | 9.939697 | 30 | 60 |
| 1 | 15 | 9.692395 | 10.307605 | 9.752716 | 10.247284 | 10.060321 | 9.939679 | 45 | 59 |
| 2 | 30 | 9.692450 | 10.307550 | 9.752789 | 10.247211 | 10.060339 | 9.939661 | 30 | 58 |
| 3 | 45 | 9.692506 | 10.307494 | 9.752863 | 10.247137 | 10.060357 | 9.939643 | 15 | 57 |
| 4 | 31 | 9.692562 | 10.307438 | 9.752937 | 10.247063 | 10.060375 | 9.939625 | 29 | 56 |
| 5 | 15 | 9.692618 | 10.307382 | 9.753010 | 10.246990 | 10.060393 | 9.939607 | 45 | 55 |
| 6 | 30 | 9.692674 | 10.307326 | 9.753084 | 10.246916 | 10.060411 | 9.939589 | 30 | 54 |
| 7 | 45 | 9.692729 | 10.307271 | 9.753158 | 10.246842 | 10.060428 | 9.939572 | 15 | 53 |
| 8 | 32 | 9.692785 | 10.307215 | 9.753231 | 10.246769 | 10.060446 | 9.939554 | 28 | 52 |
| 9 | 15 | 9.692841 | 10.307159 | 9.753305 | 10.246695 | 10.060464 | 9.939536 | 45 | 51 |
| 10 | 30 | 9.692897 | 10.307103 | 9.753379 | 10.246621 | 10.060482 | 9.939518 | 30 | 50 |
| 11 | 45 | 9.692952 | 10.307048 | 9.753452 | 10.246548 | 10.060500 | 9.939500 | 15 | 49 |
| 12 | 33 | 9.693008 | 10.306992 | 9.753526 | 10.246474 | 10.060518 | 9.939482 | 27 | 48 |
| 13 | 15 | 9.693064 | 10.306936 | 9.753599 | 10.246401 | 10.060536 | 9.939464 | 45 | 47 |
| 14 | 30 | 9.693119 | 10.306881 | 9.753673 | 10.246327 | 10.060554 | 9.939446 | 30 | 46 |
| 15 | 45 | 9.693175 | 10.306825 | 9.753747 | 10.246253 | 10.060572 | 9.939428 | 15 | 45 |
| 16 | 34 | 9.693231 | 10.306769 | 9.753820 | 10.246180 | 10.060590 | 9.939410 | 26 | 44 |
| 17 | 15 | 9.693286 | 10.306714 | 9.753894 | 10.246106 | 10.060607 | 9.939393 | 45 | 43 |
| 18 | 30 | 9.693342 | 10.306658 | 9.753967 | 10.246033 | 10.060625 | 9.939375 | 30 | 42 |
| 19 | 45 | 9.693398 | 10.306602 | 9.754041 | 10.245959 | 10.060643 | 9.939357 | 15 | 41 |
| 20 | 35 | 9.693453 | 10.306547 | 9.754115 | 10.245885 | 10.060661 | 9.939339 | 25 | 40 |
| 21 | 15 | 9.693509 | 10.306491 | 9.754188 | 10.245812 | 10.060679 | 9.939321 | 45 | 39 |
| 22 | 30 | 9.693565 | 10.306435 | 9.754262 | 10.245738 | 10.060697 | 9.939303 | 30 | 38 |
| 23 | 45 | 9.693620 | 10.306380 | 9.754335 | 10.245665 | 10.060715 | 9.939285 | 15 | 37 |
| 24 | 36 | 9.693676 | 10.306324 | 9.754409 | 10.245591 | 10.060733 | 9.939267 | 24 | 36 |
| 25 | 15 | 9.693731 | 10.306269 | 9.754482 | 10.245518 | 10.060751 | 9.939249 | 45 | 35 |
| 26 | 30 | 9.693787 | 10.306213 | 9.754556 | 10.245444 | 10.060769 | 9.939231 | 30 | 34 |
| 27 | 45 | 9.693843 | 10.306157 | 9.754629 | 10.245371 | 10.060787 | 9.939213 | 15 | 33 |
| 28 | 37 | 9.693898 | 10.306102 | 9.754703 | 10.245297 | 10.060805 | 9.939195 | 23 | 32 |
| 29 | 15 | 9.693954 | 10.306046 | 9.754776 | 10.245224 | 10.060823 | 9.939177 | 45 | 31 |
| 30 | 30 | 9.694009 | 10.305991 | 9.754850 | 10.245150 | 10.060841 | 9.939159 | 30 | 30 |
| 31 | 45 | 9.694065 | 10.305935 | 9.754923 | 10.245077 | 10.060859 | 9.939141 | 15 | 29 |
| 32 | 38 | 9.694120 | 10.305880 | 9.754997 | 10.245003 | 10.060877 | 9.939123 | 22 | 28 |
| 33 | 15 | 9.694176 | 10.305824 | 9.755070 | 10.244930 | 10.060895 | 9.939105 | 45 | 27 |
| 34 | 30 | 9.694231 | 10.305769 | 9.755144 | 10.244856 | 10.060913 | 9.939087 | 30 | 26 |
| 35 | 45 | 9.694287 | 10.305713 | 9.755217 | 10.244783 | 10.060931 | 9.939069 | 15 | 25 |
| 36 | 39 | 9.694342 | 10.305658 | 9.755291 | 10.244709 | 10.060949 | 9.939051 | 21 | 24 |
| 37 | 15 | 9.694398 | 10.305602 | 9.755364 | 10.244636 | 10.060966 | 9.939034 | 45 | 23 |
| 38 | 30 | 9.694453 | 10.305547 | 9.755438 | 10.244562 | 10.060984 | 9.939016 | 30 | 22 |
| 39 | 45 | 9.694509 | 10.305491 | 9.755511 | 10.244489 | 10.061002 | 9.938998 | 15 | 21 |
| 40 | 40 | 9.694564 | 10.305436 | 9.755585 | 10.244415 | 10.061020 | 9.938980 | 20 | 20 |
| 41 | 15 | 9.694620 | 10.305380 | 9.755658 | 10.244342 | 10.061038 | 9.938962 | 45 | 19 |
| 42 | 30 | 9.694675 | 10.305325 | 9.755731 | 10.244269 | 10.061056 | 9.938944 | 30 | 18 |
| 43 | 45 | 9.694730 | 10.305270 | 9.755805 | 10.244195 | 10.061074 | 9.938926 | 15 | 17 |
| 44 | 41 | 9.694786 | 10.305214 | 9.755878 | 10.244122 | 10.061092 | 9.938908 | 19 | 16 |
| 45 | 15 | 9.694841 | 10.305159 | 9.755952 | 10.244048 | 10.061110 | 9.938890 | 45 | 15 |
| 46 | 30 | 9.694897 | 10.305103 | 9.756025 | 10.243975 | 10.061128 | 9.938872 | 30 | 14 |
| 47 | 45 | 9.694952 | 10.305048 | 9.756098 | 10.243902 | 10.061146 | 9.938854 | 15 | 13 |
| 48 | 42 | 9.695007 | 10.304993 | 9.756172 | 10.243828 | 10.061164 | 9.938836 | 18 | 12 |
| 49 | 15 | 9.695063 | 10.304937 | 9.756245 | 10.243755 | 10.061182 | 9.938818 | 45 | 11 |
| 50 | 30 | 9.695118 | 10.304882 | 9.756319 | 10.243681 | 10.061201 | 9.938799 | 30 | 10 |
| 51 | 45 | 9.695173 | 10.304827 | 9.756392 | 10.243608 | 10.061219 | 9.938781 | 15 | 9 |
| 52 | 43 | 9.695229 | 10.304771 | 9.756465 | 10.243535 | 10.061237 | 9.938763 | 17 | 8 |
| 53 | 15 | 9.695284 | 10.304716 | 9.756539 | 10.243461 | 10.061255 | 9.938745 | 45 | 7 |
| 54 | 30 | 9.695339 | 10.304661 | 9.756612 | 10.243388 | 10.061273 | 9.938727 | 30 | 6 |
| 55 | 45 | 9.695395 | 10.304605 | 9.756685 | 10.243315 | 10.061291 | 9.938709 | 15 | 5 |
| 56 | 44 | 9.695450 | 10.304550 | 9.756759 | 10.243241 | 10.061309 | 9.938691 | 16 | 4 |
| 57 | 15 | 9.695505 | 10.304495 | 9.756832 | 10.243168 | 10.061327 | 9.938673 | 45 | 3 |
| 58 | 30 | 9.695561 | 10.304439 | 9.756905 | 10.243095 | 10.061345 | 9.938655 | 30 | 2 |
| 59 | 45 | 9.695616 | 10.304384 | 9.756979 | 10.243021 | 10.061363 | 9.938637 | 15 | 1 |
| 60 | 45 | 9.695671 | 10.304329 | 9.757052 | 10.242948 | 10.061381 | 9.938619 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 4h 1m. | | LOG. SINES, &c. | | | | 60 deg. | | |

| 1h 59m. | | LOG. SINES, &c. (t.) | | | | | | 29 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.695671 | 10.304329 | 9.757052 | 10.242948 | 10.061381 | 9.938619 | 15 | 60 |
| 1 | 15 | 9.695726 | 10.304274 | 9.757125 | 10.242875 | 10.061399 | 9.938601 | 45 | 59 |
| 2 | 30 | 9.695782 | 10.304218 | 9 757199 | 10.242801 | 10.061417 | 9.938583 | 30 | 58 |
| 3 | 45 | 9.695837 | 10.304163 | 9.757272 | 10.242728 | 10.061435 | 9.938565 | 15 | 57 |
| 4 | 46 | 9.695892 | 10.304108 | 9.757345 | 10 242655 | 10.061453 | 9 938547 | 14 | 56 |
| 5 | 15 | 9.695947 | 10.304053 | 9.757418 | 10.242582 | 10.061471 | 9.938529 | 45 | 55 |
| 6 | 30 | 9.696003 | 10.303997 | 9.757492 | 10.242508 | 10.061489 | 9.938511 | 30 | 54 |
| 7 | 45 | 9.696058 | 10.303942 | 9.757565 | 10.242435 | 10.061507 | 9.938493 | 15 | 53 |
| 8 | 47 | 9.696113 | 10.303887 | 9.757638 | 10.242362 | 10.061525 | 9.938475 | 13 | 52 |
| 9 | 15 | 9.696168 | 10.303832 | 9.757711 | 10.242289 | 10.061543 | 9.938457 | 45 | 51 |
| 10 | 30 | 9.696223 | 10.303777 | 9 757785 | 10.242215 | 10.061562 | 9.938438 | 30 | 50 |
| 11 | 45 | 9 696278 | 10.303722 | 9.757858 | 10.242142 | 10.061580 | 9.938420 | 15 | 49 |
| 12 | 48 | 9.696334 | 10.303666 | 9.757931 | 10.242069 | 10.061598 | 9.938402 | 12 | 48 |
| 13 | 15 | 9.696389 | 10.303611 | 9 758004 | 10.241996 | 10.061616 | 9.938384 | 45 | 47 |
| 14 | 30 | 9.696444 | 10.303556 | 9.758078 | 10.241922 | 10 061634 | 9.938366 | 30 | 46 |
| 15 | 45 | 9.696499 | 10.303501 | 9.758151 | 10.241849 | 10.061652 | 9.938348 | 15 | 45 |
| 16 | 49 | 9.696554 | 10.303446 | 9.758224 | 10.241776 | 10.061670 | 9.938330 | 11 | 44 |
| 17 | 15 | 9.696609 | 10.303391 | 9.758297 | 10.241703 | 10.061688 | 9.938312 | 45 | 43 |
| 18 | 30 | 9.696664 | 10.303336 | 9.758371 | 10.241629 | 10.061706 | 9.938294 | 30 | 42 |
| 19 | 45 | 9.696719 | 10.303281 | 9.758444 | 10.241556 | 10.061724 | 9.938276 | 15 | 41 |
| 20 | 50 | 9.696774 | 10.303226 | 9.758517 | 10.241483 | 10.061742 | 9.938258 | 10 | 40 |
| 21 | 15 | 9.696830 | 10.303170 | 9.758590 | 10.241410 | 10.061761 | 9.938239 | 45 | 39 |
| 22 | 30 | 9.696885 | 10.303115 | 9.758663 | 10.241337 | 10.061779 | 9.938221 | 30 | 38 |
| 23 | 45 | 9.696940 | 10.303060 | 9.758736 | 10.241264 | 10.061797 | 9.938203 | 15 | 37 |
| 24 | 51 | 9.696995 | 10.303005 | 9.758810 | 10.241190 | 10.061815 | 9.938185 | 9 | 36 |
| 25 | 15 | 9.697050 | 10.302950 | 9.758883 | 10.241117 | 10.061833 | 9.938167 | 45 | 35 |
| 26 | 30 | 9.697105 | 10.302895 | 9 758956 | 10.241044 | 10.061851 | 9.938149 | 30 | 34 |
| 27 | 45 | 9 697160 | 10.302840 | 9.759029 | 10.240971 | 10.061869 | 9.938131 | 15 | 33 |
| 28 | 52 | 9.697215 | 10.302785 | 9.759102 | 10.240898 | 10.061887 | 9.938113 | 8 | 32 |
| 29 | 15 | 9.697270 | 10.302730 | 9.759175 | 10.240825 | 10.061906 | 9.938094 | 45 | 31 |
| 30 | 30 | 9.697325 | 10.302675 | 9.759248 | 10.240752 | 10.061924 | 9.938076 | 30 | 30 |
| 31 | 45 | 9.697380 | 10.302620 | 9.759322 | 10.240678 | 10.061942 | 9.938058 | 15 | 29 |
| 32 | 53 | 9.697435 | 10.302565 | 9.759395 | 10.240605 | 10.061960 | 9.938040 | 7 | 28 |
| 33 | 15 | 9.697490 | 10.302510 | 9.759468 | 10.240532 | 10.061978 | 9.938022 | 45 | 27 |
| 34 | 30 | 9.697545 | 10.302455 | 9.759541 | 10.240459 | 10.061996 | 9.938004 | 30 | 26 |
| 35 | 45 | 9.697600 | 10.302400 | 9.759614 | 10.240386 | 10.062015 | 9.937985 | 15 | 25 |
| 36 | 54 | 9.697654 | 10.302346 | 9.759687 | 10.240313 | 10.062033 | 9.937967 | 6 | 24 |
| 37 | 15 | 9.697709 | 10.302291 | 9.759760 | 10.240240 | 10.062051 | 9.937949 | 45 | 23 |
| 38 | 30 | 9.697764 | 10.302236 | 9.759833 | 10.240167 | 10.062069 | 9.937931 | 30 | 22 |
| 39 | 45 | 9.697819 | 10.302181 | 9.759906 | 10.240094 | 10.062087 | 9.937913 | 15 | 21 |
| 40 | 55 | 9.697874 | 10.302126 | 9.759979 | 10.240021 | 10.062105 | 9.937895 | 5 | 20 |
| 41 | 15 | 9.697929 | 10.302071 | 9.760052 | 10.239948 | 10.062124 | 9.937876 | 45 | 19 |
| 42 | 30 | 9.697984 | 10.302016 | 9.760125 | 10.239875 | 10.062142 | 9.937858 | 30 | 18 |
| 43 | 45 | 9.698039 | 10.301961 | 9.760199 | 10.239801 | 10.062160 | 9.937840 | 15 | 17 |
| 44 | 56 | 9.698094 | 10.301906 | 9.760272 | 10.239728 | 10.062178 | 9.937822 | 4 | 16 |
| 45 | 15 | 9.698148 | 10.301852 | 9.760345 | 10.239655 | 10.062196 | 9.937804 | 45 | 15 |
| 46 | 30 | 9.698203 | 10.301797 | 9.760418 | 10.239582 | 10.062214 | 9.937786 | 30 | 14 |
| 47 | 45 | 9.698258 | 10.301742 | 9.760491 | 10.239509 | 10.062233 | 9.937767 | 15 | 13 |
| 48 | 57 | 9.698313 | 10.301687 | 9.760564 | 10.239436 | 10.062251 | 9.937749 | 3 | 12 |
| 49 | 15 | 9.698368 | 10.301632 | 9.760637 | 10.239363 | 10.062269 | 9.937731 | 45 | 11 |
| 50 | 30 | 9.698422 | 10.301578 | 9.760710 | 10.239290 | 10.062287 | 9.937713 | 30 | 10 |
| 51 | 45 | 9.698477 | 10.301523 | 9.760783 | 10.239217 | 10.062305 | 9.937695 | 15 | 9 |
| 52 | 58 | 9.698532 | 10.301468 | 9.760856 | 10.239144 | 10.062324 | 9.937676 | 2 | 8 |
| 53 | 15 | 9.698587 | 10.301413 | 9.760929 | 10.239071 | 10.062342 | 9.937658 | 45 | 7 |
| 54 | 30 | 9.698642 | 10.301358 | 9.761002 | 10.238998 | 10.062360 | 9.937640 | 30 | 6 |
| 55 | 45 | 9.698696 | 10.301304 | 9.761075 | 10.238925 | 10.062378 | 9.937622 | 15 | 5 |
| 56 | 59 | 9.698751 | 10.301249 | 9.761148 | 10.238852 | 10.062397 | 9.937603 | 1 | 4 |
| 57 | 15 | 9.698806 | 10.301194 | 9.761220 | 10.238780 | 10.062415 | 9.937585 | 45 | 3 |
| 58 | 30 | 9 698861 | 10.301139 | 9.761293 | 10.238707 | 10.062433 | 9.937567 | 30 | 2 |
| 59 | 45 | 9 698915 | 10.301085 | 9.761366 | 10.238634 | 10.062451 | 9.937549 | 15 | 1 |
| 60 | 60 | 9.698970 | 10.301030 | 9.761439 | 10.238561 | 10.062469 | 9.937531 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 4h 0m. | | | | LOG. SINES, &c. | | | | 60 deg. | |

| 2h 0m. | | | LOG. SINES, &c. (t.) | | | | 30 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.698970 | 10.301030 | 9.761439 | 10.238561 | 10.062469 | 9.937531 | 60 | 60 |
| 1 | 15 | 9.699025 | 10.300975 | 9.761512 | 10.238488 | 10.062488 | 9.937512 | 45 | 59 |
| 2 | 30 | 9.699079 | 10.300921 | 9.761585 | 10.238415 | 10.062506 | 9.937494 | 30 | 58 |
| 3 | 45 | 9.699134 | 10.300866 | 9.761658 | 10.238342 | 10.062524 | 9.937476 | 15 | 57 |
| 4 | 1 | 9.699189 | 10.300811 | 9.761731 | 10.238269 | 10.062542 | 9.937458 | 59 | 56 |
| 5 | 15 | 9.699243 | 10.300757 | 9.761804 | 10.238196 | 10.062561 | 9.937439 | 45 | 55 |
| 6 | 30 | 9.699298 | 10.300702 | 9.761877 | 10.238123 | 10.062579 | 9.937421 | 30 | 54 |
| 7 | 45 | 9.699353 | 10.300647 | 9.761950 | 10.238050 | 10.062597 | 9.937403 | 15 | 53 |
| 8 | 2 | 9.699407 | 10.300593 | 9.762023 | 10.237977 | 10.062615 | 9.937385 | 58 | 52 |
| 9 | 15 | 9.699462 | 10.300538 | 9.762096 | 10.237904 | 10.062634 | 9.937366 | 45 | 51 |
| 10 | 30 | 9.699517 | 10.300483 | 9.762168 | 10.237832 | 10.062652 | 9.937348 | 30 | 50 |
| 11 | 45 | 9.699571 | 10.300429 | 9.762241 | 10.237759 | 10.062670 | 9.937330 | 15 | 49 |
| 12 | 3 | 9.699626 | 10.300374 | 9.762314 | 10.237686 | 10.062688 | 9.937312 | 57 | 48 |
| 13 | 15 | 9.699680 | 10.300320 | 9.762387 | 10.237613 | 10.062707 | 9.937293 | 45 | 47 |
| 14 | 30 | 9.699735 | 10.300265 | 9.762460 | 10.237540 | 10.062725 | 9.937275 | 30 | 46 |
| 15 | 45 | 9.699789 | 10.300211 | 9.762533 | 10.237467 | 10.062743 | 9.937257 | 15 | 45 |
| 16 | 4 | 9.699844 | 10.300156 | 9.762606 | 10.237394 | 10.062762 | 9.937238 | 56 | 44 |
| 17 | 15 | 9.699899 | 10.300101 | 9.762678 | 10.237322 | 10.062780 | 9.937220 | 45 | 43 |
| 18 | 30 | 9.699953 | 10.300047 | 9.762751 | 10.237249 | 10.062798 | 9.937202 | 30 | 42 |
| 19 | 45 | 9.700008 | 10 299992 | 9.762824 | 10.237176 | 10.062816 | 9.937184 | 15 | 41 |
| 20 | 5 | 9.700062 | 10.299938 | 9.762897 | 10.237103 | 10.062835 | 9.937165 | 55 | 40 |
| 21 | 15 | 9.700117 | 10.299883 | 9.762970 | 10.237030 | 10.062853 | 9.937147 | 45 | 39 |
| 22 | 30 | 9.700171 | 10.299829 | 9.763042 | 10.236958 | 10.062871 | 9.937129 | 30 | 38 |
| 23 | 45 | 9.700226 | 10.299774 | 9.763115 | 10.236885 | 10.062890 | 9.937110 | 15 | 37 |
| 24 | 6 | 9.700280 | 10.299720 | 9.763188 | 10.236812 | 10.062908 | 9.937092 | 54 | 36 |
| 25 | 15 | 9.700335 | 10.299665 | 9.763261 | 10 236739 | 10.062926 | 9.937074 | 45 | 35 |
| 26 | 30 | 9.700389 | 10.299611 | 9.763334 | 10.236666 | 10.062945 | 9.937055 | 30 | 34 |
| 27 | 45 | 9.700444 | 10.299556 | 9.763406 | 10.236594 | 10.062963 | 9.937037 | 15 | 33 |
| 28 | 7 | 9.700498 | 10.299502 | 9.763479 | 10.236521 | 10.062981 | 9.937019 | 53 | 32 |
| 29 | 15 | 9.700552 | 10.299448 | 9.763552 | 10.236448 | 10.063000 | 9.937000 | 45 | 31 |
| 30 | 30 | 9.700607 | 10.299393 | 9.763625 | 10.236375 | 10.063018 | 9.936982 | 30 | 30 |
| 31 | 45 | 9.700661 | 10 299339 | 9.763697 | 10.236303 | 10.063036 | 9.936964 | 15 | 29 |
| 32 | 8 | 9.700716 | 10.299284 | 9.763770 | 10.236230 | 10.063054 | 9.936946 | 52 | 28 |
| 33 | 15 | 9.700770 | 10.299230 | 9.763843 | 10.236157 | 10.063073 | 9.936927 | 45 | 27 |
| 34 | 30 | 9.700825 | 10.299175 | 9.763916 | 10.236084 | 10.063091 | 9.936909 | 30 | 26 |
| 35 | 45 | 9.700879 | 10.299121 | 9.763988 | 10.236012 | 10.063109 | 9.936891 | 15 | 25 |
| 36 | 9 | 9.700933 | 10.299067 | 9.764061 | 10.235939 | 10.063128 | 9.936872 | 51 | 24 |
| 37 | 15 | 9.700988 | 10.299012 | 9.764134 | 10.235866 | 10.063146 | 9.936854 | 45 | 23 |
| 38 | 30 | 9.701042 | 10.298958 | 9.764207 | 10.235793 | 10.063165 | 9.936835 | 30 | 22 |
| 39 | 45 | 9.701096 | 10.298904 | 9.764279 | 10.235721 | 10.063183 | 9.936817 | 15 | 21 |
| 40 | 10 | 9.701151 | 10.298849 | 9.764352 | 10.235648 | 10.063201 | 9.936799 | 50 | 20 |
| 41 | 15 | 9.701205 | 10.298795 | 9.764425 | 10.235575 | 10.063220 | 9.936780 | 45 | 19 |
| 42 | 30 | 9.701259 | 10.298741 | 9.764497 | 10.235503 | 10.063238 | 9.936762 | 30 | 18 |
| 43 | 45 | 9.701314 | 10.298686 | 9.764570 | 10.235480 | 10.063256 | 9.936744 | 15 | 17 |
| 44 | 11 | 9.701368 | 10.298632 | 9.764643 | 10.235357 | 10.063275 | 9.936725 | 49 | 16 |
| 45 | 15 | 9.701422 | 10.298578 | 9.764715 | 10.235285 | 10.063293 | 9.936707 | 45 | 15 |
| 46 | 30 | 9.701477 | 10.298523 | 9.764788 | 10.235212 | 10.063311 | 9.936689 | 30 | 14 |
| 47 | 45 | 9.701531 | 10.298469 | 9.764861 | 10.235139 | 10.063330 | 9.936670 | 15 | 13 |
| 48 | 12 | 9.701585 | 10.298415 | 9.764933 | 10.235067 | 10.063348 | 9.936652 | 48 | 12 |
| 49 | 15 | 9.701639 | 10.298361 | 9.765006 | 10.234994 | 10.063367 | 9.936633 | 45 | 11 |
| 50 | 30 | 9.701694 | 10.298306 | 9.765079 | 10.234921 | 10.063385 | 9.936615 | 30 | 10 |
| 51 | 45 | 9.701748 | 10.298252 | 9.765151 | 10.234849 | 10.063403 | 9.936597 | 15 | 9 |
| 52 | 13 | 9.701802 | 10.298198 | 9.765224 | 10.234776 | 10.063422 | 9.936578 | 47 | 8 |
| 53 | 15 | 9.701856 | 10.298144 | 9.765296 | 10.234704 | 10.063440 | 9.936560 | 45 | 7 |
| 54 | 30 | 9.701911 | 10.298089 | 9.765369 | 10.234631 | 10.063459 | 9.936541 | 30 | 6 |
| 55 | 45 | 9.701965 | 10.298035 | 9.765442 | 10.234558 | 10.063477 | 9.936523 | 15 | 5 |
| 56 | 14 | 9.702019 | 10.297981 | 9.765514 | 10.234486 | 10.063495 | 9.936505 | 46 | 4 |
| 57 | 15 | 9.702073 | 10.297927 | 9.765587 | 10.234413 | 10.063514 | 9.936486 | 45 | 3 |
| 58 | 30 | 9.702127 | 10.297873 | 9.765659 | 10.234341 | 10.063532 | 9.936468 | 30 | 2 |
| 59 | 45 | 9.702182 | 10.297818 | 9.765732 | 10.234268 | 10.063551 | 9.936449 | 15 | 1 |
| 60 | 15 | 9.702236 | 10.297764 | 9.765805 | 10.234195 | 10.063569 | 9.936431 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 2h 1m. | | LOG. SINES, &c. (t.) | | | | | 30 deg. | |
| 0 | 15 | 9.702236 | 10.297764 | 9.765805 | 10.234195 | 10.063569 | 9.936431 | 45 | 60 |
| 1 | 15 | 9.702290 | 10.297710 | 9.765877 | 10.234123 | 10.063587 | 9.936413 | 45 | 59 |
| 2 | 30 | 9.702344 | 10.297656 | 9.765950 | 10.234050 | 10.063606 | 9.936394 | 30 | 58 |
| 3 | 45 | 9.702398 | 10.297602 | 9.766022 | 10.233978 | 10.063624 | 9.936376 | 15 | 57 |
| 4 | 16 | 9.702452 | 10.297548 | 9.766095 | 10.233905 | 10.063643 | 9.936357 | 44 | 56 |
| 5 | 15 | 9.702506 | 10.297494 | 9.766167 | 10.233833 | 10.063661 | 9.936339 | 45 | 55 |
| 6 | 30 | 9.702560 | 10.297440 | 9.766240 | 10.233760 | 10.063680 | 9.936320 | 30 | 54 |
| 7 | 45 | 9.702615 | 10.297385 | 9.766313 | 10.233687 | 10.063698 | 9.936302 | 15 | 53 |
| 8 | 17 | 9.702669 | 10.297331 | 9.766385 | 10.233615 | 10.063716 | 9.936284 | 43 | 52 |
| 9 | 15 | 9.702723 | 10.297277 | 9.766458 | 10.233542 | 10.063735 | 9.936265 | 45 | 51 |
| 10 | 30 | 9.702777 | 10.297223 | 9.766530 | 10.233470 | 10.063753 | 9.936247 | 30 | 50 |
| 11 | 45 | 9.702831 | 10.297169 | 9.766603 | 10.233397 | 10.063772 | 9.936228 | 15 | 49 |
| 12 | 18 | 9.702885 | 10.297115 | 9.766675 | 10.233325 | 10.063790 | 9.936210 | 42 | 48 |
| 13 | 15 | 9.702939 | 10.297061 | 9.766748 | 10.233252 | 10.063809 | 9.936191 | 45 | 47 |
| 14 | 30 | 9.702993 | 10.297007 | 9.766820 | 10.233180 | 10.063827 | 9.936173 | 30 | 46 |
| 15 | 45 | 9.703047 | 10.296953 | 9.766893 | 10.233107 | 10.063846 | 9.936154 | 15 | 45 |
| 16 | 19 | 9.703101 | 10.296899 | 9.766965 | 10.233035 | 10.063864 | 9.936136 | 41 | 44 |
| 17 | 15 | 9.703155 | 10.296845 | 9.767038 | 10.232962 | 10.063883 | 9.936117 | 45 | 43 |
| 18 | 30 | 9.703209 | 10.296791 | 9.767110 | 10.232890 | 10.063901 | 9.936099 | 30 | 42 |
| 19 | 45 | 9.703263 | 10.296737 | 9.767182 | 10.232818 | 10.063920 | 9.936080 | 15 | 41 |
| 20 | 20 | 9.703317 | 10.296683 | 9.767255 | 10.232745 | 10.063938 | 9.936062 | 40 | 40 |
| 21 | 15 | 9.703371 | 10.296629 | 9.767327 | 10.232673 | 10.063956 | 9.936044 | 45 | 39 |
| 22 | 30 | 9.703425 | 10.296575 | 9.767400 | 10.232600 | 10.063975 | 9.936025 | 30 | 38 |
| 23 | 45 | 9.703479 | 10.296521 | 9.767472 | 10.232528 | 10.063993 | 9.936007 | 15 | 37 |
| 24 | 21 | 9.703533 | 10.296467 | 9.767545 | 10.232455 | 10.064012 | 9.935988 | 39 | 36 |
| 25 | 15 | 9.703587 | 10.296413 | 9.767617 | 10.232383 | 10.064030 | 9.935970 | 45 | 35 |
| 26 | 30 | 9.703641 | 10.296359 | 9.767690 | 10.232310 | 10.064049 | 9.935951 | 30 | 34 |
| 27 | 45 | 9.703695 | 10.296305 | 9.767762 | 10.232238 | 10.064067 | 9.935933 | 15 | 33 |
| 28 | 22 | 9.703749 | 10.296251 | 9.767834 | 10.232166 | 10.064086 | 9.935914 | 38 | 32 |
| 29 | 15 | 9.703802 | 10.296198 | 9.767907 | 10.232093 | 10.064104 | 9.935896 | 45 | 31 |
| 30 | 30 | 9.703856 | 10.296144 | 9.767979 | 10.232021 | 10.064123 | 9.935877 | 30 | 30 |
| 31 | 45 | 9.703910 | 10.296090 | 9.768052 | 10.231948 | 10.064141 | 9.935859 | 15 | 29 |
| 32 | 23 | 9.703964 | 10.296036 | 9.768124 | 10.231876 | 10.064160 | 9.935840 | 37 | 28 |
| 33 | 15 | 9.704018 | 10.295982 | 9.768196 | 10.231804 | 10.064178 | 9.935822 | 45 | 27 |
| 34 | 30 | 9.704072 | 10.295928 | 9.768269 | 10.231731 | 10.064197 | 9.935803 | 30 | 26 |
| 35 | 45 | 9.704126 | 10.295874 | 9.768341 | 10.231659 | 10.064216 | 9.935784 | 15 | 25 |
| 36 | 24 | 9.704179 | 10.295821 | 9.768413 | 10.231587 | 10.064234 | 9.935766 | 36 | 24 |
| 37 | 15 | 9.704233 | 10.295767 | 9.768486 | 10.231514 | 10.064253 | 9.935747 | 45 | 23 |
| 38 | 30 | 9.704287 | 10.295713 | 9.768558 | 10.231442 | 10.064271 | 9.935729 | 30 | 22 |
| 39 | 45 | 9.704341 | 10.295659 | 9.768631 | 10.231369 | 10.064290 | 9.935710 | 15 | 21 |
| 40 | 25 | 9.704395 | 10.295605 | 9.768703 | 10.231297 | 10.064308 | 9.935692 | 35 | 20 |
| 41 | 15 | 9.704448 | 10.295552 | 9.768775 | 10.231225 | 10.064327 | 9.935673 | 45 | 19 |
| 42 | 30 | 9.704502 | 10.295498 | 9.768848 | 10.231152 | 10.064345 | 9.935655 | 30 | 18 |
| 43 | 45 | 9.704556 | 10.295444 | 9.768920 | 10.231080 | 10.064364 | 9.935636 | 15 | 17 |
| 44 | 26 | 9.704610 | 10 295390 | 9.768992 | 10.231008 | 10.064382 | 9.935618 | 34 | 16 |
| 45 | 15 | 9.704664 | 10.295336 | 9.769064 | 10.230936 | 10.064401 | 9.935599 | 45 | 15 |
| 46 | 30 | 9.704717 | 10.295283 | 9.769137 | 10.230863 | 10.064420 | 9.935580 | 30 | 14 |
| 47 | 45 | 9.704771 | 10.295229 | 9.769209 | 10.230791 | 10.064438 | 9.935562 | 15 | 13 |
| 48 | 27 | 9.704825 | 10.295175 | 9.769281 | 10.230719 | 10.064457 | 9.935543 | 33 | 12 |
| 49 | 15 | 9.704878 | 10.295122 | 9.769354 | 10.230646 | 10.064475 | 9.935525 | 45 | 11 |
| 50 | 30 | 9.704932 | 10.295068 | 9.769426 | 10.230574 | 10.064494 | 9.935506 | 30 | 10 |
| 51 | 45 | 9.704986 | 10.295014 | 9.769498 | 10.230502 | 10.064512 | 9.935488 | 15 | 9 |
| 52 | 28 | 9.705040 | 10.294960 | 9.769570 | 10.230430 | 10.064531 | 9.935469 | 32 | 8 |
| 53 | 15 | 9.705093 | 10.294907 | 9.769643 | 10.230357 | 10.064550 | 9.935450 | 45 | 7 |
| 54 | 30 | 9.705147 | 10.294853 | 9.769715 | 10.230285 | 10.064568 | 9.935432 | 30 | 6 |
| 55 | 45 | 9.705201 | 10.294799 | 9.769787 | 10 230213 | 10.064587 | 9 935413 | 15 | 5 |
| 56 | 29 | 9.705254 | 10.294746 | 9.769860 | 10.230140 | 10.064605 | 9.935395 | 31 | 4 |
| 57 | 15 | 9.705308 | 10.294692 | 9.769932 | 10.230068 | 10.064624 | 9.935376 | 45 | 3 |
| 58 | 30 | 9.705362 | 10.294638 | 9.770004 | 10.229996 | 10.064642 | 9.935358 | 30 | 2 |
| 59 | 45 | 9.706415 | 10.294585 | 9.770076 | 10.229924 | 10.064661 | 9.935339 | 15 | 1 |
| 60 | 30 | 9.705469 | 10.294531 | 9.770148 | 10.229852 | 10.064680 | 9.935320 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 3h 58 . | | LOG. SINES, &c. | | | | | 59 deg. | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 2h 2m. | | LOG. SINES, &c. (t.) | | | | | 30 deg. | |
| 0 | 30 | 9.705469 | 10.294531 | 9.770148 | 10.229852 | 10.064680 | 9.935320 | 30 | 60 |
| 1 | 15 | 9.705522 | 10.294478 | 9.770221 | 10.229779 | 10.064698 | 9.935302 | 45 | 59 |
| 2 | 30 | 9.705576 | 10.294424 | 9.770293 | 10.229707 | 10.064717 | 9.935283 | 30 | 58 |
| 3 | 45 | 9.705630 | 10.294370 | 9.770365 | 10.229635 | 10.064735 | 9.935265 | 15 | 57 |
| 4 | 31 | 9.705683 | 10.294317 | 9.770437 | 10.229563 | 10.064754 | 9.935246 | 29 | 56 |
| 5 | 15 | 9.705737 | 10.294263 | 9.770509 | 10.229491 | 10.064773 | 9.935227 | 45 | 55 |
| 6 | 30 | 9.705790 | 10.294210 | 9.770582 | 10.229418 | 10.064791 | 9.935209 | 30 | 54 |
| 7 | 45 | 9.705844 | 10.294156 | 9.770654 | 10.229346 | 10.064810 | 9.935190 | 15 | 53 |
| 8 | 32 | 9.705897 | 10.294103 | 9.770726 | 10.229274 | 10.064829 | 9.935171 | 28 | 52 |
| 9 | 15 | 9.705951 | 10.294049 | 9.770798 | 10.229202 | 10.064847 | 9.935153 | 45 | 51 |
| 10 | 30 | 9.706005 | 10.293995 | 9.770870 | 10.229130 | 10.064866 | 9.935134 | 30 | 50 |
| 11 | 45 | 9.706058 | 10.293942 | 9.770943 | 10.229057 | 10.064884 | 9.935116 | 15 | 49 |
| 12 | 33 | 9.706112 | 10.293888 | 9.771015 | 10.228985 | 10.064903 | 9.935097 | 27 | 48 |
| 13 | 15 | 9.706165 | 10.293835 | 9.771087 | 10.228913 | 10.064922 | 9.935078 | 45 | 47 |
| 14 | 30 | 9.706219 | 10.293781 | 9.771159 | 10.228841 | 10.064940 | 9.935060 | 30 | 46 |
| 15 | 45 | 9.706272 | 10.293728 | 9.771231 | 10.228769 | 10.064959 | 9.935041 | 15 | 45 |
| 16 | 34 | 9.706326 | 10.293674 | 9.771303 | 10.228697 | 10.064978 | 9.935022 | 26 | 44 |
| 17 | 15 | 9.706379 | 10.293621 | 9.771375 | 10.228625 | 10.064996 | 9.935004 | 45 | 43 |
| 18 | 30 | 9.706432 | 10.293568 | 9.771447 | 10.228553 | 10.065015 | 9.934985 | 30 | 42 |
| 19 | 45 | 9.706486 | 10.293514 | 9.771520 | 10.228480 | 10.065034 | 9.934966 | 15 | 41 |
| 20 | 35 | 9.706539 | 10.293461 | 9.771592 | 10.228408 | 10.065052 | 9.934948 | 25 | 40 |
| 21 | 15 | 9.706593 | 10.293407 | 9.771664 | 10.228336 | 10.065071 | 9.934929 | 45 | 39 |
| 22 | 30 | 9.706646 | 10.293354 | 9.771736 | 10.228264 | 10.065090 | 9.934910 | 30 | 38 |
| 23 | 45 | 9.706700 | 10.293300 | 9.771808 | 10.228192 | 10.065108 | 9.934892 | 15 | 37 |
| 24 | 36 | 9.706753 | 10.293247 | 9.771880 | 10.228120 | 10.065127 | 9.934873 | 24 | 36 |
| 25 | 15 | 9.706806 | 10.293194 | 9.771952 | 10.228048 | 10.065146 | 9.934854 | 45 | 35 |
| 26 | 30 | 9.706860 | 10.293140 | 9.772024 | 10.227976 | 10.065164 | 9.934836 | 30 | 34 |
| 27 | 45 | 9.706913 | 10.293087 | 9.772096 | 10.227904 | 10.065183 | 9.934817 | 15 | 33 |
| 28 | 37 | 9.706967 | 10.293033 | 9.772168 | 10.227832 | 10.065202 | 9.934798 | 23 | 32 |
| 29 | 15 | 9.707020 | 10.292980 | 9.772240 | 10.227760 | 10.065220 | 9.934780 | 45 | 31 |
| 30 | 30 | 9.707073 | 10.292927 | 9.772312 | 10.227688 | 10.065239 | 9.934761 | 30 | 30 |
| 31 | 45 | 9.707127 | 10.292873 | 9.772384 | 10.227616 | 10.065258 | 9.934742 | 15 | 29 |
| 32 | 38 | 9.707180 | 10.292820 | 9.772457 | 10.227543 | 10.065277 | 9.934723 | 22 | 28 |
| 33 | 15 | 9.707233 | 10.292767 | 9.772529 | 10.227471 | 10.065295 | 9.934705 | 45 | 27 |
| 34 | 30 | 9.707287 | 10.292713 | 9.772601 | 10.227399 | 10.065314 | 9.934686 | 30 | 26 |
| 35 | 45 | 9.707340 | 10.292660 | 9.772673 | 10.227327 | 10.065333 | 9.934667 | 15 | 25 |
| 36 | 39 | 9.707393 | 10.292607 | 9.772745 | 10.227255 | 10.065351 | 9.934649 | 21 | 24 |
| 37 | 15 | 9.707447 | 10.292553 | 9.772817 | 10.227183 | 10.065370 | 9.934630 | 45 | 23 |
| 38 | 30 | 9.707500 | 10.292500 | 9.772889 | 10.227111 | 10.065389 | 9.934611 | 30 | 22 |
| 39 | 45 | 9.707553 | 10.292447 | 9.772961 | 10.227039 | 10.065408 | 9.934592 | 15 | 21 |
| 40 | 40 | 9.707606 | 10.292394 | 9.773033 | 10.226967 | 10.065426 | 9.934574 | 20 | 20 |
| 41 | 15 | 9.707660 | 10.292340 | 9.773105 | 10.226895 | 10.065445 | 9.934555 | 45 | 19 |
| 42 | 30 | 9.707713 | 10.292287 | 9.773177 | 10.226823 | 10.065464 | 9.934536 | 30 | 18 |
| 43 | 45 | 9.707766 | 10.292234 | 9.773249 | 10.226751 | 10.065482 | 9.934518 | 15 | 17 |
| 44 | 41 | 9.707819 | 10.292181 | 9.773321 | 10.226679 | 10.065501 | 9.934499 | 19 | 16 |
| 45 | 15 | 9.707873 | 10.292127 | 9.773393 | 10.226607 | 10.065520 | 9.934480 | 45 | 15 |
| 46 | 30 | 9.707926 | 10.292074 | 9.773464 | 10.226536 | 10.065539 | 9.934461 | 30 | 14 |
| 47 | 45 | 9.707979 | 10.292021 | 9.773536 | 10.226464 | 10.065557 | 9.934443 | 15 | 13 |
| 48 | 42 | 9.708032 | 10.291968 | 9.773608 | 10.226392 | 10.065576 | 9.934424 | 18 | 12 |
| 49 | 15 | 9.708085 | 10.291915 | 9.773680 | 10.226320 | 10.065595 | 9.934405 | 45 | 11 |
| 50 | 30 | 9.708139 | 10.291861 | 9.773752 | 10.226248 | 10.065614 | 9.934386 | 30 | 10 |
| 51 | 45 | 9.708192 | 10.291808 | 9.773824 | 10.226176 | 10.065632 | 9.934368 | 15 | 9 |
| 52 | 43 | 9.708245 | 10.291755 | 9.773896 | 10.226104 | 10.065651 | 9.934349 | 17 | 8 |
| 53 | 15 | 9.708298 | 10.291702 | 9.773968 | 10.226032 | 10.065670 | 9.934330 | 45 | 7 |
| 54 | 30 | 9.708351 | 10.291649 | 9.774040 | 10.225960 | 10.065689 | 9.934311 | 30 | 6 |
| 55 | 45 | 9.708404 | 10.291596 | 9.774112 | 10.225888 | 10.065708 | 9.934292 | 15 | 5 |
| 56 | 44 | 9.708457 | 10.291543 | 9.774184 | 10.225816 | 10.065726 | 9.934274 | 16 | 4 |
| 57 | 15 | 9.708511 | 10.291489 | 9.774256 | 10.225744 | 10.065745 | 9.934255 | 45 | 3 |
| 58 | 30 | 9.708564 | 10.291436 | 9.774328 | 10.225672 | 10.065764 | 9.934236 | 30 | 2 |
| 59 | 45 | 9.708617 | 10.291383 | 9.774399 | 10.225601 | 10.065783 | 9.934217 | 15 | 1 |
| 60 | 45 | 9.708670 | 10.291330 | 9.774471 | 10.225529 | 10.065801 | 9.934199 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 3h 57m. | | LOG. SINES, &c. | | | | | 59 deg. | |

| 2h 3m. | | | LOG. SINES, &c. (t.) | | | | 30 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.708670 | 10.291330 | 9.774471 | 10.225529 | 10.065801 | 9.934199 | 15 | 60 |
| 1 | 15 | 9.708723 | 10.291277 | 9.774543 | 10.225457 | 10.065820 | 9.934180 | 45 | 59 |
| 2 | 30 | 9.708776 | 10.291224 | 9.774615 | 10.225385 | 10.065839 | 9.934161 | 30 | 58 |
| 3 | 45 | 9.708829 | 10.291171 | 9.774687 | 10.225313 | 10.065858 | 9.934142 | 15 | 57 |
| 4 | 46 | 9.708882 | 10.291118 | 9.774759 | 10.225241 | 10.065877 | 9.934123 | 14 | 56 |
| 5 | 15 | 9.708935 | 10.291065 | 9.774831 | 10.225169 | 10.065895 | 9.934105 | 45 | 55 |
| 6 | 30 | 9.708988 | 10.291012 | 9.774902 | 10.225098 | 10.065914 | 9.934086 | 30 | 54 |
| 7 | 45 | 9.709041 | 10.290959 | 9.774974 | 10.225026 | 10.065933 | 9.934067 | 15 | 53 |
| 8 | 47 | 9.709094 | 10.290906 | 9.775046 | 10.224954 | 10.065952 | 9.934048 | 13 | 52 |
| 9 | 15 | 9.709147 | 10.290853 | 9.775118 | 10.224882 | 10.065971 | 9.934029 | 45 | 51 |
| 10 | 30 | 9.709200 | 10.290800 | 9.775190 | 10.224810 | 10.065990 | 9.934010 | 30 | 50 |
| 11 | 45 | 9.709253 | 10.290747 | 9.775262 | 10.224738 | 10.066008 | 9.933992 | 15 | 49 |
| 12 | 48 | 9.709306 | 10.290694 | 9.775333 | 10.224667 | 10.066027 | 9.933973 | 12 | 48 |
| 13 | 15 | 9.709359 | 10.290641 | 9.775405 | 10.224595 | 10.066046 | 9.933954 | 45 | 47 |
| 14 | 30 | 9.709412 | 10.290588 | 9.775477 | 10.224523 | 10.066065 | 9.933935 | 30 | 46 |
| 15 | 45 | 9.709465 | 10.290535 | 9.775549 | 10.224451 | 10.066084 | 9.933916 | 15 | 45 |
| 16 | 49 | 9.709518 | 10.290482 | 9.775621 | 10.224379 | 10.066102 | 9.933898 | 11 | 44 |
| 17 | 15 | 9.709571 | 10.290429 | 9.775692 | 10.224308 | 10.066121 | 9.933879 | 45 | 43 |
| 18 | 30 | 9.709624 | 10.290376 | 9.775764 | 10.224236 | 10.066140 | 9.933860 | 30 | 42 |
| 19 | 45 | 9.709677 | 10.290323 | 9.775836 | 10.224164 | 10.066159 | 9.933841 | 15 | 41 |
| 20 | 50 | 9.709730 | 10.290270 | 9.775908 | 10.224092 | 10.066178 | 9.933822 | 10 | 40 |
| 21 | 15 | 9.709783 | 10.290217 | 9.775979 | 10.224021 | 10.066197 | 9.933803 | 45 | 39 |
| 22 | 30 | 9.709836 | 10.290164 | 9.776051 | 10.223949 | 10.066216 | 9.933784 | 30 | 38 |
| 23 | 45 | 9.709889 | 10.290111 | 9.776123 | 10.223877 | 10.066234 | 9.933766 | 15 | 37 |
| 24 | 51 | 9.709941 | 10.290059 | 9.776195 | 10.223805 | 10.066253 | 9.933747 | 9 | 36 |
| 25 | 15 | 9.709994 | 10.290006 | 9.776266 | 10.223734 | 10.066270 | 9.933730 | 45 | 35 |
| 26 | 30 | 9.710047 | 10.289953 | 9.776338 | 10.223662 | 10.066291 | 9.933709 | 30 | 34 |
| 27 | 45 | 9.710100 | 10.289900 | 9.776410 | 10.223590 | 10.066310 | 9.933690 | 15 | 33 |
| 28 | 52 | 9.710153 | 10.289847 | 9.776482 | 10.223518 | 10.006329 | 9.933671 | 8 | 32 |
| 29 | 15 | 9.710206 | 10.289794 | 9.776553 | 10.223447 | 10.066348 | 9.933652 | 45 | 31 |
| 30 | 30 | 9.710259 | 10.289741 | 9.776625 | 10.223375 | 10.066367 | 9.933633 | 30 | 30 |
| 31 | 45 | 9.710311 | 10.289689 | 9.776697 | 10.223303 | 10.066385 | 9.933615 | 15 | 29 |
| 32 | 53 | 9.710364 | 10.289636 | 9.776768 | 10.223232 | 10.066404 | 9.933596 | 7 | 28 |
| 33 | 15 | 9.710417 | 10.289583 | 9.776840 | 10.223160 | 10.066423 | 9.933577 | 45 | 27 |
| 34 | 30 | 9.710470 | 10.289530 | 9.776912 | 10.223088 | 10.066442 | 9.933558 | 30 | 26 |
| 35 | 45 | 9 710523 | 10.289477 | 9 776983 | 10.223017 | 10.066461 | 9.933539 | 15 | 25 |
| 36 | 54 | 9.710575 | 10.289425 | 9.777055 | 10.222945 | 10.066480 | 9.933520 | 6 | 24 |
| 37 | 15 | 9.710628 | 10.289372 | 9.777127 | 10.222873 | 10.066499 | 9.933501 | 45 | 23 |
| 38 | 30 | 9.710681 | 10.289319 | 9.777198 | 10.222802 | 10.066518 | 9.933482 | 30 | 22 |
| 39 | 45 | 9.710734 | 10.289266 | 9.777270 | 10.222730 | 10.066537 | 9.933463 | 15 | 21 |
| 40 | 55 | 9.710786 | 10.289214 | 9.777342 | 10.222658 | 10.066556 | 9.933444 | 5 | 20 |
| 41 | 15 | 9.710839 | 10.289161 | 9.777413 | 10.222587 | 10.066574 | 9.933426 | 45 | 19 |
| 42 | 30 | 9.710892 | 10.289108 | 9.777485 | 10.222515 | 10.066593 | 9.933407 | 30 | 18 |
| 43 | 45 | 9.710944 | 10.289056 | 9.777557 | 10.222443 | 10.066612 | 9.933388 | 15 | 17 |
| 44 | 56 | 9.710997 | 10.289003 | 9.777628 | 10.222372 | 10.066631 | 9.933369 | 4 | 16 |
| 45 | 15 | 9.711050 | 10.288950 | 9.777700 | 10.222300 | 10.066650 | 9.933350 | 45 | 15 |
| 46 | 30 | 9.711103 | 10.288897 | 9.777772 | 10.222228 | 10.066669 | 9.933331 | 30 | 14 |
| 47 | 45 | 9.711155 | 10.288845 | 9.777843 | 10.222157 | 10.066688 | 9.933312 | 15 | 13 |
| 48 | 57 | 9.711208 | 10.288792 | 9.777915 | 10.222085 | 10.066707 | 9.933293 | 3 | 12 |
| 49 | 15 | 9.711261 | 10.288739 | 9.777986 | 10.222014 | 10.066726 | 9.933274 | 45 | 11 |
| 50 | 30 | 9.711313 | 10.288687 | 9.778058 | 10.221942 | 10.066745 | 9.933255 | 30 | 10 |
| 51 | 45 | 9.711366 | 10.288634 | 9.778130 | 10.221870 | 10.066764 | 9.933236 | 15 | 9 |
| 52 | 58 | 9 711419 | 10.288581 | 9.778201 | 10.221799 | 10.066783 | 9.933217 | 2 | 8 |
| 53 | 15 | 9.711471 | 10.288529 | 9.778273 | 10.221727 | 10.066802 | 9.933198 | 45 | 7 |
| 54 | 30 | 9.711524 | 10.288476 | 9.778344 | 10.221656 | 10.066821 | 9.933179 | 30 | 6 |
| 55 | 45 | 9.711576 | 10.288424 | 9.778416 | 10.221584 | 10.066840 | 9.933160 | 15 | 5 |
| 56 | 59 | 9.711629 | 10.288371 | 9.778487 | 10.221513 | 10.066859 | 9 933141 | 1 | 4 |
| 57 | 15 | 9.711682 | 10.288318 | 9.778559 | 10.221441 | 10.066878 | 9.933122 | 45 | 3 |
| 58 | 30 | 9.711734 | 10.288266 | 9.778631 | 10.221369 | 10.066897 | 9.933103 | 30 | 2 |
| 59 | 45 | 9.711787 | 10.288213 | 9.778702 | 10.221298 | 10.066915 | 9.933085 | 15 | 1 |
| 60 | 60 | 9 711839 | 10.288161 | 9.778774 | 10.221226 | 10.066934 | 9.933066 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 56m. | | | LOG. SINES, &c. | | | | 59 deg. | | |

| 2h 4m. | | | LOG. SINES, &c. (t.) | | | | 31 deg | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9 711839 | 10.288161 | 9.778774 | 10.221226 | 10.066934 | 9.933066 | 60 | 60 |
| 1 | 15 | 9.711892 | 10.288108 | 9.778845 | 10.221155 | 10.066953 | 9.933047 | 45 | 59 |
| 2 | 30 | 9.711944 | 10.288056 | 9.778917 | 10.221083 | 10.066972 | 9.933028 | 30 | 58 |
| 3 | 45 | 9.711997 | 10.288003 | 9.778988 | 10.221012 | 10.066991 | 9.933009 | 15 | 57 |
| 4 | 1 | 9.712049 | 10.287951 | 9.779060 | 10.220940 | 10.067010 | 9.932990 | 59 | 56 |
| 5 | 15 | 9.712102 | 10.287898 | 9.779131 | 10.220869 | 10.067029 | 9.932971 | 45 | 55 |
| 6 | 30 | 9.712155 | 10.287845 | 9.779203 | 10.220797 | 10.067048 | 9.932952 | 30 | 54 |
| 7 | 45 | 9.712207 | 10.287793 | 9.779274 | 10.220726 | 10.067067 | 9.932933 | 15 | 53 |
| 8 | 2 | 9.712260 | 10.287740 | 9.779346 | 10.220654 | 10.067086 | 9.932914 | 58 | 52 |
| 9 | 15 | 9.712312 | 10.287688 | 9.779417 | 10.220583 | 10.067105 | 9.932895 | 45 | 51 |
| 10 | 30 | 9.712364 | 10.287636 | 9.779489 | 10.220511 | 10.067124 | 9.932876 | 30 | 50 |
| 11 | 45 | 9.712417 | 10.287583 | 9.779560 | 10.220440 | 10.067143 | 9.932857 | 15 | 49 |
| 12 | 3 | 9.712469 | 10.287531 | 9.779632 | 10.220368 | 10.067162 | 9.932838 | 57 | 48 |
| 13 | 15 | 9.712522 | 10.287478 | 9.779703 | 10.220297 | 10.067181 | 9.932819 | 45 | 47 |
| 14 | 30 | 9.712574 | 10.287426 | 9.779775 | 10.220225 | 10.067200 | 9.932800 | 30 | 46 |
| 15 | 45 | 9.712627 | 10.287373 | 9.779846 | 10.220154 | 10.067219 | 9.932781 | 15 | 45 |
| 16 | 4 | 9.712679 | 10.287321 | 9.779918 | 10.220082 | 10.067238 | 9.932762 | 56 | 44 |
| 17 | 15 | 9.712732 | 10.287268 | 9.779989 | 10.220011 | 10.067258 | 9.932742 | 45 | 43 |
| 18 | 30 | 9.712784 | 10.287216 | 9.780061 | 10.219939 | 10.067277 | 9.932723 | 30 | 42 |
| 19 | 45 | 9.712836 | 10.287164 | 9.780132 | 10.219868 | 10.067296 | 9.932704 | 15 | 41 |
| 20 | 5 | 9.712889 | 10.287111 | 9.780203 | 10.219797 | 10.067315 | 9.932685 | 55 | 40 |
| 21 | 15 | 9.712941 | 10.287059 | 9.780275 | 10.219725 | 10.067334 | 9.932666 | 45 | 39 |
| 22 | 30 | 9.712994 | 10.287006 | 9.780346 | 10.219654 | 10.067353 | 9.932647 | 30 | 38 |
| 23 | 45 | 9.713046 | 10.286954 | 9.780418 | 10.219582 | 10.067372 | 9.932628 | 15 | 37 |
| 24 | 6 | 9.713098 | 10.286902 | 9.780489 | 10.219511 | 10.067391 | 9.932609 | 54 | 36 |
| 25 | 15 | 9.713151 | 10.286849 | 9.780560 | 10.219440 | 10.067410 | 9.932590 | 45 | 35 |
| 26 | 30 | 9.713203 | 10.286797 | 9.780632 | 10.219368 | 10.067429 | 9.932571 | 30 | 34 |
| 27 | 45 | 9.713255 | 10.286745 | 9.780703 | 10.219297 | 10.067448 | 9.932552 | 15 | 33 |
| 28 | 7 | 9.713308 | 10.286692 | 9.780775 | 10.219225 | 10.067467 | 9.932533 | 53 | 32 |
| 29 | 15 | 9.713360 | 10.286640 | 9.780846 | 10.219154 | 10.067486 | 9.932514 | 45 | 31 |
| 30 | 30 | 9.713412 | 10.286588 | 9.780917 | 10.219083 | 10.067505 | 9.932495 | 30 | 30 |
| 31 | 45 | 9.713465 | 10.286535 | 9.780989 | 10.219011 | 10.067524 | 9.932476 | 15 | 29 |
| 32 | 8 | 9.713517 | 10.286483 | 9.781060 | 10.218940 | 10.067543 | 9.932457 | 52 | 28 |
| 33 | 15 | 9.713569 | 10.286431 | 9.781131 | 10.218869 | 10.067562 | 9.932438 | 45 | 27 |
| 34 | 30 | 9.713621 | 10.286379 | 9.781203 | 10.218797 | 10.067581 | 9.932419 | 30 | 26 |
| 35 | 45 | 9.713674 | 10.286326 | 9.781274 | 10.218726 | 10.067601 | 9.932399 | 15 | 25 |
| 36 | 9 | 9.713726 | 10.286274 | 9.781346 | 10.218654 | 10.067620 | 9.932380 | 51 | 24 |
| 37 | 15 | 9.713778 | 10.286222 | 9.781417 | 10.218583 | 10.067639 | 9.932361 | 45 | 23 |
| 38 | 30 | 9.713830 | 10.286170 | 9.781488 | 10.218512 | 10.067658 | 9.932342 | 30 | 22 |
| 39 | 45 | 9.713883 | 10.286117 | 9.781560 | 10.218440 | 10.067677 | 9.932323 | 15 | 21 |
| 40 | 10 | 9.713935 | 10.286065 | 9.781631 | 10.218369 | 10.067696 | 9.932304 | 50 | 20 |
| 41 | 15 | 9.713987 | 10.286013 | 9.781702 | 10.218298 | 10.067715 | 9.932285 | 45 | 19 |
| 42 | 30 | 9.714039 | 10.285961 | 9.781773 | 10.218227 | 10.067734 | 9.932266 | 30 | 18 |
| 43 | 45 | 9.714091 | 10.285909 | 9.781845 | 10.218155 | 10.067753 | 9 932247 | 15 | 17 |
| 44 | 11 | 9.714144 | 10.285856 | 9.781916 | 10.218084 | 10.067772 | 9.932228 | 49 | 16 |
| 45 | 15 | 9.714196 | 10.285804 | 9.781987 | 10.218013 | 10.067792 | 9.932208 | 45 | 15 |
| 46 | 30 | 9.714248 | 10.285752 | 9.782059 | 10.217941 | 10.067811 | 9.932189 | 30 | 14 |
| 47 | 45 | 9.714300 | 10.285700 | 9.782130 | 10.217870 | 10 067830 | 9.932170 | 15 | 13 |
| 48 | 12 | 9.714352 | 10.285648 | 9.782201 | 10.217799 | 10.067849 | 9.932151 | 48 | 12 |
| 49 | 15 | 9.714404 | 10.285596 | 9.782273 | 10.217727 | 10.067868 | 9.932132 | 45 | 11 |
| 50 | 30 | 9.714457 | 10.285543 | 9.782344 | 10.217656 | 10.067887 | 9.932113 | 30 | 10 |
| 51 | 45 | 9.714509 | 10.285491 | 9.782415 | 10.217585 | 10.067906 | 9.932094 | 15 | 9 |
| 52 | 13 | 9.714561 | 10.285439 | 9.782486 | 10.217514 | 10.067925 | 9.932075 | 47 | 8 |
| 53 | 15 | 9.714613 | 10.285387 | 9.782558 | 10.217442 | 10.067945 | 9.932055 | 45 | 7 |
| 54 | 30 | 9.714665 | 10.285335 | 9.782629 | 10.217371 | 10.067964 | 9.932036 | 30 | 6 |
| 55 | 45 | 9.714717 | 10.285283 | 9.782700 | 10.217300 | 10.067983 | 9.932017 | 15 | 5 |
| 56 | 14 | 9.714769 | 10.285231 | 9.782771 | 10.217229 | 10.068002 | 9.931998 | 46 | 4 |
| 57 | 15 | 9.714821 | 10.285179 | 9.782843 | 10.217157 | 10.068021 | 9.931979 | 45 | 3 |
| 58 | 30 | 9.714873 | 10.285127 | 9.782914 | 10.217086 | 10.068040 | 9.931960 | 30 | 2 |
| 59 | 45 | 9 714925 | 10.285075 | 9.782985 | 10.217015 | 10.068060 | 9 931940 | 15 | 1 |
| 60 | 15 | 9.714978 | 10.285022 | 9.783056 | 10 216944 | 10.068079 | 9.931921 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 55m. | | | LOG. SINES, &c. | | | | 58 deg | | |

| 2h 5m. | | LOG. SINES, &c. (t.) | | | | | 31 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.714978 | 10.285022 | 9.783056 | 10.216944 | 10.068079 | 9.931921 | 45 | 60 |
| 1 | 15 | 9.715030 | 10.284970 | 9.783127 | 10.216873 | 10.068098 | 9.931902 | 45 | 59 |
| 2 | 30 | 9.715082 | 10.284918 | 9.783199 | 10.216801 | 10.068117 | 9.931883 | 30 | 58 |
| 3 | 45 | 9.715134 | 10.284866 | 9.783270 | 10.216730 | 10.068136 | 9.931864 | 15 | 57 |
| 4 | 16 | 9.715186 | 10.284814 | 9.783341 | 10.216659 | 10.068155 | 9.931845 | 44 | 56 |
| 5 | 15 | 9.715238 | 10.284762 | 9.783412 | 10.216588 | 10.068175 | 9.931825 | 45 | 55 |
| 6 | 30 | 9.715290 | 10.284710 | 9.783483 | 10.216517 | 10.068194 | 9.931806 | 30 | 54 |
| 7 | 45 | 9.715342 | 10.284658 | 9.783555 | 10.216445 | 10.068213 | 9.931787 | 15 | 53 |
| 8 | 17 | 9.715394 | 10.284606 | 9.783626 | 10.216374 | 10.068232 | 9.931768 | 43 | 52 |
| 9 | 15 | 9.715446 | 10.284554 | 9.783697 | 10.216303 | 10.068251 | 9.931749 | 45 | 51 |
| 10 | 30 | 9.715498 | 10.284502 | 9.783768 | 10.216232 | 10.068271 | 9.931729 | 30 | 50 |
| 11 | 45 | 9.715550 | 10.284450 | 9.783839 | 10.216161 | 10.068290 | 9.931710 | 15 | 49 |
| 12 | 18 | 9.715601 | 10.284399 | 9.783910 | 10.216090 | 10.068309 | 9.931691 | 42 | 48 |
| 13 | 15 | 9.715653 | 10.284347 | 9.783981 | 10.216019 | 10.068328 | 9.931672 | 45 | 47 |
| 14 | 30 | 9.715705 | 10.284295 | 9.784053 | 10.215947 | 10.068347 | 9.931653 | 30 | 46 |
| 15 | 45 | 9.715757 | 10.284243 | 9.784124 | 10.215876 | 10.068367 | 9.931633 | 15 | 45 |
| 16 | 19 | 9.715809 | 10.284191 | 9.784195 | 10.215805 | 10.068386 | 9.931614 | 41 | 44 |
| 17 | 15 | 9.715861 | 10.284139 | 9.784266 | 10.215734 | 10.068405 | 9.931595 | 45 | 43 |
| 18 | 30 | 9.715913 | 10.284087 | 9.784337 | 10.215663 | 10.068424 | 9.931576 | 30 | 42 |
| 19 | 45 | 9.715965 | 10.284036 | 9.784408 | 10.215592 | 10.068443 | 9.931557 | 15 | 41 |
| 20 | 20 | 9.716017 | 10.283983 | 9.784479 | 10.215521 | 10.068463 | 9.931537 | 40 | 40 |
| 21 | 15 | 9.716069 | 10.283931 | 9.784550 | 10.215450 | 10.068482 | 9.931518 | 45 | 39 |
| 22 | 30 | 9.716120 | 10.283880 | 9.784622 | 10.215378 | 10.068501 | 9.931499 | 30 | 38 |
| 23 | 45 | 9.716172 | 10.283828 | 9.784693 | 10.215307 | 10.068520 | 9.931480 | 15 | 37 |
| 24 | 21 | 9.716224 | 10.283776 | 9.784764 | 10.215236 | 10.068540 | 9.931460 | 39 | 36 |
| 25 | 15 | 9.716276 | 10.283724 | 9.784835 | 10.215165 | 10.068559 | 9.931441 | 45 | 35 |
| 26 | 30 | 9.716328 | 10.283672 | 9.784906 | 10.215094 | 10.068578 | 9.931422 | 30 | 34 |
| 27 | 45 | 9.716380 | 10.283620 | 9.784977 | 10.215023 | 10.068597 | 9.931403 | 15 | 33 |
| 28 | 22 | 9.716432 | 10.283568 | 9.785048 | 10.214952 | 10.068617 | 9.931383 | 38 | 32 |
| 29 | 15 | 9.716483 | 10.283517 | 9.785119 | 10.214881 | 10.068636 | 9.931364 | 45 | 31 |
| 30 | 30 | 9.716535 | 10.283465 | 9.785190 | 10.214810 | 10.068655 | 9.931345 | 30 | 30 |
| 31 | 45 | 9.716587 | 10.283413 | 9.785261 | 10.214739 | 10.068674 | 9.931326 | 15 | 29 |
| 32 | 23 | 9.716639 | 10.283361 | 9.785332 | 10.214668 | 10.068694 | 9.931306 | 37 | 28 |
| 33 | 15 | 9.716690 | 10.283310 | 9.785403 | 10.214597 | 10.068713 | 9.931287 | 45 | 27 |
| 34 | 30 | 9.716742 | 10.283258 | 9.785474 | 10.214526 | 10.068732 | 9.931268 | 30 | 26 |
| 35 | 45 | 9.716794 | 10.283206 | 9.785545 | 10.214455 | 10.068751 | 9.931249 | 15 | 25 |
| 36 | 24 | 9.716846 | 10.283154 | 9.785616 | 10.214384 | 10.068771 | 9.931229 | 36 | 24 |
| 37 | 15 | 9.716897 | 10.283103 | 9.785687 | 10.214313 | 10.068790 | 9.931210 | 45 | 23 |
| 38 | 30 | 9.716949 | 10.283051 | 9.785758 | 10.214242 | 10.068809 | 9.931191 | 30 | 22 |
| 39 | 45 | 9.717001 | 10.282999 | 9.785829 | 10.214171 | 10.068829 | 9.931171 | 15 | 21 |
| 40 | 25 | 9.717053 | 10.282947 | 9.785900 | 10.214100 | 10.068848 | 9.931152 | 35 | 20 |
| 41 | 15 | 9.717104 | 10.282896 | 9.785971 | 10.214029 | 10.068867 | 9.931133 | 45 | 19 |
| 42 | 30 | 9.717156 | 10.282844 | 9.786042 | 10.213958 | 10.068886 | 9.931114 | 30 | 18 |
| 43 | 45 | 9.717208 | 10.282792 | 9.786113 | 10.213887 | 10.068906 | 9.931094 | 15 | 17 |
| 44 | 26 | 9.717259 | 10.282741 | 9.786184 | 10.213816 | 10.068925 | 9.931075 | 34 | 16 |
| 45 | 15 | 9.717311 | 10.282689 | 9.786255 | 10.213745 | 10.068944 | 9.931056 | 45 | 15 |
| 46 | 30 | 9.717363 | 10.282637 | 9.786326 | 10.213674 | 10.068964 | 9.931036 | 30 | 14 |
| 47 | 45 | 9.717414 | 10.282586 | 9.786397 | 10.213603 | 10.068083 | 9.931017 | 15 | 13 |
| 48 | 27 | 9.717466 | 10.282534 | 9.786468 | 10.213532 | 10.069002 | 9.930998 | 33 | 12 |
| 49 | 15 | 9.717518 | 10.282482 | 9.786539 | 10.213461 | 10.069022 | 9.930978 | 45 | 11 |
| 50 | 30 | 9.717569 | 10.282431 | 9.786610 | 10.213390 | 10.069041 | 9.930959 | 30 | 10 |
| 51 | 45 | 9.717621 | 10.282379 | 9.786681 | 10.213319 | 10.069060 | 9.930940 | 15 | 9 |
| 52 | 28 | 9.717672 | 10.282328 | 9.786752 | 10.213248 | 10.069080 | 9.930920 | 32 | 8 |
| 53 | 15 | 9.717724 | 10.282276 | 9.786823 | 10.213177 | 10.069099 | 9.930901 | 45 | 7 |
| 54 | 30 | 9.717776 | 10.282224 | 9.786894 | 10.213106 | 10.069118 | 9.930882 | 30 | 6 |
| 55 | 45 | 9.717827 | 10.282173 | 9.786965 | 10.213035 | 10.069138 | 9.930862 | 15 | 5 |
| 56 | 29 | 9.717879 | 10.282121 | 9.787036 | 10.212964 | 10.069157 | 9.930843 | 31 | 4 |
| 57 | 15 | 9.717930 | 10.282070 | 9.787107 | 10.212893 | 10.069176 | 9.930824 | 45 | 3 |
| 58 | 30 | 9.717982 | 10.282018 | 9.787177 | 10.212823 | 10.069196 | 9.930804 | 30 | 2 |
| 59 | 45 | 9.718034 | 10.281966 | 9.787248 | 10.212752 | 10.069215 | 9.930785 | 15 | 1 |
| 60 | 30 | 9.718085 | 10.281915 | 9.787319 | 10.212681 | 10.069234 | 9.930766 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 54m. | LOG. SINES &c. | 58 deg. |
|---|---|---|

| | 2h 6m. | | LOG. SINES, &c. (t.) | | | | 31 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.718085 | 10.281915 | 9.787319 | 10.212681 | 10.069234 | 9.930766 | 30 | 60 |
| 1 | 15 | 9.718137 | 10.281863 | 9.787390 | 10.212610 | 10.069254 | 9.930746 | 45 | 59 |
| 2 | 30 | 9.718188 | 10.281812 | 9.787461 | 10.212539 | 10.069273 | 9.930727 | 30 | 58 |
| 3 | 45 | 9.718240 | 10.281760 | 9.787532 | 10.212468 | 10.069292 | 9.930708 | 15 | 57 |
| 4 | 31 | 9.718291 | 10.281709 | 9.787603 | 10.212397 | 10.069312 | 9.930688 | 29 | 56 |
| 5 | 15 | 9.718343 | 10.281657 | 9.787674 | 10.212326 | 10.069331 | 9.930669 | 45 | 55 |
| 6 | 30 | 9.718394 | 10.281606 | 9 787745 | 10.212255 | 10.069350 | 9.930650 | 30 | 54 |
| 7 | 45 | 9.718446 | 10.281554 | 9.787815 | 10.212185 | 10.069370 | 9.930630 | 15 | 53 |
| 8 | 32 | 9.718497 | 10.281503 | 9.787886 | 10.212114 | 10.069389 | 9.930611 | 28 | 52 |
| 9 | 15 | 9.718549 | 10.281451 | 9.787957 | 10.212043 | 10.069409 | 9.930591 | 45 | 51 |
| 10 | 30 | 9 718600 | 10.281400 | 9.788028 | 10.211972 | 10.069428 | 9.930572 | 30 | 50 |
| 11 | 45 | 9.718651 | 10.281349 | 9.788099 | 10.211901 | 10.069447 | 9.930553 | 15 | 49 |
| 12 | 33 | 9.718703 | 10.281297 | 9.788170 | 10.211830 | 10.069467 | 9.930533 | 27 | 48 |
| 13 | 15 | 9.718754 | 10.281246 | 9.788240 | 10.211760 | 10.069486 | 9.930514 | 45 | 47 |
| 14 | 30 | 9.718806 | 10.281194 | 9.788311 | 10.211689 | 10.069506 | 9.930494 | 30 | 46 |
| 15 | 45 | 9.718857 | 10.281143 | 9.788382 | 10.211618 | 10.069525 | 9.930475 | 15 | 45 |
| 16 | 34 | 9.718909 | 10.281091 | 9.788453 | 10.211547 | 10.069544 | 9.930456 | 26 | 44 |
| 17 | 15 | 9.718960 | 10.281040 | 9.788524 | 10.211476 | 10.069564 | 9.930436 | 45 | 43 |
| 18 | 30 | 9.719011 | 10.280989 | 9.788594 | 10.211406 | 10.069583 | 9.930417 | 30 | 42 |
| 19 | 45 | 9.719063 | 10.280937 | 9.788665 | 10.211335 | 10.069603 | 9.930397 | 15 | 41 |
| 20 | 35 | 9.719114 | 10.280886 | 9.788736 | 10.211264 | 10.069622 | 9.930378 | 25 | 40 |
| 21 | 15 | 9.719166 | 10.280834 | 9.788807 | 10.211193 | 10.069641 | 9.930359 | 45 | 39 |
| 22 | 30 | 9.719217 | 10.280783 | 9.788878 | 10.211122 | 10.069661 | 9.930339 | 30 | 38 |
| 23 | 45 | 9.719268 | 10.280732 | 9.788948 | 10.211052 | 10.069680 | 9.930320 | 15 | 37 |
| 24 | 36 | 9.719320 | 10.280680 | 9.789019 | 10.210981 | 10.069700 | 9.930300 | 24 | 36 |
| 25 | 15 | 9.719371 | 10.280629 | 9.789090 | 10.210910 | 10.069719 | 9.930281 | 45 | 35 |
| 26 | 30 | 9.719422 | 10.280578 | 9.789161 | 10.210839 | 10.069739 | 9.930261 | 30 | 34 |
| 27 | 45 | 9.719474 | 10.280526 | 9.789231 | 10.210769 | 10.069758 | 9.930242 | 15 | 33 |
| 28 | 37 | 9.719525 | 10.280475 | 9.789302 | 10.210698 | 10.069777 | 9.930223 | 23 | 32 |
| 29 | 15 | 9.719576 | 10.280424 | 9.789373 | 10.210627 | 10.069797 | 9.930203 | 45 | 31 |
| 30 | 30 | 9.719627 | 10.280373 | 9.789444 | 10.210556 | 10.069816 | 9.930184 | 30 | 30 |
| 31 | 45 | 9.719679 | 10.280321 | 9.789514 | 10 210486 | 10.069836 | 9.930164 | 15 | 29 |
| 32 | 38 | 9.719730 | 10.280270 | 9.789585 | 10.210415 | 10.069855 | 9.930145 | 22 | 28 |
| 33 | 15 | 9.719781 | 10.280219 | 9.789656 | 10.210344 | 10.069875 | 9.930125 | 45 | 27 |
| 34 | 30 | 9.719833 | 10.280167 | 9.789727 | 10.210273 | 10.069894 | 9.930106 | 30 | 26 |
| 35 | 45 | 9.719884 | 10.280116 | 9.789797 | 10.210203 | 10.069914 | 9.930086 | 15 | 25 |
| 36 | 39 | 9.719935 | 10.280065 | 9.789868 | 10.210132 | 10.069933 | 9.930067 | 21 | 24 |
| 37 | 15 | 9.719986 | 10.280014 | 9.789939 | 10.210061 | 10.069953 | 9.930047 | 45 | 23 |
| 38 | 30 | 9.720037 | 10.279963 | 9.790009 | 10.209991 | 10.069972 | 9.930028 | 30 | 22 |
| 39 | 45 | 9.720089 | 10.279911 | 9.790080 | 10.209920 | 10.069991 | 9.930009 | 15 | 21 |
| 40 | 40 | 9.720140 | 10.279860 | 9.790151 | 10.209849 | 10.070011 | 9.929989 | 20 | 20 |
| 41 | 15 | 9.720191 | 10.279809 | 9.790221 | 10.209779 | 10.070030 | 9.929970 | 45 | 19 |
| 42 | 30 | 9.720242 | 10.279758 | 9.790292 | 10.209708 | 10.070050 | 9.929950 | 30 | 18 |
| 43 | 45 | 9.720293 | 10.279707 | 9.790363 | 10.209637 | 10.070069 | 9.929931 | 15 | 17 |
| 44 | 41 | 9.720345 | 10.279655 | 9.790433 | 10.209567 | 10.070089 | 9.929911 | 19 | 16 |
| 45 | 15 | 9.720396 | 10.279604 | 9.790504 | 10.209496 | 10.070108 | 9.929892 | 45 | 15 |
| 46 | 30 | 9.720447 | 10.279553 | 9.790575 | 10.209425 | 10.070128 | 9.929872 | 30 | 14 |
| 47 | 45 | 9.720498 | 10.279502 | 9.790645 | 10.209355 | 10.070147 | 9.929853 | 15 | 13 |
| 48 | 42 | 9.720549 | 10.279451 | 9.790716 | 10.209284 | 10.070167 | 9.929833 | 18 | 12 |
| 49 | 15 | 9.720600 | 10.279400 | 9.790787 | 10.209213 | 10.070186 | 9.929814 | 45 | 11 |
| 50 | 30 | 9.720651 | 10.279349 | 9.790857 | 10.209143 | 10.070206 | 9.929794 | 30 | 10 |
| 51 | 45 | 9.720703 | 10.279297 | 9.790928 | 10.209072 | 10.070225 | 9.929775 | 15 | 9 |
| 52 | 43 | 9.720754 | 10.279246 | 9.790999 | 10.209001 | 10.070245 | 9.929755 | 17 | 8 |
| 53 | 15 | 9 720805 | 10.279195 | 9.791069 | 10.208931 | 10.070264 | 9.929736 | 45 | 7 |
| 54 | 30 | 9.720856 | 10.279144 | 9.791140 | 10.208860 | 10.070284 | 9.929716 | 30 | 6 |
| 55 | 45 | 9.720907 | 10.279093 | 9.791210 | 10.208790 | 10.070304 | 9.929696 | 15 | 5 |
| 56 | 44 | 9.720958 | 10.279042 | 9.791281 | 10.208719 | 10.070323 | 9.929677 | 16 | 4 |
| 57 | 15 | 9.721009 | 10.278991 | 9.791352 | 10.208648 | 10.070343 | 9.929657 | 45 | 3 |
| 58 | 30 | 9.721060 | 10.278940 | 9.791422 | 10.208578 | 10.070362 | 9.929638 | 30 | 2 |
| 59 | 45 | 9.721111 | 10.278889 | 9.791493 | 10.208507 | 10.070382 | 9.929618 | 15 | 1 |
| 60 | 45 | 9.721162 | 10.278838 | 9.791563 | 10.208437 | 10.070401 | 9.929599 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 3h 53m. | | LOG. SINES, &c. | | | | 58 deg. | | |

| 2h 7m. | | | LOG. SINES, &c. (t.) | | | | 31 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.721162 | 10.278838 | 9.791563 | 10.208437 | 10.070401 | 9.929599 | 15 | 60 |
| 1 | 15 | 9.721213 | 10.278787 | 9.791634 | 10.208366 | 10.070421 | 9.929579 | 45 | 59 |
| 2 | 30 | 9.721264 | 10.278736 | 9.791705 | 10.208295 | 10.070440 | 9.929560 | 30 | 58 |
| 3 | 45 | 9.721315 | 10.278685 | 9.791775 | 10.208225 | 10.070460 | 9.929540 | 15 | 57 |
| 4 | 46 | 9.721366 | 10.278634 | 9.791846 | 10.208154 | 10.070479 | 9.929521 | 14 | 56 |
| 5 | 15 | 9.721417 | 10.278583 | 9.791916 | 10.208084 | 10.070499 | 9.929501 | 45 | 55 |
| 6 | 30 | 9.721468 | 10.278532 | 9.791987 | 10.208013 | 10.070519 | 9.929481 | 30 | 54 |
| 7 | 45 | 9.721519 | 10.278481 | 9.792057 | 10.207943 | 10.070538 | 9.929462 | 15 | 53 |
| 8 | 47 | 9.721570 | 10.278430 | 9.792128 | 10.207872 | 10.070558 | 9.929442 | 13 | 52 |
| 9 | 15 | 9.721621 | 10.278379 | 9.792198 | 10.207802 | 10.070577 | 9.929423 | 45 | 51 |
| 10 | 30 | 9.721672 | 10.278328 | 9.792269 | 10.207731 | 10.070597 | 9.929403 | 30 | 50 |
| 11 | 45 | 9.721723 | 10.278277 | 9.792340 | 10.207660 | 10.070616 | 9.929384 | 15 | 49 |
| 12 | 48 | 9.721774 | 10.278226 | 9.792410 | 10.207590 | 10.070636 | 9.929364 | 12 | 48 |
| 13 | 15 | 9.721825 | 10.278175 | 9.792481 | 10.207519 | 10.070656 | 9.929344 | 45 | 47 |
| 14 | 30 | 9.721876 | 10.278124 | 9.792551 | 10.207449 | 10.070675 | 9.929325 | 30 | 46 |
| 15 | 45 | 9.721927 | 10.278073 | 9.792622 | 10.207378 | 10.070695 | 9.929305 | 15 | 45 |
| 16 | 49 | 9.721978 | 10.278022 | 9.792692 | 10.207308 | 10.070714 | 9.929286 | 11 | 44 |
| 17 | 15 | 9.722029 | 10.277971 | 9.792763 | 10.207237 | 10.070734 | 9.929266 | 45 | 43 |
| 18 | 30 | 9.722080 | 10.277920 | 9.792833 | 10.207167 | 10.070754 | 9.929246 | 30 | 42 |
| 19 | 45 | 9.722130 | 10.277870 | 9.792904 | 10.207096 | 10.070773 | 9.929227 | 15 | 41 |
| 20 | 50 | 9.722181 | 10.277819 | 9.792974 | 10.207026 | 10.070793 | 9.929207 | 10 | 40 |
| 21 | 15 | 9.722232 | 10.277768 | 9.793045 | 10.206955 | 10.070812 | 9.929188 | 45 | 39 |
| 22 | 30 | 9.722283 | 10.277717 | 9.793115 | 10.206885 | 10.070832 | 9.929168 | 30 | 38 |
| 23 | 45 | 9.722334 | 10.277666 | 9.793185 | 10.206815 | 10.070852 | 9.929148 | 15 | 37 |
| 24 | 51 | 9.722385 | 10.277615 | 9.793256 | 10.206744 | 10.070871 | 9.929129 | 9 | 36 |
| 25 | 15 | 9.722436 | 10.277564 | 9.793326 | 10.206674 | 10.070891 | 9.929109 | 45 | 35 |
| 26 | 30 | 9.722486 | 10.277514 | 9.793397 | 10.206603 | 10.070910 | 9.929090 | 30 | 34 |
| 27 | 45 | 9.722537 | 10.277463 | 9.793467 | 10.206533 | 10.070930 | 9.929070 | 15 | 33 |
| 28 | 52 | 9.722588 | 10.277412 | 9.793538 | 10.206462 | 10.070950 | 9.929050 | 8 | 32 |
| 29 | 15 | 9.722639 | 10.277361 | 9.793608 | 10.206392 | 10.070969 | 9.929031 | 45 | 31 |
| 30 | 30 | 9.722690 | 10.277310 | 9.793679 | 10.206321 | 10.070989 | 9.929011 | 30 | 30 |
| 31 | 45 | 9.722740 | 10.277260 | 9.793749 | 10.206251 | 10.071009 | 9.928991 | 15 | 29 |
| 32 | 53 | 9.722791 | 10.277209 | 9.793819 | 10.206181 | 10.071028 | 9.928972 | 7 | 28 |
| 33 | 15 | 9.722842 | 10.277158 | 9.793890 | 10.206110 | 10.071048 | 9.928952 | 45 | 27 |
| 34 | 30 | 9.722893 | 10.277107 | 9.793960 | 10.206040 | 10.071068 | 9.928932 | 30 | 26 |
| 35 | 45 | 9.722944 | 10.277056 | 9.794031 | 10.205969 | 10.071087 | 9.928913 | 15 | 25 |
| 36 | 54 | 9.722994 | 10.277006 | 9.794101 | 10.205899 | 10.071107 | 9.928893 | 6 | 24 |
| 37 | 15 | 9.723045 | 10.276955 | 9.794171 | 10.205829 | 10 071127 | 9.928873 | 45 | 23 |
| 38 | 30 | 9.723096 | 10.276904 | 9.794242 | 10.205758 | 10.071146 | 9.928854 | 30 | 22 |
| 39 | 45 | 9.723146 | 10.276854 | 9.794312 | 10.205688 | 10 071166 | 9.928834 | 15 | 21 |
| 40 | 55 | 9.723197 | 10.276803 | 9.794383 | 10.205617 | 10.071186 | 9.928814 | 5 | 20 |
| 41 | 15 | 9.723248 | 10.276752 | 9.794453 | 10.205547 | 10.071205 | 9.928795 | 45 | 19 |
| 42 | 30 | 9.723299 | 10.276701 | 9.794523 | 10.205477 | 10.071225 | 9.928775 | 30 | 18 |
| 43 | 45 | 9.723349 | 10.276651 | 9.794594 | 10.205406 | 10.071245 | 9.928755 | 15 | 17 |
| 44 | 56 | 9.723400 | 10.276600 | 9.794664 | 10.205336 | 10.071264 | 9.928736 | 4 | 16 |
| 45 | 15 | 9.723451 | 10.276549 | 9.794734 | 10.205266 | 10.071284 | 9.928716 | 45 | 15 |
| 46 | 30 | 9.723501 | 10.276499 | 9.794805 | 10.205195 | 10.071304 | 9.928696 | 30 | 14 |
| 47 | 45 | 9.723552 | 10.276448 | 9.794875 | 10.205125 | 10.071323 | 9.928677 | 15 | 13 |
| 48 | 57 | 9.723603 | 10.276397 | 9.794945 | 10.205055 | 10.071343 | 9.928657 | 3 | 12 |
| 49 | 15 | 9.723653 | 10.276347 | 9.795016 | 10.204984 | 10.071363 | 9.928637 | 45 | 11 |
| 50 | 30 | 9.723704 | 10.276296 | 9.795086 | 10.204914 | 10.071382 | 9.928618 | 30 | 10 |
| 51 | 45 | 9.723754 | 10.276246 | 9.795156 | 10.204844 | 10.071402 | 9.928598 | 15 | 9 |
| 52 | 58 | 9.723805 | 10.276195 | 9.795227 | 10.204773 | 10.071422 | 9.928578 | 2 | 8 |
| 53 | 15 | 9.723856 | 10.276144 | 9.795297 | 10.204703 | 10.071441 | 9.928559 | 45 | 7 |
| 54 | 30 | 9.723906 | 10.276094 | 9.795367 | 10.204633 | 10.071461 | 9.928539 | 30 | 6 |
| 55 | 45 | 9.723957 | 10.276043 | 9.795438 | 10.204562 | 10.071481 | 9.928519 | 15 | 5 |
| 56 | 59 | 9.724007 | 10.275993 | 9.795508 | 10.204492 | 10.071501 | 9.928499 | 1 | 4 |
| 57 | 15 | 9.724058 | 10.275942 | 9.795578 | 10.204422 | 10.071520 | 9.928480 | 45 | 3 |
| 58 | 30 | 9.724109 | 10.275891 | 9.795649 | 10.204351 | 10.071540 | 9.928460 | 30 | 2 |
| 59 | 45 | 9.724159 | 10.275841 | 9.795719 | 10.204281 | 10.071560 | 9.928440 | 15 | 1 |
| 60 | 60 | 9.724210 | 10.275790 | 9.795789 | 10.204211 | 10.071580 | 9.928420 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 52m. | LOG. SINES &c. | 58 deg. |
|---|---|---|

| 2h 8m. | | | LOG SINES, &c. (t.) | | | | | 32 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.724210 | 10.275790 | 9.795789 | 10.204211 | 10.071580 | 9.928420 | 60 | 60 |
| 1 | 15 | 9.724260 | 10.275740 | 9.795859 | 10.204141 | 10.071599 | 9.928401 | 45 | 59 |
| 2 | 30 | 9.724311 | 10.275689 | 9.795930 | 10.204070 | 10.071619 | 9.928381 | 30 | 58 |
| 3 | 45 | 9.724361 | 10.275639 | 9.796000 | 10.204000 | 10.071639 | 9.928361 | 15 | 57 |
| 4 | 1 | 9.724412 | 10.275588 | 9.796070 | 10.203930 | 10.071659 | 9 928341 | 59 | 56 |
| 5 | 15 | 9.724462 | 10.275538 | 9.796141 | 10.203859 | 10.071678 | 9.928322 | 45 | 55 |
| 6 | 30 | 9.724513 | 10.275487 | 9.796211 | 10.203789 | 10.071698 | 9.928302 | 30 | 54 |
| 7 | 45 | 9 724563 | 10.275437 | 9.796281 | 10.203719 | 10.071718 | 9.928282 | 15 | 53 |
| 8 | 2 | 9.724614 | 10.275386 | 9.796351 | 10.203649 | 10.071738 | 9.928262 | 58 | 52 |
| 9 | 15 | 9.724664 | 10.275336 | 9.796421 | 10.203579 | 10.071757 | 9.928243 | 45 | 51 |
| 10 | 30 | 9.724715 | 10.275285 | 9.796492 | 10.203508 | 10.071777 | 9.928223 | 30 | 50 |
| 11 | 45 | 9.724765 | 10.275235 | 9.796562 | 10.203438 | 10.071797 | 9.928203 | 15 | 49 |
| 12 | 3 | 9.724816 | 10.275184 | 9.796632 | 10.203368 | 10.071817 | 9.928183 | 57 | 48 |
| 13 | 15 | 9.724866 | 10.275134 | 9.796702 | 10.203298 | 10.071836 | 9.928164 | 45 | 47 |
| 14 | 30 | 9.724916 | 10.275084 | 9.796773 | 10.203227 | 10.071856 | 9.928144 | 30 | 46 |
| 15 | 45 | 9.724967 | 10.275033 | 9.796843 | 10.203157 | 10.071876 | 9.928124 | 15 | 45 |
| 16 | 4 | 9.725017 | 10.274983 | 9.796913 | 10.203087 | 10.071896 | 9.928104 | 56 | 44 |
| 17 | 15 | 9.725068 | 10.274932 | 9.796983 | 10.203017 | 10.071916 | 9.928084 | 45 | 43 |
| 18 | 30 | 9.725118 | 10.274882 | 9.797053 | 10.202947 | 10.071935 | 9.928065 | 30 | 42 |
| 19 | 45 | 9.725169 | 10.274831 | 9.797124 | 10.202876 | 10.071955 | 9.928045 | 15 | 41 |
| 20 | 5 | 9.725219 | 10.274781 | 9.797194 | 10.202806 | 10.071975 | 9.928025 | 55 | 40 |
| 21 | 15 | 9.725269 | 10.274731 | 9.797264 | 10.202736 | 10.071995 | 9.928005 | 45 | 39 |
| 22 | 30 | 9.725320 | 10.274680 | 9.797334 | 10.202666 | 10.072015 | 9.927985 | 30 | 38 |
| 23 | 45 | 9.725370 | 10.274630 | 9.797404 | 10.202596 | 10.072034 | 9.927966 | 15 | 37 |
| 24 | 6 | 9.725420 | 10.274580 | 9.797474 | 10.202526 | 10.072054 | 9.927946 | 54 | 36 |
| 25 | 15 | 9.725471 | 10.274529 | 9.797545 | 10.202455 | 10.072074 | 9.927926 | 45 | 35 |
| 26 | 30 | 9.725521 | 10.274479 | 9.797615 | 10.202385 | 10.072094 | 9.927906 | 30 | 34 |
| 27 | 45 | 9.725571 | 10.274429 | 9.797685 | 10.202315 | 10.072114 | 9.927886 | 15 | 33 |
| 28 | 7 | 9.725622 | 10.274378 | 9.797755 | 10.202245 | 10.072133 | 9.927867 | 53 | 32 |
| 29 | 15 | 9.725672 | 10.274328 | 9.797825 | 10.202175 | 10.072153 | 9.927847 | 45 | 31 |
| 30 | 30 | 9.725722 | 10.274278 | 9.797895 | 10.202105 | 10.072173 | 9.927827 | 30 | 30 |
| 31 | 45 | 9.725773 | 10.274227 | 9.797965 | 10.202035 | 10.072193 | 9.927807 | 15 | 29 |
| 32 | 8 | 9.725823 | 10.274177 | 9.798036 | 10.201964 | 10.072213 | 9.927787 | 52 | 28 |
| 33 | 15 | 9.725873 | 10.274127 | 9.798106 | 10.201894 | 10.072233 | 9.927767 | 45 | 27 |
| 34 | 30 | 9.725923 | 10.274077 | 9.798176 | 10.201824 | 10.072252 | 9.927748 | 30 | 26 |
| 35 | 45 | 9.725974 | 10.274026 | 9.798246 | 10.201754 | 10.072272 | 9.927728 | 15 | 25 |
| 36 | 9 | 9.726024 | 10.273976 | 9.798316 | 10.201684 | 10.072292 | 9.927708 | 51 | 24 |
| 37 | 15 | 9.726074 | 10.273926 | 9.798386 | 10.201614 | 10.072312 | 9.927688 | 45 | 23 |
| 38 | 30 | 9.726124 | 10.273876 | 9.798456 | 10.201544 | 10.072332 | 9.927668 | 30 | 22 |
| 39 | 45 | 9.726175 | 10.273825 | 9.798526 | 10.201474 | 10.072352 | 9.927648 | 15 | 21 |
| 40 | 10 | 9.726225 | 10.273775 | 9.798596 | 10.201404 | 10.072372 | 9.927628 | 50 | 20 |
| 41 | 15 | 9.726275 | 10.273725 | 9.798666 | 10.201334 | 10.072391 | 9.927609 | 45 | 19 |
| 42 | 30 | 9.726325 | 10.273675 | 9.798736 | 10.201264 | 10.072411 | 9.927589 | 30 | 18 |
| 43 | 45 | 9.726375 | 10.273625 | 9.798807 | 10.201193 | 10.072431 | 9.927569 | 15 | 17 |
| 44 | 11 | 9.726426 | 10.273574 | 9.798877 | 10.201123 | 10.072451 | 9.927549 | 49 | 16 |
| 45 | 15 | 9.726476 | 10.273524 | 9.798947 | 10.201053 | 10.072471 | 9.927529 | 45 | 15 |
| 46 | 30 | 9.726526 | 10.273474 | 9.799017 | 10.200983 | 10.072491 | 9.927509 | 30 | 14 |
| 47 | 45 | 9.726576 | 10.273424 | 9.799087 | 10.200913 | 10.072511 | 9.927489 | 15 | 13 |
| 48 | 12 | 9.726626 | 10.273374 | 9.799157 | 10.200843 | 10 072531 | 9.927469 | 48 | 12 |
| 49 | 15 | 9.726676 | 10.273324 | 9.799227 | 10.200773 | 10.072550 | 9.927450 | 45 | 11 |
| 50 | 30 | 9.726727 | 10.273273 | 9.799297 | 10.200703 | 10.072570 | 9.927430 | 30 | 10 |
| 51 | 45 | 9.726777 | 10.273223 | 9.799367 | 10.200633 | 10.072590 | 9.927410 | 15 | 9 |
| 52 | 13 | 9.726827 | 10.273173 | 9.799437 | 10.200563 | 10.072610 | 9.927390 | 47 | 8 |
| 53 | 15 | 9.726877 | 10.273123 | 9.799507 | 10.200493 | 10.072630 | 9.927370 | 45 | 7 |
| 54 | 30 | 9.726927 | 10.273073 | 9.799577 | 10.200423 | 10.072650 | 9.927350 | 30 | 6 |
| 55 | 45 | 9.726977 | 10.273023 | 9.799647 | 10.200353 | 10.072670 | 9.927330 | 15 | 5 |
| 56 | 14 | 9.727027 | 10.272973 | 9.799717 | 10.200283 | 10.072690 | 9.927310 | 46 | 4 |
| 57 | 15 | 9.727077 | 10.272923 | 9.799787 | 10.200213 | 10.072710 | 9.927290 | 45 | 3 |
| 58 | 30 | 9.727127 | 10.272873 | 9.799857 | 10.200143 | 10.072730 | 9.927270 | 30 | 2 |
| 59 | 45 | 9.727178 | 10.272822 | 9.799927 | 10.200073 | 10.072750 | 9.927250 | 15 | 1 |
| 60 | 15 | 9.727228 | 10.272772 | 9 79099. | 10.200003 | 10.072769 | 9.927231 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 51m. | | | LOG. SINES, &c. | | | | | 57 deg. | |

| sec. | ′ ″ | sine. | cosecant | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $2^h\ 9^m$ | | LOG. SINES, &c. (t.) | | | | 32 deg. | | |
| 0 | 15 | 9.727228 | 10.272772 | 9.799997 | 10.200003 | 10.072769 | 9.927231 | 45 | 60 |
| 1 | 15 | 9.727278 | 10.272722 | 9.800067 | 10.199933 | 10.072789 | 9.927211 | 45 | 59 |
| 2 | 30 | 9.727328 | 10.272672 | 9.800137 | 10.199863 | 10.072809 | 9.927191 | 30 | 58 |
| 3 | 45 | 9.727378 | 10.272622 | 9.800207 | 10.199793 | 10.072829 | 9.927171 | 15 | 57 |
| 4 | 16 | 9.727428 | 10.272572 | 9.800277 | 10.199723 | 10.072849 | 9.927151 | 44 | 56 |
| 5 | 15 | 9.727478 | 10.272522 | 9.800347 | 10.199653 | 10.072869 | 9.927131 | 45 | 55 |
| 6 | 30 | 9.727528 | 10.272472 | 9.800417 | 10.199583 | 10.072889 | 9.927111 | 30 | 54 |
| 7 | 45 | 9.727578 | 10.272422 | 9.800487 | 10.199513 | 10.072909 | 9.927091 | 15 | 53 |
| 8 | 17 | 9.727628 | 10.272372 | 9.800557 | 10.199443 | 10.072929 | 9.927071 | 43 | 52 |
| 9 | 15 | 9.727678 | 10.272322 | 9.800627 | 10.199373 | 10.072949 | 9.927051 | 45 | 51 |
| 10 | 30 | 9.727728 | 10.272272 | 9.800697 | 10.199303 | 10.072969 | 9.927031 | 30 | 50 |
| 11 | 45 | 9.727778 | 10.272222 | 9.800766 | 10.199234 | 10.072989 | 9.927011 | 15 | 49 |
| 12 | 18 | 9.727828 | 10.272172 | 9.800836 | 10.199164 | 10.073009 | 9.926991 | 42 | 48 |
| 13 | 15 | 9.727878 | 10.272122 | 9.800906 | 10.199094 | 10.073029 | 9.926971 | 45 | 47 |
| 14 | 30 | 9.727928 | 10.272072 | 9.800976 | 10.199024 | 10.073049 | 9.926951 | 30 | 46 |
| 15 | 45 | 9.727978 | 10.272022 | 9.801046 | 10.198954 | 10.073069 | 9.926931 | 15 | 45 |
| 16 | 19 | 9.728027 | 10.271973 | 9.801116 | 10.198884 | 10.073089 | 9.926911 | 41 | 44 |
| 17 | 15 | 9.728077 | 10.271923 | 9.801186 | 10.198814 | 10.073109 | 9.926891 | 45 | 43 |
| 18 | 30 | 9.728127 | 10.271873 | 9.801256 | 10.198744 | 10.073129 | 9.926871 | 30 | 42 |
| 19 | 45 | 9.728177 | 10.271823 | 9.801326 | 10.198674 | 10.073149 | 9.926851 | 15 | 41 |
| 20 | 20 | 9.728227 | 10.271773 | 9.801396 | 10.198604 | 10.073169 | 9.926831 | 40 | 40 |
| 21 | 15 | 9.728277 | 10.271723 | 9.801466 | 10.198534 | 10.073189 | 9.926811 | 45 | 39 |
| 22 | 30 | 9.728327 | 10.271673 | 9.801535 | 10.198465 | 10.073209 | 9.926791 | 30 | 38 |
| 23 | 45 | 9.728377 | 10.271623 | 9.801605 | 10.198395 | 10.073229 | 9.926771 | 15 | 37 |
| 24 | 21 | 9.728427 | 10.271573 | 9.801675 | 10.198325 | 10.073249 | 9.926751 | 39 | 36 |
| 25 | 15 | 9.728476 | 10.271524 | 9.801745 | 10.198255 | 10.073269 | 9.926731 | 45 | 35 |
| 26 | 30 | 9.728526 | 10.271474 | 9.801815 | 10.198185 | 10.073289 | 9.926711 | 30 | 34 |
| 27 | 45 | 9.728576 | 10.271424 | 9.801885 | 10.198115 | 10.073309 | 9.926691 | 15 | 33 |
| 28 | 22 | 9.728626 | 10.271374 | 9.801955 | 10.198045 | 10.073329 | 9.926671 | 38 | 32 |
| 29 | 15 | 9.728676 | 10.271324 | 9.802024 | 10.197976 | 10.073349 | 9.926651 | 45 | 31 |
| 30 | 30 | 9.728726 | 10.271274 | 9.802094 | 10.197906 | 10.073369 | 9.926631 | 30 | 30 |
| 31 | 45 | 9.728775 | 10.271225 | 9.802164 | 10.197836 | 10.073389 | 9.926611 | 15 | 29 |
| 32 | 23 | 9.728825 | 10.271175 | 9.802234 | 10.197766 | 10.073409 | 9.926591 | 37 | 28 |
| 33 | 15 | 9.728875 | 10.271125 | 9.802304 | 10.197696 | 10.073429 | 9.926571 | 45 | 27 |
| 34 | 30 | 9.728925 | 10.271075 | 9.802374 | 10.197626 | 10.073449 | 9.926551 | 30 | 26 |
| 35 | 45 | 9.728975 | 10.271025 | 9.802443 | 10.197557 | 10.073469 | 9.926531 | 15 | 25 |
| 36 | 24 | 9.729024 | 10.270976 | 9.802513 | 10.197487 | 10.073489 | 9.926511 | 36 | 24 |
| 37 | 15 | 9.729074 | 10.270926 | 9.802583 | 10.197417 | 10.073509 | 9.926491 | 45 | 23 |
| 38 | 30 | 9.729124 | 10.270876 | 9.802653 | 10.197347 | 10.073529 | 9.926471 | 30 | 22 |
| 39 | 45 | 9.729174 | 10.270826 | 9.802723 | 10.197277 | 10.073549 | 9.926451 | 15 | 21 |
| 40 | 25 | 9.729223 | 10.270777 | 9.802792 | 10.197208 | 10.073569 | 9.926431 | 35 | 20 |
| 41 | 15 | 9.729273 | 10.270727 | 9.802862 | 10.197138 | 10.073589 | 9.926411 | 45 | 19 |
| 42 | 30 | 9.729323 | 10.270677 | 9.802932 | 10.197068 | 10.073609 | 9.926391 | 30 | 18 |
| 43 | 45 | 9.729373 | 10.270627 | 9.803002 | 10.196998 | 10.073629 | 9.926371 | 15 | 17 |
| 44 | 26 | 9.729422 | 10.270578 | 9.803072 | 10.196928 | 10.073649 | 9.926351 | 34 | 16 |
| 45 | 15 | 9.729472 | 10.270528 | 9.803141 | 10.196859 | 10.073669 | 9.926331 | 45 | 15 |
| 46 | 30 | 9.729522 | 10.270478 | 9.803211 | 10.196789 | 10.073689 | 9.926311 | 30 | 14 |
| 47 | 45 | 9.729571 | 10.270429 | 9.803281 | 10.196719 | 10.073710 | 9.926290 | 15 | 13 |
| 48 | 27 | 9.729621 | 10.270379 | 9.803351 | 10.196649 | 10.073730 | 9.926270 | 33 | 12 |
| 49 | 15 | 9.729671 | 10.270329 | 9.803420 | 10.196580 | 10.073750 | 9.926250 | 45 | 11 |
| 50 | 30 | 9.729720 | 10.270280 | 9.803490 | 10.196510 | 10.073770 | 9.926230 | 30 | 10 |
| 51 | 45 | 9.729770 | 10.270230 | 9.803560 | 10.196440 | 10.073790 | 9.926210 | 15 | 9 |
| 52 | 28 | 9.729820 | 10.270180 | 9.803630 | 10.196370 | 10.073810 | 9.926190 | 32 | 8 |
| 53 | 15 | 9.729869 | 10.270131 | 9.803699 | 10.196301 | 10.073830 | 9.926170 | 45 | 7 |
| 54 | 30 | 9.729919 | 10.270081 | 9.803769 | 10.196231 | 10.073850 | 9.926150 | 30 | 6 |
| 55 | 45 | 9.729968 | 10.270032 | 9.803839 | 10.196161 | 10.073870 | 9.926130 | 15 | 5 |
| 56 | 29 | 9.730018 | 10.269982 | 9.803908 | 10.196092 | 10.073890 | 9.926110 | 31 | 4 |
| 57 | 15 | 9.730068 | 10.269932 | 9.803978 | 10.196022 | 10.073911 | 9.926089 | 45 | 3 |
| 58 | 30 | 9.730117 | 10.269883 | 9.804048 | 10.195952 | 10.073931 | 9.926069 | 30 | 2 |
| 59 | 45 | 9.730167 | 10.269833 | 9.804118 | 10.195882 | 10.073951 | 9.926049 | 15 | 1 |
| 60 | 30 | 9.730216 | 10.269784 | 9.804187 | 10.195813 | 10.073971 | 9.926029 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | $3^h\ 50^m$. | | LOG. SINES, &c. | | | | 57 deg | | |

| 2h 10m. | | | LOG. SINES, &c. (t.) | | | | 32 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
| 0 | 30 | 9.730216 | 10.269784 | 9.804187 | 10.195813 | 10.073971 | 9.926029 | 30 | 60 |
| 1 | 15 | 9.730266 | 10.269734 | 9.804257 | 10.195743 | 10.073991 | 9.926009 | 45 | 59 |
| 2 | 30 | 9.730316 | 10.269684 | 9.804327 | 10.195673 | 10.074011 | 9.925989 | 30 | 58 |
| 3 | 45 | 9.730365 | 10.269635 | 9.804396 | 10.195604 | 10.074031 | 9.925969 | 15 | 57 |
| 4 | 31 | 9.730415 | 10.269585 | 9.804466 | 10.195534 | 10.074051 | 9.925949 | 29 | 56 |
| 5 | 15 | 9.730464 | 10.269536 | 9.804536 | 10.195464 | 10.074072 | 9.925928 | 45 | 55 |
| 6 | 30 | 9.730514 | 10.269486 | 9.804605 | 10.195395 | 10.074092 | 9.925908 | 30 | 54 |
| 7 | 45 | 9.730563 | 10.269437 | 9.804675 | 10.195325 | 10.074112 | 9.925888 | 15 | 53 |
| 8 | 32 | 9.730613 | 10.269387 | 9.804745 | 10.195255 | 10.074132 | 9.925868 | 28 | 52 |
| 9 | 15 | 9.730662 | 10.269338 | 9.804814 | 10.195186 | 10.074152 | 9.925848 | 45 | 51 |
| 10 | 30 | 9.730712 | 10.269288 | 9.804884 | 10.195116 | 10.074172 | 9.925828 | 30 | 50 |
| 11 | 45 | 9.730761 | 10.269239 | 9.804954 | 10.195046 | 10.074192 | 9.925808 | 15 | 49 |
| 12 | 33 | 9.730811 | 10.269189 | 9.805023 | 10.194977 | 10.074213 | 9.925787 | 27 | 48 |
| 13 | 15 | 9.730860 | 10.269140 | 9.805093 | 10.194907 | 10.074233 | 9.925767 | 45 | 47 |
| 14 | 30 | 9.730910 | 10.269090 | 9.805163 | 10.194837 | 10.074253 | 9.925747 | 30 | 46 |
| 15 | 45 | 9.730959 | 10.269041 | 9.805232 | 10.194768 | 10.074273 | 9.925727 | 15 | 45 |
| 16 | 34 | 9.731009 | 10.268991 | 9.805302 | 10.194698 | 10.074293 | 9.925707 | 26 | 44 |
| 17 | 15 | 9.731058 | 10.268942 | 9.805371 | 10.194629 | 10.074313 | 9.925687 | 45 | 43 |
| 18 | 30 | 9.731108 | 10.268892 | 9.805441 | 10.194559 | 10.074334 | 9.925666 | 30 | 42 |
| 19 | 45 | 9.731157 | 10.268843 | 9.805511 | 10.194489 | 10.074354 | 9.925646 | 15 | 41 |
| 20 | 35 | 9.731206 | 10.268794 | 9.805580 | 10.194420 | 10.074374 | 9.925626 | 25 | 40 |
| 21 | 15 | 9.731256 | 10.268744 | 9.805650 | 10.194350 | 10.074394 | 9.925606 | 45 | 39 |
| 22 | 30 | 9.731305 | 10.268695 | 9.805719 | 10.194281 | 10.074414 | 9.925586 | 30 | 38 |
| 23 | 45 | 9.731355 | 10.268645 | 9.805789 | 10.194211 | 10.074434 | 9.925566 | 15 | 37 |
| 24 | 36 | 9.731404 | 10.268596 | 9.805859 | 10.194141 | 10.074455 | 9.925545 | 24 | 36 |
| 25 | 15 | 9.731453 | 10.268547 | 9.805928 | 10.194072 | 10.074475 | 9.925525 | 45 | 35 |
| 26 | 30 | 9.731503 | 10.268497 | 9.805998 | 10.194002 | 10.074495 | 9.925505 | 30 | 34 |
| 27 | 45 | 9.731552 | 10.268448 | 9.806067 | 10.193933 | 10.074515 | 9.925485 | 15 | 33 |
| 28 | 37 | 9.731601 | 10.268399 | 9.806137 | 10.193863 | 10.074535 | 9.925465 | 23 | 32 |
| 29 | 15 | 9.731651 | 10.268349 | 9.806206 | 10.193794 | 10.074556 | 9.925444 | 45 | 31 |
| 30 | 30 | 9.731700 | 10.268300 | 9.806276 | 10.193724 | 10.074576 | 9.925424 | 30 | 30 |
| 31 | 45 | 9.731749 | 10.268251 | 9.806346 | 10.193654 | 10.074596 | 9.925404 | 15 | 29 |
| 32 | 38 | 9.731799 | 10.268201 | 9.806415 | 10.193585 | 10.074616 | 9.925384 | 22 | 28 |
| 33 | 15 | 9.731848 | 10.268152 | 9.806485 | 10.193515 | 10.074637 | 9.925363 | 45 | 27 |
| 34 | 30 | 9.731897 | 10.268103 | 9.806554 | 10.193446 | 10.074657 | 9.925343 | 30 | 26 |
| 35 | 45 | 9.731947 | 10.268053 | 9.806624 | 10.193376 | 10.074677 | 9.925323 | 15 | 25 |
| 36 | 39 | 9.731996 | 10.268004 | 9.806693 | 10.193307 | 10.074697 | 9.925303 | 21 | 24 |
| 37 | 15 | 9.732045 | 10.267955 | 9.806763 | 10.193237 | 10.074718 | 9.925282 | 45 | 23 |
| 38 | 30 | 9.732095 | 10.267905 | 9.806832 | 10.193168 | 10.074738 | 9.925262 | 30 | 22 |
| 39 | 45 | 9.732144 | 10.267856 | 9.806902 | 10.193098 | 10.074758 | 9.925242 | 15 | 21 |
| 40 | 40 | 9.732193 | 10.267807 | 9.806971 | 10.193029 | 10.074778 | 9.925222 | 20 | 20 |
| 41 | 15 | 9.732242 | 10.267758 | 9.807041 | 10.192959 | 10.074799 | 9.925201 | 45 | 19 |
| 42 | 30 | 9.732292 | 10.267708 | 9.807110 | 10.192890 | 10.074819 | 9.925181 | 30 | 18 |
| 43 | 45 | 9.732341 | 10.267659 | 9.807180 | 10.192820 | 10.074839 | 9.925161 | 15 | 17 |
| 44 | 41 | 9.732390 | 10.267610 | 9.807249 | 10.192751 | 10.074859 | 9.925141 | 19 | 16 |
| 45 | 15 | 9.732439 | 10.267561 | 9.807319 | 10.192681 | 10.074880 | 9.925120 | 45 | 15 |
| 46 | 30 | 9.732489 | 10.267511 | 9.807388 | 10.192612 | 10.074900 | 9.925100 | 30 | 14 |
| 47 | 45 | 9.732538 | 10.267462 | 9.807458 | 10.192542 | 10.074920 | 9.925080 | 15 | 13 |
| 48 | 42 | 9.732587 | 10.267413 | 9.807527 | 10.192473 | 10.074940 | 9.925060 | 18 | 12 |
| 49 | 15 | 9.732636 | 10.267364 | 9.807597 | 10.192403 | 10.074961 | 9.925039 | 45 | 11 |
| 50 | 30 | 9.732685 | 10.267315 | 9.807666 | 10.192334 | 10.074981 | 9.925019 | 30 | 10 |
| 51 | 45 | 9.732734 | 10.267266 | 9.807736 | 10.192264 | 10.075001 | 9.924999 | 15 | 9 |
| 52 | 43 | 9.732784 | 10.267216 | 9.807805 | 10.192195 | 10.075021 | 9.924979 | 17 | 8 |
| 53 | 15 | 9.732833 | 10.267167 | 9.807875 | 10.192125 | 10.075042 | 9.924958 | 45 | 7 |
| 54 | 30 | 9.732882 | 10.267118 | 9.807944 | 10.192056 | 10.075062 | 9.924938 | 30 | 6 |
| 55 | 45 | 9.732931 | 10.267069 | 9.808013 | 10.191987 | 10.075082 | 9.924918 | 15 | 5 |
| 56 | 44 | 9.732980 | 10.267020 | 9.808083 | 10.191917 | 10.075103 | 9.924897 | 16 | 4 |
| 57 | 15 | 9.733029 | 10.266971 | 9.808152 | 10.191848 | 10.075123 | 9.924877 | 45 | 3 |
| 58 | 30 | 9.733079 | 10.266921 | 9.808222 | 10.191778 | 10.075143 | 9.924857 | 30 | 2 |
| 59 | 45 | 9.733128 | 10.266872 | 9.808291 | 10.191709 | 10.075164 | 9.924836 | 15 | 1 |
| 60 | 45 | 9.733177 | 10.266823 | 9.808361 | 10.191639 | 10.075184 | 9.924816 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ | sec. |
| 3h 49m. | | | LOG. SINES, &c. | | | | 57 deg. | | |

| 2h 11m. | | LOG. SINES, &c. (t.) | | | | | 32 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.733177 | 10.266823 | 9 808361 | 10.191639 | 10.075184 | 9.924816 | 15 | 60 |
| 1 | 15 | 9.733226 | 10.266774 | 9.808430 | 10.191570 | 10.075204 | 9.924796 | 45 | 59 |
| 2 | 30 | 9.733275 | 10.266725 | 9.808499 | 10.191501 | 10.075225 | 9.924775 | 30 | 58 |
| 3 | 45 | 9.733324 | 10.266676 | 9.808569 | 10.191431 | 10.075245 | 9.924755 | 15 | 57 |
| 4 | 46 | 9.733373 | 10.266627 | 9.808638 | 10.191362 | 10.075265 | 9.924735 | 14 | 56 |
| 5 | 15 | 9.733422 | 10.266578 | 9.808708 | 10.191292 | 10.075286 | 9.924714 | 45 | 55 |
| 6 | 30 | 9.733471 | 10.266529 | 9.808777 | 10.191223 | 10.075306 | 9.924694 | 30 | 54 |
| 7 | 45 | 9.733520 | 10.266480 | 9.808846 | 10.191154 | 10.075326 | 9.924674 | 15 | 53 |
| 8 | 47 | 9.733569 | 10.266431 | 9.808916 | 10.191084 | 10.075347 | 9.924653 | 13 | 52 |
| 9 | 15 | 9.733618 | 10.266382 | 9.808985 | 10.191015 | 10.075367 | 9.924633 | 45 | 51 |
| 10 | 30 | 9.733667 | 10.266333 | 9.809055 | 10.190945 | 10.075387 | 9.924613 | 30 | 50 |
| 11 | 45 | 9.733716 | 10.266284 | 9.809124 | 10.190876 | 10.075408 | 9.924592 | 15 | 49 |
| 12 | 48 | 9.733765 | 10.266235 | 9 809193 | 10.190807 | 10.075428 | 9.924572 | 12 | 48 |
| 13 | 15 | 9.733814 | 10.266186 | 9.809263 | 10.190737 | 10.075448 | 9.924552 | 45 | 47 |
| 14 | 30 | 9.733863 | 10.266137 | 9.809332 | 10.190668 | 10.075469 | 9.924531 | 30 | 46 |
| 15 | 45 | 9.733912 | 10.266088 | 9.809401 | 10.190599 | 10.075489 | 9.924511 | 15 | 45 |
| 16 | 49 | 9.733961 | 10.266039 | 9.809471 | 10.190529 | 10.075509 | 9.924491 | 11 | 44 |
| 17 | 15 | 9.734010 | 10.265990 | 9.809540 | 10.190460 | 10.075530 | 9.924470 | 45 | 43 |
| 18 | 30 | 9.734059 | 10.265941 | 9.809609 | 10.190391 | 10.075550 | 9.924450 | 30 | 42 |
| 19 | 45 | 9.734108 | 10.265892 | 9.809679 | 10.190321 | 10.075570 | 9.924430 | 15 | 41 |
| 20 | 50 | 9.734157 | 10.265843 | 9.809748 | 10.190252 | 10.075591 | 9.924409 | 10 | 40 |
| 21 | 15 | 9.734206 | 10.265794 | 9.809817 | 10.190183 | 10 075611 | 9.924389 | 45 | 39 |
| 22 | 30 | 9.734255 | 10.265745 | 9.809887 | 10.190113 | 10.075632 | 9.924368 | 30 | 38 |
| 23 | 45 | 9.734304 | 10.265696 | 9.809956 | 10.190044 | 10.075652 | 9.924348 | 15 | 37 |
| 24 | 51 | 9.734353 | 10.265647 | 9.810025 | 10.189975 | 10.075672 | 9.924328 | 9 | 36 |
| 25 | 15 | 9.734402 | 10.265598 | 9.810095 | 10.189905 | 10.075693 | 9.924307 | 45 | 35 |
| 26 | 30 | 9.734451 | 10.265549 | 9.810164 | 10.189836 | 10.075713 | 9.924287 | 30 | 34 |
| 27 | 45 | 9.734500 | 10.265500 | 9.810233 | 10.189767 | 10.075734 | 9.924266 | 15 | 33 |
| 28 | 52 | 9.734548 | 10.265452 | 9.810302 | 10.189698 | 10.075754 | 9.924246 | 8 | 32 |
| 29 | 15 | 9.734597 | 10.265403 | 9.810372 | 10.189628 | 10.075774 | 9.924226 | 45 | 31 |
| 30 | 30 | 9.734646 | 10.265354 | 9.810441 | 10.189559 | 10.075795 | 9.924205 | 30 | 30 |
| 31 | 45 | 9.734695 | 10.265305 | 9.810510 | 10.189490 | 10.075815 | 9.924185 | 15 | 29 |
| 32 | 53 | 9.734744 | 10.265256 | 9.810580 | 10.189420 | 10.075836 | 9.924164 | 7 | 28 |
| 33 | 15 | 9.734793 | 10.265207 | 9.810649 | 10.189351 | 10.075856 | 9.924144 | 45 | 27 |
| 34 | 30 | 9.734842 | 10.265158 | 9.810718 | 10.189282 | 10.075876 | 9.924124 | 30 | 26 |
| 35 | 45 | 9.734890 | 10.265110 | 9.810787 | 10.189213 | 10.075897 | 9.924103 | 15 | 25 |
| 36 | 54 | 9.734939 | 10.265061 | 9.810857 | 10.189143 | 10.075917 | 9 924083 | 6 | 24 |
| 37 | 15 | 9.734988 | 10 265012 | 9.810926 | 10.189074 | 10.075938 | 9.924062 | 45 | 23 |
| 38 | 30 | 9.735037 | 10.264963 | 9.810995 | 10.189005 | 10.075958 | 9.924042 | 30 | 22 |
| 39 | 45 | 9.735086 | 10.264914 | 9.811064 | 10.188936 | 10.075979 | 9.924021 | 15 | 21 |
| 40 | 55 | 9.735134 | 10.264866 | 9.811134 | 10.188866 | 10.075999 | 9.924001 | 5 | 20 |
| 41 | 15 | 9.735183 | 10.264817 | 9.811203 | 10.188797 | 10.076020 | 9.923980 | 45 | 19 |
| 42 | 30 | 9.735232 | 10.264768 | 9.811272 | 10.188728 | 10.076040 | 9.923960 | 30 | 18 |
| 43 | 45 | 9.735281 | 10.264719 | 9.811341 | 10.188659 | 10.076060 | 9.923940 | 15 | 17 |
| 44 | 56 | 9.735330 | 10.264670 | 9.811410 | 10.188590 | 10.076081 | 9.923919 | 4 | 16 |
| 45 | 15 | 9.735378 | 10.264622 | 9.811480 | 10.188520 | 10.076101 | 9.923899 | 45 | 15 |
| 46 | 30 | 9.735427 | 10.264573 | 9.811549 | 10.188451 | 10.076122 | 9.923878 | 30 | 14 |
| 47 | 45 | 9.735476 | 10.264524 | 9.811618 | 10.188382 | 10.076142 | 9.923858 | 15 | 13 |
| 48 | 57 | 9.735525 | 10.264475 | 9.811687 | 10.188313 | 10.076163 | 9.923837 | 3 | 12 |
| 49 | 15 | 9.735573 | 10.264427 | 9.811756 | 10.188244 | 10.076183 | 9.923817 | 45 | 11 |
| 50 | 30 | 9.735622 | 10.264378 | 9.811826 | 10.188174 | 10.076204 | 9.923796 | 30 | 10 |
| 51 | 45 | 9.735671 | 10.264329 | 9.811895 | 10.188105 | 10.076224 | 9.923776 | 15 | 9 |
| 52 | 58 | 9.735719 | 10.264281 | 9.811964 | 10.188036 | 10.076245 | 9.923755 | 2 | 8 |
| 53 | 15 | 9.735768 | 10.264232 | 9.812033 | 10.187967 | 10.076265 | 9.923735 | 45 | 7 |
| 54 | 30 | 9.735817 | 10.264183 | 9.812102 | 10.187898 | 10.076286 | 9.923714 | 30 | 6 |
| 55 | 45 | 9.735865 | 10.264135 | 9.812172 | 10.187828 | 10.076306 | 9.923694 | 15 | 5 |
| 56 | 59 | 9.735914 | 10.264086 | 9.812241 | 10.187759 | 10.076327 | 9.923673 | 1 | 4 |
| 57 | 15 | 9.735963 | 10.264037 | 9.812310 | 10.187690 | 10.076347 | 9.923653 | 45 | 3 |
| 58 | 30 | 9.736011 | 10.263989 | 9.812379 | 10.187621 | 10.076368 | 9.923632 | 30 | 2 |
| 59 | 45 | 9.736060 | 10.263940 | 9.812448 | 10.187552 | 10.076388 | 9.923612 | 15 | 1 |
| 60 | 60 | 9.736109 | 10.263891 | 9.812517 | 10.187483 | 10.076409 | 9.923591 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3° 48m. | | | LOG. SINES &c. | | | | | 57 deg. | |

| 9h 12m. | | | LOG. SINES, &c. (t.) | | | | 33 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.736109 | 10.263891 | 9.812517 | 10.187483 | 10.076409 | 9.923591 | 60 | 60 |
| 1 | 15 | 9.736157 | 10.263843 | 9.812586 | 10.187414 | 10.076429 | 9.923571 | 45 | 59 |
| 2 | 30 | 9.736206 | 10.263794 | 9.812656 | 10.187344 | 10.076450 | 9.923550 | 30 | 58 |
| 3 | 45 | 9.736255 | 10.263745 | 9.812725 | 10.187275 | 10.076470 | 9.923530 | 15 | 57 |
| 4 | 1 | 9.736303 | 10.263697 | 9.812794 | 10.187206 | 10.076491 | 9.923509 | 59 | 56 |
| 5 | 15 | 9.736352 | 10.263648 | 9.812863 | 10.187137 | 10.076511 | 9.923489 | 45 | 55 |
| 6 | 30 | 9.736400 | 10.263600 | 9.812932 | 10.187068 | 10.076532 | 9.923468 | 30 | 54 |
| 7 | 45 | 9.736449 | 10.263551 | 9.813001 | 10.186999 | 10.076552 | 9.923448 | 15 | 53 |
| 8 | 2 | 9.736498 | 10.263502 | 9.813070 | 10.186930 | 10.076573 | 9.923427 | 58 | 52 |
| 9 | 15 | 9.736546 | 10.263454 | 9.813139 | 10.186861 | 10.076593 | 9.923407 | 45 | 51 |
| 10 | 30 | 9.736595 | 10.263405 | 9.813209 | 10.186791 | 10.076614 | 9.923386 | 30 | 50 |
| 11 | 45 | 9.736643 | 10.263357 | 9.813278 | 10.186722 | 10.076634 | 9.923366 | 15 | 49 |
| 12 | 3 | 9.736692 | 10.263308 | 9.813347 | 10.186653 | 10.076655 | 9.923345 | 57 | 48 |
| 13 | 15 | 9.736740 | 10.263260 | 9.813416 | 10.186584 | 10.076676 | 9.923324 | 45 | 47 |
| 14 | 30 | 9.736789 | 10.263211 | 9.813485 | 10.186515 | 10.076696 | 9.923304 | 30 | 46 |
| 15 | 45 | 9.736837 | 10.263163 | 9.813554 | 10.186446 | 10.076717 | 9.923283 | 15 | 45 |
| 16 | 4 | 9.736886 | 10.263114 | 9.813623 | 10.186377 | 10.076737 | 9.923263 | 56 | 44 |
| 17 | 15 | 9.736934 | 10.263066 | 9.813692 | 10.186308 | 10.076758 | 9.923242 | 45 | 43 |
| 18 | 30 | 9.736983 | 10.263017 | 9.813761 | 10.186239 | 10.076778 | 9.923222 | 30 | 42 |
| 19 | 45 | 9.737031 | 10.262969 | 9.813830 | 10.186170 | 10.076799 | 9.923201 | 15 | 41 |
| 20 | 5 | 9.737080 | 10.262920 | 9.813899 | 10.186101 | 10.076820 | 9.923180 | 55 | 40 |
| 21 | 15 | 9.737128 | 10.262872 | 9.813968 | 10.186032 | 10.076840 | 9.923160 | 45 | 39 |
| 22 | 30 | 9.737177 | 10.262823 | 9.814037 | 10.185963 | 10.076861 | 9.923139 | 30 | 38 |
| 23 | 45 | 9.737225 | 10.262775 | 9.814106 | 10.185894 | 10.076881 | 9.923119 | 15 | 37 |
| 24 | 6 | 9.737274 | 10.262726 | 9.814175 | 10.185825 | 10.076902 | 9.923098 | 54 | 36 |
| 25 | 15 | 9.737322 | 10.262678 | 9.814245 | 10.185755 | 10.076922 | 9.923078 | 45 | 35 |
| 26 | 30 | 9.737371 | 10.262629 | 9.814314 | 10.185686 | 10.076943 | 9.923057 | 30 | 34 |
| 27 | 45 | 9.737419 | 10.262581 | 9.814383 | 10.185617 | 10.076964 | 9.923036 | 15 | 33 |
| 28 | 7 | 9.737467 | 10.262533 | 9.814452 | 10.185548 | 10.076984 | 9.923016 | 53 | 32 |
| 29 | 15 | 9.737516 | 10.262484 | 9.814521 | 10.185479 | 10.077005 | 9.922995 | 45 | 31 |
| 30 | 30 | 9.737564 | 10.262436 | 9.814590 | 10.185410 | 10.077025 | 9.922975 | 30 | 30 |
| 31 | 45 | 9.737613 | 10.262387 | 9.814659 | 10.185341 | 10.077046 | 9.922954 | 15 | 29 |
| 32 | 8 | 9.737661 | 10.262339 | 9.814728 | 10.185272 | 10.077067 | 9.922933 | 52 | 28 |
| 33 | 15 | 9.737709 | 10.262291 | 9.814797 | 10.185203 | 10.077087 | 9.922913 | 45 | 27 |
| 34 | 30 | 9.737758 | 10.262242 | 9.814866 | 10.185134 | 10.077108 | 9.922892 | 30 | 26 |
| 35 | 45 | 9.737806 | 10.262194 | 9.814935 | 10.185065 | 10.077129 | 9.922871 | 15 | 25 |
| 36 | 9 | 9.737855 | 10.262145 | 9.815004 | 10.184996 | 10.077149 | 9.922851 | 51 | 24 |
| 37 | 15 | 9.737903 | 10.262097 | 9.815073 | 10.184927 | 10.077170 | 9.922830 | 45 | 23 |
| 38 | 30 | 9.737951 | 10.262049 | 9.815142 | 10.184858 | 10.077190 | 9.922810 | 30 | 22 |
| 39 | 45 | 9.738000 | 10.262000 | 9.815211 | 10.184789 | 10.077211 | 9.922789 | 15 | 21 |
| 40 | 10 | 9.738048 | 10.261952 | 9.815279 | 10.184721 | 10.077232 | 9.922768 | 50 | 20 |
| 41 | 15 | 9.738096 | 10.261904 | 9.815348 | 10.184652 | 10.077252 | 9.922748 | 45 | 19 |
| 42 | 30 | 9.738145 | 10.261855 | 9.815417 | 10.184583 | 10.077273 | 9.922727 | 30 | 18 |
| 43 | 45 | 9.738193 | 10.261807 | 9.815486 | 10.184514 | 10.077294 | 9.922706 | 15 | 17 |
| 44 | 11 | 9.738241 | 10.261759 | 9.815555 | 10.184445 | 10.077314 | 9.922686 | 49 | 16 |
| 45 | 15 | 9.738289 | 10.261711 | 9.815624 | 10.184376 | 10.077335 | 9.922665 | 45 | 15 |
| 46 | 30 | 9.738338 | 10.261662 | 9.815693 | 10.184307 | 10.077356 | 9.922644 | 30 | 14 |
| 47 | 45 | 9.738386 | 10.261614 | 9.815762 | 10.184238 | 10.077376 | 9.922624 | 15 | 13 |
| 48 | 12 | 9.738434 | 10.261566 | 9.815831 | 10.184169 | 10.077397 | 9.922603 | 48 | 12 |
| 49 | 15 | 9.738482 | 10.261518 | 9.815900 | 10.184100 | 10.077418 | 9.922582 | 45 | 11 |
| 50 | 30 | 9.738531 | 10.261469 | 9.815969 | 10.184031 | 10.077438 | 9.922562 | 30 | 10 |
| 51 | 45 | 9.738579 | 10.261421 | 9.816038 | 10.183962 | 10.077459 | 9.922541 | 15 | 9 |
| 52 | 13 | 9.738627 | 10.261373 | 9.816107 | 10.183893 | 10.077480 | 9.922520 | 47 | 8 |
| 53 | 15 | 9.738675 | 10.261325 | 9.816176 | 10.183824 | 10.077500 | 9.922500 | 45 | 7 |
| 54 | 30 | 9.738724 | 10.261276 | 9.816245 | 10.183755 | 10.077521 | 9.922479 | 30 | 6 |
| 55 | 45 | 9.738772 | 10.261228 | 9.816313 | 10.183687 | 10.077542 | 9.922458 | 15 | 5 |
| 56 | 14 | 9.738820 | 10.261180 | 9.816382 | 10.183618 | 10.077562 | 9.922438 | 46 | 4 |
| 57 | 15 | 9.738868 | 10.261132 | 9.816451 | 10.183549 | 10.077583 | 9.922417 | 45 | 3 |
| 58 | 30 | 9.738916 | 10.261084 | 9.816520 | 10.183480 | 10.077604 | 9.922396 | 30 | 2 |
| 59 | 45 | 9.738965 | 10.261035 | 9.816589 | 10.183411 | 10.077624 | 9.922376 | 15 | 1 |
| 60 | 15 | 9.739013 | 10.260987 | 9.816658 | 10.183342 | 10.077645 | 9.922355 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 2h 13m. | | LOG. SINES, &c. (t.) | | | | | 33 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.739013 | 10.260987 | 9.816658 | 10.183342 | 10.077645 | 9.922355 | 45 | 60 |
| 1 | 15 | 9.739061 | 10.260939 | 9.816727 | 10.183273 | 10.077666 | 9.922334 | 45 | 59 |
| 2 | 30 | 9.739109 | 10.260891 | 9.816796 | 10.183204 | 10.077687 | 9.922313 | 30 | 58 |
| 3 | 45 | 9.739157 | 10.260843 | 9.816865 | 10.183135 | 10.077707 | 9.922293 | 15 | 57 |
| 4 | 16 | 9.739205 | 10.260795 | 9.816933 | 10.183067 | 10.077728 | 9.922272 | 44 | 56 |
| 5 | 15 | 9.739254 | 10.260746 | 9.817002 | 10.182998 | 10.077749 | 9.922251 | 45 | 55 |
| 6 | 30 | 9.739302 | 10.260698 | 9.817071 | 10.182929 | 10.077769 | 9.922231 | 30 | 54 |
| 7 | 45 | 9.739350 | 10.260650 | 9.817140 | 10.182860 | 10.077790 | 9.922210 | 15 | 53 |
| 8 | 17 | 9.739398 | 10.260602 | 9.817209 | 10.182791 | 10.077811 | 9.922189 | 43 | 52 |
| 9 | 15 | 9.739446 | 10.260554 | 9.817278 | 10.182722 | 10.077832 | 9.922168 | 45 | 51 |
| 10 | 30 | 9.739494 | 10.260506 | 9.817346 | 10.182654 | 10.077852 | 9.922148 | 30 | 50 |
| 11 | 45 | 9.739542 | 10.260458 | 9.817415 | 10.182585 | 10.077873 | 9.922127 | 15 | 49 |
| 12 | 18 | 9.739590 | 10.260410 | 9.817484 | 10.182516 | 10.077894 | 9.922106 | 42 | 48 |
| 13 | 15 | 9.739638 | 10.260362 | 9.817553 | 10.182447 | 10.077915 | 9.922085 | 45 | 47 |
| 14 | 30 | 9.739686 | 10.260314 | 9.817622 | 10.182378 | 10.077935 | 9.922065 | 30 | 46 |
| 15 | 45 | 9.739735 | 10.260265 | 9.817691 | 10.182309 | 10.077956 | 9.922044 | 15 | 45 |
| 16 | 19 | 9.739783 | 10.260217 | 9.817759 | 10.182241 | 10.077977 | 9.922023 | 41 | 44 |
| 17 | 15 | 9.739831 | 10.260169 | 9.817828 | 10.182172 | 10.077998 | 9.922002 | 45 | 43 |
| 18 | 30 | 9.739879 | 10.260121 | 9.817897 | 10.182103 | 10.078018 | 9.921982 | 30 | 42 |
| 19 | 45 | 9.739927 | 10.260073 | 9.817966 | 10.182034 | 10.078039 | 9.921961 | 15 | 41 |
| 20 | 20 | 9.739975 | 10.260025 | 9.818035 | 10.181965 | 10.078060 | 9.921940 | 40 | 40 |
| 21 | 15 | 9.740023 | 10.259977 | 9.818103 | 10.181897 | 10.078081 | 9.921919 | 45 | 39 |
| 22 | 30 | 9.740071 | 10.259929 | 9.818172 | 10.181828 | 10.078101 | 9.921899 | 30 | 38 |
| 23 | 45 | 9.740119 | 10.259881 | 9.818241 | 10.181759 | 10.078122 | 9.921878 | 15 | 37 |
| 24 | 21 | 9.740167 | 10.259833 | 9.818310 | 10.181690 | 10.078143 | 9.921857 | 39 | 36 |
| 25 | 15 | 9.740215 | 10.259785 | 9.818379 | 10.181621 | 10.078164 | 9.921836 | 45 | 35 |
| 26 | 30 | 9.740263 | 10.259737 | 9.818447 | 10.181553 | 10.078185 | 9.921815 | 30 | 34 |
| 27 | 45 | 9.740311 | 10.259689 | 9.818516 | 10.181484 | 10.078205 | 9.921795 | 15 | 33 |
| 28 | 22 | 9.740359 | 10.259641 | 9.818585 | 10.181415 | 10.078226 | 9.921774 | 38 | 32 |
| 29 | 15 | 9.740407 | 10.259593 | 9.818654 | 10.181346 | 10.078247 | 9.921753 | 45 | 31 |
| 30 | 30 | 9.740455 | 10.259545 | 9.818722 | 10.181278 | 10.078268 | 9.921732 | 30 | 30 |
| 31 | 45 | 9.740502 | 10.259498 | 9.818791 | 10.181209 | 10.078289 | 9.921711 | 15 | 29 |
| 32 | 23 | 9.740550 | 10.259450 | 9.818860 | 10.181140 | 10.078309 | 9.921691 | 37 | 28 |
| 33 | 15 | 9.740598 | 10.259402 | 9.818929 | 10.181071 | 10.078330 | 9.921670 | 45 | 27 |
| 34 | 30 | 9.740646 | 10.259354 | 9.818997 | 10.181003 | 10.078351 | 9.921649 | 30 | 26 |
| 35 | 45 | 9.740694 | 10.259306 | 9.819066 | 10.180934 | 10.078372 | 9.921628 | 15 | 25 |
| 36 | 24 | 9.740742 | 10.259258 | 9.819135 | 10.180865 | 10.078393 | 9.921607 | 36 | 24 |
| 37 | 15 | 9.740790 | 10.259210 | 9.819203 | 10.180797 | 10.078414 | 9.921586 | 45 | 23 |
| 38 | 30 | 9.740838 | 10.259162 | 9.819272 | 10.180728 | 10.078434 | 9.921566 | 30 | 22 |
| 39 | 45 | 9.740886 | 10.259114 | 9.819341 | 10.180659 | 10.078455 | 9.921545 | 15 | 21 |
| 40 | 25 | 9.740934 | 10.259066 | 9.819410 | 10.180590 | 10.078476 | 9.921524 | 35 | 20 |
| 41 | 15 | 9.740981 | 10.259019 | 9.819478 | 10.180522 | 10.078497 | 9.921503 | 45 | 19 |
| 42 | 30 | 9.741029 | 10.258971 | 9.819547 | 10.180453 | 10.078518 | 9.921482 | 30 | 18 |
| 43 | 45 | 9.741077 | 10.258923 | 9.819616 | 10.180384 | 10.078539 | 9.921461 | 15 | 17 |
| 44 | 26 | 9.741125 | 10.258875 | 9.819684 | 10.180316 | 10.078559 | 9.921441 | 34 | 16 |
| 45 | 15 | 9.741173 | 10.258827 | 9.819753 | 10.180247 | 10.078580 | 9.921420 | 45 | 15 |
| 46 | 30 | 9.741221 | 10.258779 | 9.819822 | 10.180178 | 10.078601 | 9.921399 | 30 | 14 |
| 47 | 45 | 9.741268 | 10.258732 | 9.819890 | 10.180110 | 10.078622 | 9.921378 | 15 | 13 |
| 48 | 27 | 9.741316 | 10.258684 | 9.819959 | 10.180041 | 10.078643 | 9.921357 | 33 | 12 |
| 49 | 15 | 9.741364 | 10.258636 | 9.820028 | 10.179972 | 10.078664 | 9.921336 | 45 | 11 |
| 50 | 30 | 9.741412 | 10.258588 | 9.820096 | 10.179904 | 10.078685 | 9.921315 | 30 | 10 |
| 51 | 45 | 9.741460 | 10.258540 | 9.820165 | 10.179835 | 10.078705 | 9.921295 | 15 | 9 |
| 52 | 28 | 9.741507 | 10.258493 | 9.820234 | 10.179766 | 10.078726 | 9.921274 | 32 | 8 |
| 53 | 15 | 9.741555 | 10.258445 | 9.820302 | 10.179698 | 10.078747 | 9.921253 | 45 | 7 |
| 54 | 30 | 9.741603 | 10.258397 | 9.820371 | 10.179629 | 10.078768 | 9.921232 | 30 | 6 |
| 55 | 45 | 9.741651 | 10.258349 | 9.820440 | 10.179560 | 10.078789 | 9.921211 | 15 | 5 |
| 56 | 29 | 9.741699 | 10.258301 | 9.820508 | 10.179492 | 10.078810 | 9.921190 | 31 | 4 |
| 57 | 15 | 9.741746 | 10.258254 | 9.820577 | 10.179423 | 10.078831 | 9.921169 | 45 | 3 |
| 58 | 30 | 9.741794 | 10.258206 | 9.820646 | 10.179354 | 10.078852 | 9.921148 | 30 | 2 |
| 59 | 45 | 9.741842 | 10.258158 | 9.820714 | 10.179286 | 10.078873 | 9.921127 | 15 | 1 |
| 60 | 30 | 9.741889 | 10.258111 | 9.820783 | 10.179217 | 10.078893 | 9.921107 | 30 | 0 |
| sec. | ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 46m. | | | | LOG. SINES, &c. | | | 56 deg. | | |

| 2h 14m. | | | | LOG. SINES, &c. (t.) | | | | 33 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.741889 | 10.258111 | 9.820783 | 10.179217 | 10.078893 | 9.921107 | 30 | 60 |
| 1 | 15 | 9.741937 | 10.258063 | 9.820851 | 10.179149 | 10.078914 | 9.921086 | 45 | 59 |
| 2 | 30 | 9.741985 | 10.258015 | 9.820920 | 10.179080 | 10.078935 | 9.921065 | 30 | 58 |
| 3 | 45 | 9.742033 | 10.257967 | 9.820989 | 10.179011 | 10.078956 | 9.921044 | 15 | 57 |
| 4 | 31 | 9.742080 | 10.257920 | 9.821057 | 10.178943 | 10.078977 | 9.921023 | 29 | 56 |
| 5 | 15 | 9.742128 | 10.257872 | 9.821126 | 10.178874 | 10.078998 | 9.921002 | 45 | 55 |
| 6 | 30 | 9.742176 | 10.257824 | 9.821195 | 10.178805 | 10.079019 | 9.920981 | 30 | 54 |
| 7 | 45 | 9.742223 | 10.257777 | 9.821263 | 10.178737 | 10.079040 | 9.920960 | 15 | 53 |
| 8 | 32 | 9.742271 | 10.257729 | 9.821332 | 10.178668 | 10.079061 | 9.920939 | 28 | 52 |
| 9 | 15 | 9.742319 | 10.257681 | 9.821400 | 10.178600 | 10.079082 | 9.920918 | 45 | 51 |
| 10 | 30 | 9.742366 | 10.257634 | 9.821469 | 10.178531 | 10.079103 | 9.920897 | 30 | 50 |
| 11 | 45 | 9.742414 | 10.257586 | 9.821537 | 10.178463 | 10.079124 | 9.920876 | 15 | 49 |
| 12 | 33 | 9.742462 | 10.257538 | 9.821606 | 10.178394 | 10.079145 | 9.920855 | 27 | 48 |
| 13 | 15 | 9.742509 | 10.257491 | 9.821675 | 10.178325 | 10.079165 | 9.920835 | 45 | 47 |
| 14 | 30 | 9.742557 | 10.257443 | 9.821743 | 10.178257 | 10.079186 | 9.920814 | 30 | 46 |
| 15 | 45 | 9.742604 | 10.257396 | 9.821812 | 10.178188 | 10.079207 | 9.920793 | 15 | 45 |
| 16 | 34 | 9.742652 | 10.257348 | 9.821880 | 10.178120 | 10.079228 | 9.920772 | 26 | 44 |
| 17 | 15 | 9.742700 | 10.257300 | 9.821949 | 10.178051 | 10.079249 | 9.920751 | 45 | 43 |
| 18 | 30 | 9.742747 | 10.257253 | 9.822017 | 10.177983 | 10.079270 | 9.920730 | 30 | 42 |
| 19 | 45 | 9.742795 | 10.257205 | 9.822086 | 10.177914 | 10.079291 | 9.920709 | 15 | 41 |
| 20 | 35 | 9.742842 | 10.257158 | 9.822154 | 10.177846 | 10.079312 | 9.920688 | 25 | 40 |
| 21 | 15 | 9.742890 | 10.257110 | 9.822223 | 10.177777 | 10.079333 | 9.920667 | 45 | 39 |
| 22 | 30 | 9.742937 | 10.257063 | 9.822291 | 10.177709 | 10.079354 | 9.920646 | 30 | 38 |
| 23 | 45 | 9.742985 | 10.257015 | 9.822360 | 10.177640 | 10.079375 | 9.920625 | 15 | 37 |
| 24 | 36 | 9.743032 | 10.256968 | 9.822429 | 10.177571 | 10.079396 | 9.920604 | 24 | 36 |
| 25 | 15 | 9.743080 | 10.256920 | 9.822497 | 10.177503 | 10.079417 | 9.920583 | 45 | 35 |
| 26 | 30 | 9.743128 | 10.256872 | 9.822566 | 10.177434 | 10.079438 | 9.920562 | 30 | 34 |
| 27 | 45 | 9.743175 | 10.256825 | 9.822634 | 10.177366 | 10.079459 | 9.920541 | 15 | 33 |
| 28 | 37 | 9.743223 | 10.256777 | 9.822703 | 10.177297 | 10.079480 | 9.920520 | 23 | 32 |
| 29 | 15 | 9.743270 | 10.256730 | 9.822771 | 10.177229 | 10.079501 | 9.920499 | 45 | 31 |
| 30 | 30 | 9.743318 | 10.256682 | 9.822840 | 10.177160 | 10.079522 | 9.920478 | 30 | 30 |
| 31 | 45 | 9.743365 | 10.256635 | 9.822908 | 10.177092 | 10.079543 | 9.920457 | 15 | 29 |
| 32 | 38 | 9.743413 | 10.256587 | 9.822977 | 10.177023 | 10.079564 | 9.920436 | 22 | 28 |
| 33 | 15 | 9.743460 | 10.256540 | 9.823045 | 10.176955 | 10.079585 | 9.920415 | 45 | 27 |
| 34 | 30 | 9.743507 | 10.256493 | 9.823114 | 10.176886 | 10.079606 | 9.920394 | 30 | 26 |
| 35 | 45 | 9.743555 | 10.256445 | 9.823182 | 10.176818 | 10.079627 | 9.920373 | 15 | 25 |
| 36 | 39 | 9.743602 | 10.256398 | 9.823250 | 10.176750 | 10.079648 | 9.920352 | 21 | 24 |
| 37 | 15 | 9.743650 | 10.256350 | 9.823319 | 10.176681 | 10.079669 | 9.920331 | 45 | 23 |
| 38 | 30 | 9.743697 | 10.256303 | 9.823387 | 10.176613 | 10.079690 | 9.920310 | 30 | 22 |
| 39 | 45 | 9.743745 | 10.256255 | 9.823456 | 10.176544 | 10.079711 | 9.920289 | 15 | 21 |
| 40 | 40 | 9.743792 | 10.256208 | 9.823524 | 10.176476 | 10.079732 | 9.920268 | 20 | 20 |
| 41 | 15 | 9.743840 | 10.256160 | 9.823593 | 10.176407 | 10.079753 | 9.920247 | 45 | 19 |
| 42 | 30 | 9.743887 | 10.256113 | 9.823661 | 10.176339 | 10.079774 | 9.920226 | 30 | 18 |
| 43 | 45 | 9.743934 | 10.256066 | 9.823730 | 10.176270 | 10.079795 | 9.920205 | 15 | 17 |
| 44 | 41 | 9.743982 | 10.256018 | 9.823798 | 10.176202 | 10.079816 | 9.920184 | 19 | 16 |
| 45 | 15 | 9.744029 | 10.255971 | 9.823867 | 10.176133 | 10.079837 | 9.920163 | 45 | 15 |
| 46 | 30 | 9.744076 | 10.255924 | 9.823935 | 10.176065 | 10.079859 | 9.920141 | 30 | 14 |
| 47 | 45 | 9.744124 | 10.255876 | 9.824003 | 10.175997 | 10.079880 | 9.920120 | 15 | 13 |
| 48 | 42 | 9.744171 | 10.255829 | 9.824072 | 10.175928 | 10.079901 | 9.920099 | 18 | 12 |
| 49 | 15 | 9.744219 | 10.255781 | 9.824140 | 10.175860 | 10.079922 | 9.920078 | 45 | 11 |
| 50 | 30 | 9.744266 | 10.255734 | 9.824209 | 10.175791 | 10.079943 | 9.920057 | 30 | 10 |
| 51 | 45 | 9.744313 | 10.255687 | 9.824277 | 10.175723 | 10.079964 | 9.920036 | 15 | 9 |
| 52 | 43 | 9.744361 | 10.255639 | 9.824345 | 10.175655 | 10.079985 | 9.920015 | 17 | 8 |
| 53 | 15 | 9.744408 | 10.255592 | 9.824414 | 10.175586 | 10.080006 | 9.919994 | 45 | 7 |
| 54 | 30 | 9.744455 | 10.255545 | 9.824482 | 10.175518 | 10.080027 | 9.919973 | 30 | 6 |
| 55 | 45 | 9.744502 | 10.255498 | 9.824551 | 10.175449 | 10.080048 | 9.919952 | 15 | 5 |
| 56 | 44 | 9.744550 | 10.255450 | 9.824619 | 10.175381 | 10.080069 | 9.919931 | 16 | 4 |
| 57 | 15 | 9.744597 | 10.255403 | 9.824687 | 10.175313 | 10.080090 | 9.919910 | 45 | 3 |
| 58 | 30 | 9.744644 | 10.255356 | 9.824756 | 10.175244 | 10.080111 | 9.919889 | 30 | 2 |
| 59 | 45 | 9.744692 | 10.255308 | 9.824824 | 10.175176 | 10.080133 | 9.919867 | 15 | 1 |
| 60 | 45 | 9.744739 | 10.255261 | 9.824893 | 10.175107 | 10.080154 | 9.919846 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 45m. | | | | LOG. SINES, &c. | | | | 56 deg | |

| 2h 23m. | | LOG. SINES, &c. (t.) | | | | | 35 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.766598 | 10.233402 | 9.857270 | 10.142730 | 10.090672 | 9.909328 | 15 | 60 |
| 1 | 15 | 9.766642 | 10.233358 | 9.857337 | 10.142663 | 10.090695 | 9.909305 | 45 | 59 |
| 2 | 30 | 9.766686 | 10.233314 | 9.857404 | 10.142596 | 10.090717 | 9.909283 | 30 | 58 |
| 3 | 45 | 9.766730 | 10.233270 | 9.857470 | 10.142530 | 10.090740 | 9.909260 | 15 | 57 |
| 4 | 46 | 9.766774 | 10.233226 | 9.857537 | 10.142463 | 10.090763 | 9.909237 | 14 | 56 |
| 5 | 15 | 9.766818 | 10.233182 | 9.857603 | 10.142397 | 10.090786 | 9.909214 | 45 | 55 |
| 6 | 30 | 9.766862 | 10.233138 | 9.857670 | 10.142330 | 10.090808 | 9.909192 | 30 | 54 |
| 7 | 45 | 9.766905 | 10.233095 | 9.857736 | 10.142264 | 10.090831 | 9.909169 | 15 | 53 |
| 8 | 47 | 9.766949 | 10.233051 | 9.857803 | 10.142197 | 10.090854 | 9.909146 | 13 | 52 |
| 9 | 15 | 9.766993 | 10.233007 | 9.857870 | 10.142130 | 10.090877 | 9.909123 | 45 | 51 |
| 10 | 30 | 9.767037 | 10.232963 | 9.857936 | 10.142064 | 10.090899 | 9.909101 | 30 | 50 |
| 11 | 45 | 9.767081 | 10.232919 | 9.858003 | 10 141997 | 10.090922 | 9.909078 | 15 | 49 |
| 12 | 48 | 9.767124 | 10.232876 | 9.858069 | 10.141931 | 10.090945 | 9.909055 | 12 | 48 |
| 13 | 15 | 9.767168 | 10.232832 | 9.858136 | 10.141864 | 10.090968 | 9.909032 | 45 | 47 |
| 14 | 30 | 9.767212 | 10.232788 | 9.858202 | 10.141798 | 10.090991 | 9.909009 | 30 | 46 |
| 15 | 45 | 9.767256 | 10.232744 | 9.858269 | 10.141731 | 10.091013 | 9.908987 | 15 | 45 |
| 16 | 49 | 9.767300 | 10.232700 | 9.858336 | 10.141664 | 10.091036 | 9.908964 | 11 | 44 |
| 17 | 15 | 9.767343 | 10.232657 | 9.858402 | 10.141598 | 10.091059 | 9.908941 | 45 | 43 |
| 18 | 30 | 9.767387 | 10.232613 | 9.858469 | 10.141531 | 10.091082 | 9.908918 | 30 | 42 |
| 19 | 45 | 9.767431 | 10.232569 | 9.858535 | 10.141465 | 10.091105 | 9.908895 | 15 | 41 |
| 20 | 50 | 9.767475 | 10.232525 | 9.858602 | 10.141398 | 10.091127 | 9.908873 | 10 | 40 |
| 21 | 15 | 9.767518 | 10.232482 | 9.858668 | 10.141332 | 10.091150 | 9.908850 | 45 | 39 |
| 22 | 30 | 9.767562 | 10.232438 | 9.858735 | 10.141265 | 10.091173 | 9.908827 | 30 | 38 |
| 23 | 45 | 9.767606 | 10.232394 | 9.858801 | 10.141199 | 10.091196 | 9.908804 | 15 | 37 |
| 24 | 51 | 9.767649 | 10.232351 | 9.858868 | 10.141132 | 10.091219 | 9.908781 | 9 | 36 |
| 25 | 15 | 9.767693 | 10.232307 | 9.858934 | 10.141066 | 10.091241 | 9.908759 | 45 | 35 |
| 26 | 30 | 9.767737 | 10.232263 | 9.859001 | 10.140999 | 10.091264 | 9.908736 | 30 | 34 |
| 27 | 45 | 9.767780 | 10.232220 | 9.859068 | 10.140932 | 10.091287 | 9.908713 | 15 | 33 |
| 28 | 52 | 9.767824 | 10.232176 | 9.859134 | 10.140866 | 10.091310 | 9.908690 | 8 | 32 |
| 29 | 15 | 9 767868 | 10.232132 | 9.859201 | 10.140799 | 10.091333 | 9.908667 | 45 | 31 |
| 30 | 30 | 9.767912 | 10.232088 | 9.859267 | 10.140733 | 10.091356 | 9.908644 | 30 | 30 |
| 31 | 45 | 9.767955 | 10.232045 | 9.859334 | 10.140666 | 10.091378 | 9.908622 | 15 | 29 |
| 32 | 53 | 9 767999 | 10.232001 | 9.859400 | 10.140600 | 10.091401 | 9.908599 | 7 | 28 |
| 33 | 15 | 9.768043 | 10.231957 | 9.859467 | 10.140533 | 10.091424 | 9.908576 | 45 | 27 |
| 34 | 30 | 9.768086 | 10.231914 | 9.859533 | 10.140467 | 10.091447 | 9.908553 | 30 | 26 |
| 35 | 45 | 9.768130 | 10.231870 | 9 859600 | 10.140400 | 10.091470 | 9.908530 | 15 | 25 |
| 36 | 54 | 9.768173 | 10.231827 | 9.859666 | 10.140334 | 10.091493 | 9.908507 | 6 | 24 |
| 37 | 15 | 9.768217 | 10.231783 | 9.859733 | 10.140267 | 10.091516 | 9.908484 | 45 | 23 |
| 38 | 30 | 9.768261 | 10.231739 | 9.859799 | 10.140201 | 10.091538 | 9.908462 | 30 | 22 |
| 39 | 45 | 9.768304 | 10.231696 | 9.859866 | 10.140134 | 10.091561 | 9.908439 | 15 | 21 |
| 40 | 55 | 9.768348 | 10.231652 | 9.859932 | 10.140068 | 10.091584 | 9.908416 | 5 | 20 |
| 41 | 15 | 9.768392 | 10.231608 | 9.859999 | 10.140001 | 10.091607 | 9.908393 | 45 | 19 |
| 42 | 30 | 9.768435 | 10.231565 | 9.860065 | 10.139935 | 10.091630 | 9.908370 | 30 | 18 |
| 43 | 45 | 9.768479 | 10.231521 | 9.860131 | 10.139869 | 10.091653 | 9.908347 | 15 | 17 |
| 44 | 56 | 9.768522 | 10.231478 | 9.860198 | 10.139802 | 10.091676 | 9.908324 | 4 | 16 |
| 45 | 15 | 9.768566 | 10.231434 | 9 860264 | 10.139736 | 10.091699 | 9.908301 | 45 | 15 |
| 46 | 30 | 9.768609 | 10.231391 | 9.860331 | 10.139669 | 10.091722 | 9.908278 | 30 | 14 |
| 47 | 45 | 9.768653 | 10.231347 | 9.860397 | 10.139603 | 10.091744 | 9.908256 | 15 | 13 |
| 48 | 57 | 9.768697 | 10.231303 | 9.860464 | 10.139536 | 10.091767 | 9.908233 | 3 | 12 |
| 49 | 15 | 9.768740 | 10.231260 | 9.860530 | 10.139470 | 10.091790 | 9.908210 | 45 | 11 |
| 50 | 30 | 9.768784 | 10.231216 | 9.860597 | 10.139403 | 10.091813 | 9.908187 | 30 | 10 |
| 51 | 45 | 9.768827 | 10.231173 | 9.860663 | 10.139337 | 10.091836 | 9.908164 | 15 | 9 |
| 52 | 58 | 9.768871 | 10.231129 | 9.860730 | 10.139270 | 10.091859 | 9.908141 | 2 | 8 |
| 53 | 15 | 9.768914 | 10.231086 | 9.860796 | 10.139204 | 10.091882 | 9.908118 | 45 | 7 |
| 54 | 30 | 9.768958 | 10.231042 | 9.860862 | 10.139138 | 10.091905 | 9.908095 | 30 | 6 |
| 55 | 45 | 9.769001 | 10.230999 | 9.860929 | 10.139071 | 10.091928 | 9.908072 | 15 | 5 |
| 56 | 59 | 9.769045 | 10.230955 | 9.860995 | 10 139005 | 10.091951 | 9 908049 | 1 | 4 |
| 57 | 15 | 9.769088 | 10.230912 | 9.861062 | 10.138938 | 10.091974 | 9.908026 | 45 | 3 |
| 58 | 30 | 9.769132 | 10.230868 | 9.861128 | 10.138872 | 10.091997 | 9.908003 | 30 | 2 |
| 59 | 45 | 9.769175 | 10.230825 | 9.861195 | 10.138805 | 10.092019 | 9.907981 | 15 | 1 |
| 60 | 60 | 9.769219 | 10.230781 | 9.861261 | 10.138739 | 10.092042 | 9.907958 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 36m. | | LOG. SINES, &c. | | | | | 54 deg. | | |

| 2h 24m. | | | LOG. SINES, &c. (k) | | | | 36 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.769219 | 10.230781 | 9.861261 | 10.138739 | 10.092042 | 9.907958 | 60 | 60 |
| 1 | 15 | 9.769262 | 10.230738 | 9.861327 | 10.138673 | 10.092065 | 9.907935 | 45 | 59 |
| 2 | 30 | 9.769306 | 10.230694 | 9.861394 | 10.138606 | 10.092088 | 9.907912 | 30 | 58 |
| 3 | 45 | 9.769349 | 10.230651 | 9.861460 | 10.138540 | 10.092111 | 9.907889 | 15 | 57 |
| 4 | 1 | 9.769392 | 10.230608 | 9.861527 | 10.138473 | 10.092134 | 9 907866 | 59 | 56 |
| 5 | 15 | 9.769436 | 10.230564 | 9.861593 | 10.138407 | 10.092157 | 9.907843 | 45 | 55 |
| 6 | 30 | 9.769479 | 10.230521 | 9.861659 | 10.138341 | 10.092180 | 9.907820 | 30 | 54 |
| 7 | 45 | 9.769523 | 10.230477 | 9.861726 | 10.138274 | 10.092203 | 9.907797 | 15 | 53 |
| 8 | 2 | 9.769566 | 10.230434 | 9.861792 | 10.138208 | 10.092226 | 9.907774 | 58 | 52 |
| 9 | 15 | 9.769610 | 10.230390 | 9.861859 | 10.138141 | 10.092249 | 9.907751 | 45 | 51 |
| 10 | 30 | 9.769653 | 10.230347 | 9.861925 | 10.138075 | 10.092272 | 9.907728 | 30 | 50 |
| 11 | 45 | 9.769696 | 10.230304 | 9.861991 | 10.138009 | 10.092295 | 9.907705 | 15 | 49 |
| 12 | 3 | 9.769740 | 10.230260 | 9.862058 | 10.137942 | 10.092318 | 9.907682 | 57 | 48 |
| 13 | 15 | 9.769783 | 10.230217 | 9.862124 | 10.137876 | 10.092341 | 9.907659 | 45 | 47 |
| 14 | 30 | 9.769827 | 10.230173 | 9.862191 | 10.137809 | 10.092364 | 9.907636 | 30 | 46 |
| 15 | 45 | 9.769870 | 10.230130 | 9.862257 | 10.137743 | 10.092387 | 9.907613 | 15 | 45 |
| 16 | 4 | 9.769913 | 10.230087 | 9.862323 | 10.137677 | 10.092410 | 9.907590 | 56 | 44 |
| 17 | 15 | 9.769957 | 10.230043 | 9.862390 | 10.137610 | 10.092433 | 9.907567 | 45 | 43 |
| 18 | 30 | 9.770000 | 10.230000 | 9.862456 | 10.137544 | 10.092456 | 9.907544 | 30 | 42 |
| 19 | 45 | 9.770043 | 10.229957 | 9.862522 | 10.137478 | 10.092479 | 9.907521 | 15 | 41 |
| 20 | 5 | 9.770087 | 10.229913 | 9.862589 | 10.137411 | 10.092502 | 9.907498 | 55 | 40 |
| 21 | 15 | 9.770130 | 10.229870 | 9.862655 | 10.137345 | 10.092525 | 9.907475 | 45 | 39 |
| 22 | 30 | 9.770173 | 10.229827 | 9.862721 | 10.137279 | 10.092548 | 9.907452 | 30 | 38 |
| 23 | 45 | 9.770217 | 10.229783 | 9.862788 | 10.137212 | 10.092571 | 9.907429 | 15 | 37 |
| 24 | 6 | 9.770260 | 10.229740 | 9.862854 | 10.137146 | 10.092594 | 9.907406 | 54 | 36 |
| 25 | 15 | 9.770303 | 10.229697 | 9.862920 | 10.137080 | 10.092617 | 9.907383 | 45 | 35 |
| 26 | 30 | 9.770347 | 10.229653 | 9.862987 | 10.137013 | 10.092640 | 9.907360 | 30 | 34 |
| 27 | 45 | 9.770390 | 10.229610 | 9.863053 | 10.136947 | 10.092663 | 9.907337 | 15 | 33 |
| 28 | 7 | 9.770433 | 10.229567 | 9.863119 | 10.136881 | 10.092686 | 9.907314 | 53 | 32 |
| 29 | 15 | 9.770476 | 10.229524 | 9.863186 | 10.136814 | 10.092709 | 9.907291 | 45 | 31 |
| 30 | 30 | 9.770520 | 10.229480 | 9.863252 | 10.136748 | 10.092732 | 9.907268 | 30 | 30 |
| 31 | 45 | 9.770563 | 10.229437 | 9.863318 | 10.136682 | 10.092755 | 9.907245 | 15 | 29 |
| 32 | 8 | 9.770606 | 10.229394 | 9.863385 | 10.136615 | 10.092778 | 9.907222 | 52 | 28 |
| 33 | 15 | 9.770650 | 10.229350 | 9.863451 | 10.136549 | 10.092802 | 9.907198 | 45 | 27 |
| 34 | 30 | 9.770693 | 10.229307 | 9.863517 | 10.136483 | 10.092825 | 9.907175 | 30 | 26 |
| 35 | 45 | 9.770736 | 10.229264 | 9.863584 | 10.136416 | 10.092848 | 9.907152 | 15 | 25 |
| 36 | 9 | 9.770779 | 10.229221 | 9.863650 | 10.136350 | 10.092871 | 9.907129 | 51 | 24 |
| 37 | 15 | 9.770822 | 10.229178 | 9.863716 | 10.136284 | 10.092894 | 9.907106 | 45 | 23 |
| 38 | 30 | 9.770866 | 10.229134 | 9.863783 | 10.136217 | 10.092917 | 9.907083 | 30 | 22 |
| 39 | 45 | 9.770909 | 10.229091 | 9.863849 | 10.136151 | 10.092940 | 9.907060 | 15 | 21 |
| 40 | 10 | 9.770952 | 10.229048 | 9.863915 | 10.136085 | 10.092963 | 9.907037 | 50 | 20 |
| 41 | 15 | 9.770995 | 10.229005 | 9.863981 | 10.136019 | 10.092986 | 9.907014 | 45 | 19 |
| 42 | 30 | 9.771039 | 10.228961 | 9.864048 | 10.135952 | 10.093009 | 9.906991 | 30 | 18 |
| 43 | 45 | 9.771082 | 10.228918 | 9.864114 | 10.135886 | 10.093032 | 9.906968 | 15 | 17 |
| 44 | 11 | 9.771125 | 10.228875 | 9.864180 | 10.135820 | 10.093055 | 9.906945 | 49 | 16 |
| 45 | 15 | 9.771168 | 10.228832 | 9.864247 | 10.135753 | 10.093079 | 9.906921 | 45 | 15 |
| 46 | 30 | 9.771211 | 10.228789 | 9.864313 | 10.135687 | 10.093102 | 9.906898 | 30 | 14 |
| 47 | 45 | 9.771254 | 10.228746 | 9.864379 | 10.135621 | 10.093125 | 9.906875 | 15 | 13 |
| 48 | 12 | 9.771298 | 10.228702 | 9.864445 | 10.135555 | 10.093148 | 9.906852 | 48 | 12 |
| 49 | 15 | 9.771341 | 10.228659 | 9.864512 | 10.135488 | 10.093171 | 9.906829 | 45 | 11 |
| 50 | 30 | 9.771384 | 10.228616 | 9.864578 | 10.135422 | 10.093194 | 9.906806 | 30 | 10 |
| 51 | 45 | 9.771427 | 10.228573 | 9.864644 | 10.135356 | 10.093217 | 9.906783 | 15 | 9 |
| 52 | 13 | 9.771470 | 10.228530 | 9.864710 | 10.135290 | 10.093240 | 9.906760 | 47 | 8 |
| 53 | 15 | 9.771513 | 10.228487 | 9.864777 | 10.135223 | 10.093263 | 9.906737 | 45 | 7 |
| 54 | 30 | 9.771556 | 10.228444 | 9.864843 | 10.135157 | 10.093287 | 9.906713 | 30 | 6 |
| 55 | 45 | 9.771599 | 10.228401 | 9.864909 | 10.135091 | 10.093310 | 9.906690 | 15 | 5 |
| 56 | 14 | 9.771643 | 10.228357 | 9.864975 | 10.135025 | 10.093333 | 9.906667 | 46 | 4 |
| 57 | 15 | 9.771686 | 10.228314 | 9.865042 | 10.134958 | 10.093356 | 9.906644 | 45 | 3 |
| 58 | 30 | 9.771729 | 10.228271 | 9.865108 | 10.134892 | 10.093379 | 9.906621 | 30 | 2 |
| 59 | 45 | 9.771772 | 10.228228 | 9.865174 | 10.134826 | 10.093402 | 9.906598 | 15 | - |
| 60 | 15 | 9.771815 | 10.228185 | 9 865240 | 10.134760 | 10.093426 | 9.906574 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 2h 25m. | | | LOG. SINES, &c. (t.) | | | | 36 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.771815 | 10.228185 | 9.865240 | 10.134760 | 10.093426 | 9.906574 | 45 | 60 |
| 1 | 15 | 9.771858 | 10.228142 | 9.865307 | 10.134693 | 10.093449 | 9.906551 | 45 | 59 |
| 2 | 30 | 9.771901 | 10.228099 | 9.865373 | 10.134627 | 10.093472 | 9.906528 | 30 | 58 |
| 3 | 45 | 9.771944 | 10.228056 | 9.865439 | 10.134561 | 10.093495 | 9.906505 | 15 | 57 |
| 4 | 16 | 9.771987 | 10.228013 | 9.865505 | 10.134495 | 10.093518 | 9.906482 | 44 | 56 |
| 5 | 15 | 9.772030 | 10.227970 | 9.865571 | 10.134429 | 10.093541 | 9.906459 | 45 | 55 |
| 6 | 30 | 9.772073 | 10.227927 | 9.865638 | 10.134362 | 10.093565 | 9.906435 | 30 | 54 |
| 7 | 45 | 9.772116 | 10.227884 | 9.865704 | 10.134296 | 10.093588 | 9.906412 | 15 | 53 |
| 8 | 17 | 9.772159 | 10.227841 | 9.865770 | 10.134230 | 10.093611 | 9.906389 | 43 | 52 |
| 9 | 15 | 9.772202 | 10.227798 | 9.865836 | 10.134164 | 10.093634 | 9.906366 | 45 | 51 |
| 10 | 30 | 9.772245 | 10.227755 | 9.865903 | 10.134097 | 10.093657 | 9.906343 | 30 | 50 |
| 11 | 45 | 9.772288 | 10.227712 | 9.865969 | 10.134031 | 10.093680 | 9.906320 | 15 | 49 |
| 12 | 18 | 9.772331 | 10.227669 | 9.866035 | 10.133965 | 10.093704 | 9.906296 | 42 | 48 |
| 13 | 15 | 9.772374 | 10.227626 | 9.866101 | 10.133899 | 10.093727 | 9.906273 | 45 | 47 |
| 14 | 30 | 9.772417 | 10.227583 | 9.866167 | 10.133833 | 10.093750 | 9.906250 | 30 | 46 |
| 15 | 45 | 9.772460 | 10.227540 | 9.866233 | 10.133767 | 10.093773 | 9.906227 | 15 | 45 |
| 16 | 19 | 9.772503 | 10.227497 | 9.866300 | 10.133700 | 10.093796 | 9.906204 | 41 | 44 |
| 17 | 15 | 9.772546 | 10.227454 | 9.866366 | 10.133634 | 10.093820 | 9.906180 | 45 | 43 |
| 18 | 30 | 9.772589 | 10.227411 | 9.866432 | 10.133568 | 10.093843 | 9.906157 | 30 | 42 |
| 19 | 45 | 9.772632 | 10.227368 | 9.866498 | 10.133502 | 10.093866 | 9.906134 | 15 | 41 |
| 20 | 20 | 9.772675 | 10.227325 | 9.866564 | 10.133436 | 10.093889 | 9.906111 | 40 | 40 |
| 21 | 15 | 9.772718 | 10.227282 | 9.866631 | 10.133369 | 10.093913 | 9.906087 | 45 | 39 |
| 22 | 30 | 9.772761 | 10.227239 | 9.866697 | 10.133303 | 10.093936 | 9.906064 | 30 | 38 |
| 23 | 45 | 9.772804 | 10.227196 | 9.866763 | 10.133237 | 10.093959 | 9.906041 | 15 | 37 |
| 24 | 21 | 9.772847 | 10.227153 | 9.866829 | 10.133171 | 10.093982 | 9.906018 | 39 | 36 |
| 25 | 15 | 9.772890 | 10.227110 | 9.866895 | 10.133105 | 10.094006 | 9.905994 | 45 | 35 |
| 26 | 30 | 9.772933 | 10.227067 | 9.866961 | 10.133039 | 10.094029 | 9.905971 | 30 | 34 |
| 27 | 45 | 9.772976 | 10.227024 | 9.867028 | 10.132972 | 10.094052 | 9.905948 | 15 | 33 |
| 28 | 22 | 9.773018 | 10.226982 | 9.867094 | 10.132906 | 10.094075 | 9.905925 | 38 | 32 |
| 29 | 15 | 9.773061 | 10.226939 | 9.867160 | 10.132840 | 10.094099 | 9.905901 | 45 | 31 |
| 30 | 30 | 9.773104 | 10.226896 | 9.867226 | 10.132774 | 10.094122 | 9.905878 | 30 | 30 |
| 31 | 45 | 9.773147 | 10.226853 | 9.867292 | 10.132708 | 10.094145 | 9.905855 | 15 | 29 |
| 32 | 23 | 9.773190 | 10.226810 | 9.867358 | 10.132642 | 10.094168 | 9.905832 | 37 | 28 |
| 33 | 15 | 9.773233 | 10.226767 | 9.867424 | 10.132576 | 10.094192 | 9.905808 | 45 | 27 |
| 34 | 30 | 9.773276 | 10.226724 | 9.867490 | 10.132510 | 10.094215 | 9.905785 | 30 | 26 |
| 35 | 45 | 9.773318 | 10.226682 | 9.867557 | 10.132443 | 10.094238 | 9.905762 | 15 | 25 |
| 36 | 24 | 9.773361 | 10.226639 | 9.867623 | 10.132377 | 10.094261 | 9.905739 | 36 | 24 |
| 37 | 15 | 9.773404 | 10.226596 | 9.867689 | 10.132311 | 10.094285 | 9.905715 | 45 | 23 |
| 38 | 30 | 9.773447 | 10.226553 | 9.867755 | 10.132245 | 10.094308 | 9.905692 | 30 | 22 |
| 39 | 45 | 9.773490 | 10.226510 | 9.867821 | 10.132179 | 10.094331 | 9.905669 | 15 | 21 |
| 40 | 25 | 9.773533 | 10.226467 | 9.867887 | 10.132113 | 10.094355 | 9.905645 | 35 | 20 |
| 41 | 15 | 9.773575 | 10.226425 | 9.867953 | 10.132047 | 10.094378 | 9.905622 | 45 | 19 |
| 42 | 30 | 9.773618 | 10.226382 | 9.868019 | 10.131981 | 10.094401 | 9.905599 | 30 | 18 |
| 43 | 45 | 9.773661 | 10.226339 | 9.868086 | 10.131914 | 10.094425 | 9.905575 | 15 | 17 |
| 44 | 26 | 9.773704 | 10.226296 | 9.868152 | 10.131848 | 10.094448 | 9.905552 | 34 | 16 |
| 45 | 15 | 9.773747 | 10.226253 | 9.868218 | 10.131782 | 10.094471 | 9.905529 | 45 | 15 |
| 46 | 30 | 9.773789 | 10.226211 | 9.868284 | 10.131716 | 10.094494 | 9.905506 | 30 | 14 |
| 47 | 45 | 9.773832 | 10.226168 | 9.868350 | 10.131650 | 10.094518 | 9.905482 | 15 | 13 |
| 48 | 27 | 9.773875 | 10.226125 | 9.868416 | 10.131584 | 10.094541 | 9.905459 | 33 | 12 |
| 49 | 15 | 9.773918 | 10.226082 | 9.868482 | 10.131518 | 10.094564 | 9.905436 | 45 | 11 |
| 50 | 30 | 9.773960 | 10.226040 | 9.868548 | 10.131452 | 10.094588 | 9.905412 | 30 | 10 |
| 51 | 45 | 9.774003 | 10.225997 | 9.868614 | 10.131386 | 10.094611 | 9.905389 | 15 | 9 |
| 52 | 28 | 9.774046 | 10.225954 | 9.868680 | 10.131320 | 10.094634 | 9.905366 | 32 | 8 |
| 53 | 15 | 9.774089 | 10.225911 | 9.868746 | 10.131254 | 10.094658 | 9.905342 | 45 | 7 |
| 54 | 30 | 9.774131 | 10.225869 | 9.868812 | 10.131188 | 10.094681 | 9.905319 | 30 | 6 |
| 55 | 45 | 9.774174 | 10.225826 | 9.868879 | 10.131121 | 10.094705 | 9.905295 | 15 | 5 |
| 56 | 29 | 9.774217 | 10.225783 | 9.868945 | 10.131055 | 10.094728 | 9.905272 | 31 | 4 |
| 57 | 15 | 9.774259 | 10.225741 | 9.869011 | 10.130989 | 10.094751 | 9.905249 | 45 | 3 |
| 58 | 30 | 9.774302 | 10.225698 | 9.869077 | 10.130923 | 10.094775 | 9.905225 | 30 | 2 |
| 59 | 45 | 9.774345 | 10.225655 | 9.869143 | 10.130857 | 10.094798 | 9.905202 | 15 | 1 |
| 60 | 30 | 9.774388 | 10.225612 | 9.869209 | 10.130791 | 10.094821 | 9.905179 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 34m. | | | LOG. SINES, &c. | | | | 53 deg. | | |

| 2h 26m. | | | LOG. SINES, &c. (t.) | | | 36 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec |
| 0 | 30 | 9.774388 | 10.225612 | 9.869209 | 10.130791 | 10.094821 | 9.905179 | 30 | 60 |
| 1 | 15 | 9.774430 | 10.225570 | 9.869275 | 10.130725 | 10.094845 | 9.905155 | 45 | 59 |
| 2 | 30 | 9.774473 | 10.225527 | 9.869341 | 10.130659 | 10.094868 | 9.905132 | 30 | 58 |
| 3 | 45 | 9.774516 | 10.225484 | 9.869407 | 10.130593 | 10.094891 | 9.905109 | 15 | 57 |
| 4 | 31 | 9.774558 | 10.225442 | 9.869473 | 10.130527 | 10.094915 | 9.905085 | 29 | 56 |
| 5 | 15 | 9.774601 | 10.225399 | 9.869539 | 10.130461 | 10.094938 | 9.905062 | 45 | 55 |
| 6 | 30 | 9.774644 | 10.225356 | 9.869605 | 10.130395 | 10.094962 | 9.905038 | 30 | 54 |
| 7 | 45 | 9.774686 | 10.225314 | 9.869671 | 10.130329 | 10.094985 | 9.905015 | 15 | 53 |
| 8 | 32 | 9.774729 | 10.225271 | 9.869737 | 10.130263 | 10.095008 | 9.904992 | 28 | 52 |
| 9 | 15 | 9.774771 | 10.225229 | 9.869803 | 10.130197 | 10 095032 | 9.904968 | 45 | 51 |
| 10 | 30 | 9.774814 | 10.225186 | 9.869869 | 10.130131 | 10.095055 | 9.904945 | 30 | 50 |
| 11 | 45 | 9.774857 | 10.225143 | 9.869935 | 10.130065 | 10.095079 | 9.904921 | 15 | 49 |
| 12 | 33 | 9.774899 | 10.225101 | 9.870001 | 10.129999 | 10.095102 | 9.904898 | 27 | 48 |
| 13 | 15 | 9.774942 | 10.225058 | 9.870067 | 10.129933 | 10.095125 | 9.904875 | 45 | 47 |
| 14 | 30 | 9.774984 | 10.225016 | 9.870133 | 10.129867 | 10.095149 | 9.904851 | 30 | 46 |
| 15 | 45 | 9.775027 | 10.224973 | 9.870199 | 10.129801 | 10.095172 | 9.904828 | 15 | 45 |
| 16 | 34 | 9.775070 | 10.224930 | 9.870265 | 10.129735 | 10.095196 | 9.904804 | 26 | 44 |
| 17 | 15 | 9.775112 | 10.224888 | 9.870331 | 10.129669 | 10.095219 | 9.904781 | 45 | 43 |
| 18 | 30 | 9.775155 | 10.224845 | 9.870397 | 10.129603 | 10.095243 | 9.904757 | 30 | 42 |
| 19 | 45 | 9.775197 | 10.224803 | 9.870463 | 10.129537 | 10.095266 | 9.904734 | 15 | 41 |
| 20 | 35 | 9.775240 | 10.224760 | 9.870529 | 10.129471 | 10.095289 | 9.904711 | 25 | 40 |
| 21 | 15 | 9.775282 | 10.224718 | 9.870595 | 10.129405 | 10.095313 | 9.904687 | 45 | 39 |
| 22 | 30 | 9.775325 | 10.224675 | 9.870661 | 10.129339 | 10.095336 | 9.904664 | 30 | 38 |
| 23 | 45 | 9.775368 | 10.224632 | 9.870727 | 10.129273 | 10.095360 | 9.904640 | 15 | 37 |
| 24 | 36 | 9.775410 | 10.224590 | 9.870793 | 10.129207 | 10.095383 | 9.904617 | 24 | 36 |
| 25 | 15 | 9.775453 | 10.224547 | 9.870859 | 10.129141 | 10.095407 | 9.904593 | 45 | 35 |
| 26 | 30 | 9.775495 | 10.224505 | 9.870925 | 10.129075 | 10.095430 | 9.904570 | 30 | 34 |
| 27 | 45 | 9.775538 | 10.224462 | 9.870991 | 10.129009 | 10.095454 | 9.904546 | 15 | 33 |
| 28 | 37 | 9.775580 | 10.224420 | 9.871057 | 10.128943 | 10.095477 | 9.904523 | 23 | 32 |
| 29 | 15 | 9.775623 | 10.224377 | 9.871123 | 10.128877 | 10.095501 | 9.904499 | 45 | 31 |
| 30 | 30 | 9.775665 | 10.224335 | 9.871189 | 10.128811 | 10.095524 | 9.904476 | 30 | 30 |
| 31 | 45 | 9.775708 | 10.224292 | 9.871255 | 10.128745 | 10.095548 | 9.904452 | 15 | 29 |
| 32 | 38 | 9.775750 | 10.224250 | 9.871321 | 10.128679 | 10.095571 | 9.904429 | 22 | 28 |
| 33 | 15 | 9.775793 | 10.224207 | 9.871387 | 10.128613 | 10.095594 | 9.904406 | 45 | 27 |
| 34 | 30 | 9.775835 | 10.224165 | 9.871453 | 10.128547 | 10.095618 | 9.904382 | 30 | 26 |
| 35 | 45 | 9.775877 | 10.224123 | 9.871519 | 10.128481 | 10.095641 | 9.904359 | 15 | 25 |
| 36 | 39 | 9 775920 | 10.224080 | 9.871585 | 10.128415 | 10.095665 | 9.904335 | 21 | 24 |
| 37 | 15 | 9.775962 | 10.224038 | 9.871651 | 10.128349 | 10.095688 | 9.904312 | 45 | 23 |
| 38 | 30 | 9.776005 | 10.223995 | 9.871717 | 10.128283 | 10.095712 | 9.904288 | 30 | 22 |
| 39 | 45 | 9.776047 | 10.223953 | 9.871783 | 10.128217 | 10.095735 | 9.904265 | 15 | 21 |
| 40 | 40 | 9.776090 | 10.223910 | 9.871849 | 10.128151 | 10.095759 | 9.904241 | 20 | 20 |
| 41 | 15 | 9.776132 | 10.223868 | 9.871914 | 10.128086 | 10.095782 | 9.904218 | 45 | 19 |
| 42 | 30 | 9.776174 | 10.223826 | 9.871980 | 10.128020 | 10.095806 | 9.904194 | 30 | 18 |
| 43 | 45 | 9.776217 | 10.223783 | 9.872046 | 10.127954 | 10.095830 | 9.904170 | 15 | 17 |
| 44 | 41 | 9.776259 | 10.223741 | 9.872112 | 10.127888 | 10.095853 | 9.904147 | 19 | 16 |
| 45 | 15 | 9.776302 | 10.223698 | 9.872178 | 10.127822 | 10.095877 | 9.904123 | 45 | 15 |
| 46 | 30 | 9.776344 | 10.223656 | 9.872244 | 10.127756 | 10.095900 | 9.904100 | 30 | 14 |
| 47 | 45 | 9.776386 | 10.223614 | 9.872310 | 10.127690 | 10.095924 | 9.904076 | 45 | 13 |
| 48 | 42 | 9.776429 | 10.223571 | 9.872376 | 10.127624 | 10.095947 | 9.904053 | 18 | 12 |
| 49 | 15 | 9.776471 | 10.223529 | 9.872442 | 10.127558 | 10.095971 | 9.904029 | 45 | 11 |
| 50 | 30 | 9.776514 | 10.223486 | 9.872508 | 10.127492 | 10.095994 | 9.904006 | 30 | 10 |
| 51 | 45 | 9.776556 | 10.223444 | 9.872574 | 10.127426 | 10.096018 | 9.903982 | 15 | 9 |
| 52 | 43 | 9.776598 | 10.223402 | 9.872640 | 10.127360 | 10.096041 | 9.903959 | 17 | 8 |
| 53 | 15 | 9.776641 | 10.223359 | 9.872705 | 10.127295 | 10.096065 | 9.903935 | 45 | 7 |
| 54 | 30 | 9.776683 | 10.223317 | 9.872771 | 10.127229 | 10.096089 | 9.903911 | 30 | 6 |
| 55 | 45 | 9.776725 | 10.223275 | 9.872837 | 10.127163 | 10.096112 | 9.903888 | 15 | 5 |
| 56 | 44 | 9.776768 | 10.223232 | 9.872903 | 10.127097 | 10.096136 | 9.903864 | 16 | 4 |
| 57 | 15 | 9.776810 | 10.223190 | 9.872969 | 10.127031 | 10.096159 | 9.903841 | 45 | 3 |
| 58 | 30 | 9.776852 | 10.223148 | 9.873035 | 10.126965 | 10.096183 | 9.903817 | 30 | 2 |
| 59 | 45 | 9.776895 | 10.223105 | 9.873101 | 10.126899 | 10.096206 | 9.903794 | 15 | 1 |
| 60 | 45 | 9.776937 | 10.223063 | 9.873167 | 10.126833 | 10.096230 | 9.903770 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 33m. | | | LOG. SINES, &c. | | | 53 deg. | | | |

| 2h 27m. | | | LOG. SINES, &c. (t.) | | | | 36 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.776937 | 10.223063 | 9.873167 | 10.126833 | 10.096230 | 9.903770 | 15 | 60 |
| 1 | 15 | 9.776979 | 10.223021 | 9.873233 | 10.126767 | 10.096254 | 9.903746 | 45 | 59 |
| 2 | 30 | 9.777021 | 10.222979 | 9.873298 | 10.126702 | 10.096277 | 9.903723 | 30 | 58 |
| 3 | 45 | 9.777064 | 10.222936 | 9.873364 | 10.126636 | 10.096301 | 9.903699 | 15 | 57 |
| 4 | 46 | 9.777106 | 10.222894 | 9.873430 | 10.126570 | 10.096324 | 9.903676 | 14 | 56 |
| 5 | 15 | 9.777148 | 10.222852 | 9.873496 | 10.126504 | 10.096348 | 9.903652 | 45 | 55 |
| 6 | 30 | 9.777190 | 10.222810 | 9.873562 | 10.126438 | 10.096372 | 9.903628 | 30 | 54 |
| 7 | 45 | 9.777233 | 10.222767 | 9.873628 | 10.126372 | 10.096395 | 9.903605 | 15 | 53 |
| 8 | 47 | 9.777275 | 10.222725 | 9.873694 | 10.126306 | 10.096419 | 9.903581 | 13 | 52 |
| 9 | 15 | 9.777317 | 10.222683 | 9.873759 | 10.126241 | 10.096442 | 9.903558 | 45 | 51 |
| 10 | 30 | 9.777359 | 10.222641 | 9.873825 | 10.126175 | 10.096466 | 9.903534 | 30 | 50 |
| 11 | 45 | 9.777402 | 10.222598 | 9.873891 | 10.126109 | 10.096490 | 9.903510 | 15 | 49 |
| 12 | 48 | 9.777444 | 10.222556 | 9.873957 | 10.126043 | 10.096513 | 9.903487 | 12 | 48 |
| 13 | 15 | 9.777486 | 10.222514 | 9.874023 | 10.125977 | 10.096537 | 9.903463 | 45 | 47 |
| 14 | 30 | 9.777528 | 10.222472 | 9.874089 | 10.125911 | 10.096560 | 9.903440 | 30 | 46 |
| 15 | 45 | 9.777571 | 10.222429 | 9.874155 | 10.125845 | 10.096584 | 9.903416 | 15 | 45 |
| 16 | 49 | 9.777613 | 10.222387 | 9.874220 | 10.125780 | 10.096608 | 9.903392 | 11 | 44 |
| 17 | 15 | 9.777655 | 10.222345 | 9.874286 | 10 125714 | 10.096631 | 9.903369 | 45 | 43 |
| 18 | 30 | 9.777697 | 10.222303 | 9.874352 | 10.125648 | 10.096655 | 9.903345 | 30 | 42 |
| 19 | 45 | 9.777739 | 10.222261 | 9 874418 | 10.125582 | 10.096679 | 9.903321 | 15 | 41 |
| 20 | 50 | 9.777781 | 10.222219 | 9.874484 | 10.125516 | 10.096702 | 9.903298 | 10 | 40 |
| 21 | 15 | 9.777824 | 10.222176 | 9.874550 | 10.125450 | 10.096726 | 9.903274 | 45 | 39 |
| 22 | 30 | 9.777866 | 10.222134 | 9.874615 | 10.125385 | 10.096750 | 9.903250 | 30 | 38 |
| 23 | 45 | 9.777908 | 10.222092 | 9.874681 | 10.125319 | 10.096773 | 9.903227 | 15 | 37 |
| 24 | 51 | 9.777950 | 10.222050 | 9.874747 | 10.125253 | 10.096797 | 9.903203 | 9 | 36 |
| 25 | 15 | 9.777992 | 10.222008 | 9.874813 | 10.125187 | 10.096821 | 9.903179 | 45 | 35 |
| 26 | 30 | 9.778034 | 10.221966 | 9.874879 | 10.125121 | 10.096844 | 9.903156 | 30 | 34 |
| 27 | 45 | 9.778076 | 10.221924 | 9.874944 | 10.125056 | 10.096868 | 9.903132 | 15 | 33 |
| 28 | 52 | 9.778119 | 10.221881 | 9.875010 | 10.124990 | 10.096892 | 9.903108 | 8 | 32 |
| 29 | 15 | 9.778161 | 10.221839 | 9.875076 | 10.124924 | 10.096915 | 9.903085 | 45 | 31 |
| 30 | 30 | 9.778203 | 10.221797 | 9.875142 | 10.124858 | 10.096939 | 9.903061 | 30 | 30 |
| 31 | 45 | 9.778245 | 10.221755 | 9.875208 | 10.124792 | 10.096963 | 9.903037 | 15 | 29 |
| 32 | 53 | 9.778287 | .0.221713 | 9.875273 | 10.124727 | 10.096986 | 9.903014 | 7 | 28 |
| 33 | 15 | 9.778329 | 10.221671 | 9.875339 | 10.124661 | 10.097010 | 9.902990 | 45 | 27 |
| 34 | 30 | 9.778371 | 10.221629 | 9.875405 | 10.124595 | 10.097034 | 9.902966 | 30 | 26 |
| 35 | 45 | 9.778413 | 10.221587 | 9.875471 | 10.124529 | 10.097058 | 9.902942 | 15 | 25 |
| 36 | 54 | 9.778455 | 10.221545 | 9.875536 | 10.124464 | 10.097081 | 9.902919 | 6 | 24 |
| 37 | 15 | 9.778497 | 10.221503 | 9.875602 | 10.124398 | 10.097105 | 9.902895 | 45 | 23 |
| 38 | 30 | 9.778539 | 10.221461 | 9.875668 | 10.124332 | 10.097129 | 9.902871 | 30 | 22 |
| 39 | 45 | 9.778581 | 10.221419 | 9.875734 | 10.124266 | 10.097152 | 9.902848 | 15 | 21 |
| 40 | 55 | 9.778623 | 10.221377 | 9.875800 | 10.124200 | 10.097176 | 9.902824 | 5 | 20 |
| 41 | 15 | 9.778666 | 10.221334 | 9.875865 | 10.124135 | 10.097200 | 9.902800 | 45 | 19 |
| 42 | 30 | 9.778708 | 10.221292 | 9.875931 | 10.124069 | 10.097224 | 9.902776 | 30 | 18 |
| 43 | 45 | 9.778750 | 10.221250 | 9.875997 | 10.124003 | 10.097247 | 9.902753 | 15 | 17 |
| 44 | 56 | 9.778792 | 10.221208 | 9.876063 | 10.123937 | 10.097271 | 9.902729 | 4 | 16 |
| 45 | 15 | 9.778834 | 10.221166 | 9.876128 | 10.123872 | 10.097295 | 9.902705 | 45 | 15 |
| 46 | 30 | 9.778876 | 10.221124 | 9.876194 | 10.123806 | 10.097319 | 9.902681 | 30 | 14 |
| 47 | 45 | 9.778918 | 10.221082 | 9.876260 | 10.123740 | 10.097342 | 9.902658 | 15 | 13 |
| 48 | 57 | 9.778960 | 10.221040 | 9.876326 | 10.123674 | 10.097366 | 9.902634 | 3 | 12 |
| 49 | 15 | 9.779002 | 10.220998 | 9.876391 | 10.123609 | 10.097390 | 9.902610 | 45 | 11 |
| 50 | 30 | 9.779044 | 10.220956 | 9.876457 | 10.123543 | 10.097414 | 9.902586 | 30 | 10 |
| 51 | 45 | 9.779086 | 10.220914 | 9.876523 | 10.123477 | 10.097437 | 9.902563 | 15 | 9 |
| 52 | 58 | 9.779127 | 10.220873 | 9.876589 | 10.123411 | 10.097461 | 9.902539 | 2 | 8 |
| 53 | 15 | 9.779169 | 10.220831 | 9.876654 | 10.123346 | 10.097485 | 9.902515 | 45 | 7 |
| 54 | 30 | 9.779211 | 10.220789 | 9.876720 | 10.123280 | 10.097509 | 9.902491 | 30 | 6 |
| 55 | 45 | 9.779253 | 10.220747 | 9.876786 | 10.123214 | 10.097532 | 9.902468 | 15 | 5 |
| 56 | 59 | 9.779295 | 10.220705 | 9.876851 | 10.123149 | 10.097556 | 9.902444 | 1 | 4 |
| 57 | 15 | 9.779337 | 10.220663 | 9.876917 | 10.123083 | 10.097580 | 9.902420 | 45 | 3 |
| 58 | 30 | 9.779379 | 10.220621 | 9.876983 | 10.123017 | 10.097604 | 9.902396 | 30 | 2 |
| 59 | 45 | 9.779421 | 10 220579 | 9.877049 | 10.122951 | 10.097628 | 9.902372 | 15 | 1 |
| 60 | 60 | 9.779463 | 10.220537 | 9.877114 | 10.122886 | 10.097651 | 9.902349 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 32m. | | | LOG. SINES, &c. | | | | 53 deg. | | |

| 2h 28m. | | LOG. SINES, &c. (t.) | | | | | 37 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | |
| 0 | 0 | 9.779463 | 10.220537 | 9.877114 | 10.122886 | 10.097651 | 9.902349 | 60 | 60 |
| 1 | 15 | 9.779505 | 10.220495 | 9.877180 | 10.122820 | 10.097675 | 9.902325 | 45 | 59 |
| 2 | 30 | 9.779547 | 10.220453 | 9.877246 | 10.122754 | 10.097699 | 9.902301 | 30 | 58 |
| 3 | 45 | 9.779589 | 10.220411 | 9.877311 | 10.122689 | 10.097723 | 9.902277 | 15 | 57 |
| 4 | 1 | 9.779631 | 10.220369 | 9.877377 | 10.122623 | 10.097747 | 9.902253 | 59 | 56 |
| 5 | 15 | 9.779672 | 10.220328 | 9.877443 | 10.122557 | 10.097770 | 9.902230 | 45 | 55 |
| 6 | 30 | 9.779714 | 10.220286 | 9.877509 | 10.122491 | 10.097794 | 9.902206 | 30 | 54 |
| 7 | 45 | 9.779756 | 10.220244 | 9.877574 | 10.122426 | 10.097818 | 9.902182 | 15 | 53 |
| 8 | 2 | 9.779798 | 10.220202 | 9.877640 | 10.122360 | 10.097842 | 9.902158 | 58 | 52 |
| 9 | 15 | 9.779840 | 10.220160 | 9.877706 | 10.122294 | 10.097866 | 9.902134 | 45 | 51 |
| 10 | 30 | 9.779882 | 10.220118 | 9.877771 | 10.122229 | 10.097890 | 9.902110 | 30 | 50 |
| 11 | 45 | 9.779924 | 10.220076 | 9.877837 | 10.122163 | 10.097913 | 9.902087 | 15 | 49 |
| 12 | 3 | 9.779965 | 10.220035 | 9.877903 | 10.122097 | 10.097937 | 9.902063 | 57 | 48 |
| 13 | 15 | 9.780007 | 10.219993 | 9.877968 | 10.122032 | 10.097961 | 9.902039 | 45 | 47 |
| 14 | 30 | 9.780049 | 10.219951 | 9.878034 | 10.121966 | 10.097985 | 9.902015 | 30 | 46 |
| 15 | 45 | 9.780091 | 10.219909 | 9.878100 | 10.121900 | 10.098009 | 9.901991 | 15 | 45 |
| 16 | 4 | 9.780133 | 10.219867 | 9.878165 | 10.121835 | 10.098033 | 9.901967 | 56 | 44 |
| 17 | 15 | 9.780175 | 10.219825 | 9.878231 | 10.121769 | 10.098057 | 9.901943 | 45 | 43 |
| 18 | 30 | 9.780216 | 10.219784 | 9.878297 | 10.121703 | 10.098080 | 9.901920 | 30 | 42 |
| 19 | 45 | 9.780258 | 10.219742 | 9.878362 | 10.121638 | 10.098104 | 9.901896 | 15 | 41 |
| 20 | 5 | 9.780300 | 10.219700 | 9.878428 | 10.121572 | 10.098128 | 9.901872 | 55 | 40 |
| 21 | 15 | 9.780342 | 10.219658 | 9.878494 | 10.121506 | 10.098152 | 9.901848 | 45 | 39 |
| 22 | 30 | 9.780384 | 10.219616 | 9.878559 | 10.121441 | 10.098176 | 9.901824 | 30 | 38 |
| 23 | 45 | 9.780425 | 10.219575 | 9.878625 | 10.121375 | 10.098200 | 9.901800 | 15 | 37 |
| 24 | 6 | 9.780467 | 10.219533 | 9.878691 | 10.121309 | 10.098224 | 9.901776 | 54 | 36 |
| 25 | 15 | 9.780509 | 10.219491 | 9.878756 | 10.121244 | 10.098248 | 9.901752 | 45 | 35 |
| 26 | 30 | 9.780551 | 10.219449 | 9.878822 | 10.121178 | 10.098271 | 9.901729 | 30 | 34 |
| 27 | 45 | 9.780592 | 10.219408 | 9.878888 | 10.121112 | 10.098295 | 9.901705 | 15 | 33 |
| 28 | 7 | 9.780634 | 10.219366 | 9.878953 | 10.121047 | 10.098319 | 9.901681 | 53 | 32 |
| 29 | 15 | 9.780676 | 10.219324 | 9.879019 | 10.120981 | 10.098343 | 9.901657 | 45 | 31 |
| 30 | 30 | 9.780717 | 10.219283 | 9.879084 | 10.120916 | 10.098367 | 9.901633 | 30 | 30 |
| 31 | 45 | 9.780759 | 10 219241 | 9.879150 | 10.120850 | 10.098391 | 9.901609 | 15 | 29 |
| 32 | 8 | 9.780801 | 10.219199 | 9.879216 | 10.120784 | 10.098415 | 9.901585 | 52 | 28 |
| 33 | 15 | 9.780843 | 10.219157 | 9.879281 | 10.120719 | 10.098439 | 9.901561 | 45 | 27 |
| 34 | 30 | 9.780884 | 10.219116 | 9.879347 | 10.120653 | 10.098463 | 9.901537 | 30 | 26 |
| 35 | 45 | 9.780926 | 10.219074 | 9.879413 | 10.120587 | 10.098487 | 9.901513 | 15 | 25 |
| 36 | 9 | 9.780968 | 10.219032 | 9.879478 | 10.120522 | 10.098511 | 9.901489 | 51 | 24 |
| 37 | 15 | 9.781009 | 10.218991 | 9.879544 | 10.120456 | 10.098534 | 9.901466 | 45 | 23 |
| 38 | 30 | 9.781051 | 10.218949 | 9.879609 | 10.120391 | 10.098558 | 9.901442 | 30 | 22 |
| 39 | 45 | 9.781093 | 10.218907 | 9.879675 | 10.120325 | 10.098582 | 9.901418 | 15 | 21 |
| 40 | 10 | 9.781134 | 10.218866 | 9.879741 | 10.120259 | 10.098606 | 9.901394 | 50 | 20 |
| 41 | 15 | 9.781176 | 10.218824 | 9.879806 | 10.120194 | 10.098630 | 9.901370 | 45 | 19 |
| 42 | 30 | 9.781218 | 10.218782 | 9.879872 | 10.120128 | 10.098654 | 9.901346 | 30 | 18 |
| 43 | 45 | 9.781259 | 10.218741 | 9.879937 | 10.120063 | 10.098678 | 9.901322 | 15 | 17 |
| 44 | 11 | 9.781301 | 10.218699 | 9.880003 | 10.119997 | 10.098702 | 9.901298 | 49 | 16 |
| 45 | 15 | 9.781343 | 10.218657 | 9.880069 | 10.119931 | 10.098726 | 9.901274 | 45 | 15 |
| 46 | 30 | 9.781384 | 10.218616 | 9.880134 | 10.119866 | 10.098750 | 9.901250 | 30 | 14 |
| 47 | 45 | 9.781426 | 10.218574 | 9.880200 | 10.119800 | 10.098774 | 9.901226 | 15 | 13 |
| 48 | 12 | 9.781467 | 10.218533 | 9.880265 | 10.119735 | 10.098798 | 9.901202 | 48 | 12 |
| 49 | 15 | 9.781509 | 10.218491 | 9.880331 | 10.119669 | 10.098822 | 9.901178 | 45 | 11 |
| 50 | 30 | 9.781551 | 10.218449 | 9.880397 | 10.119603 | 10.098846 | 9.901154 | 30 | 10 |
| 51 | 45 | 9.781592 | 10.218408 | 9.880462 | 10.119538 | 10.098870 | 9.901130 | 15 | 9 |
| 52 | 13 | 9.781634 | 10.218366 | 9.880528 | 10.119472 | 10.098894 | 9.901106 | 47 | 8 |
| 53 | 15 | 9.781675 | 10.218325 | 9.880593 | 10.119407 | 10.098918 | 9.901082 | 45 | 7 |
| 54 | 30 | 9.781717 | 10.218283 | 9.880659 | 10.119341 | 10.098942 | 9.901058 | 30 | 6 |
| 55 | 45 | 9.781759 | 10.218241 | 9.880724 | 10.119276 | 10.098966 | 9.901034 | 15 | 5 |
| 56 | 14 | 9.781800 | 10.218200 | 9.880790 | 10.119210 | 10.098990 | 9.901010 | 46 | 4 |
| 57 | 15 | 9.781842 | 10.218158 | 9.880855 | 10.119145 | 10.099014 | 9.900986 | 45 | 3 |
| 58 | 30 | 9.781883 | 10.218117 | 9.880921 | 10.119079 | 10.099038 | 9.900962 | 30 | 2 |
| 59 | 45 | 9.781925 | 10.218075 | 9.880987 | 10.119013 | 10.099062 | 9.900938 | 15 | 1 |
| 60 | 15 | 9.781966 | 10.218034 | 9.881052 | 10.118948 | 10.099086 | 9.900914 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 31m. | LOG. SINES, &c. | 52 deg. |
|---|---|---|

| 2h 29m. | | LOG. SINES, &c. (t.) | | | | | 37 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| Sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | — |
| 0 | 15 | 9.781966 | 10.218034 | 9.881052 | 10.118948 | 10.099086 | 9.900914 | 45 | 60 |
| 1 | 15 | 9.782008 | 10.217992 | 9.881118 | 10.118882 | 10.099110 | 9.900890 | 45 | 59 |
| 2 | 30 | 9.782049 | 10.217951 | 9.881183 | 10.118817 | 10.099134 | 9.900866 | 30 | 58 |
| 3 | 45 | 9.782091 | 10.217909 | 9.881249 | 10.118751 | 10.099158 | 9.900842 | 15 | 57 |
| 4 | 16 | 9.782132 | 10.217868 | 9.881314 | 10.118686 | 10.099182 | 9.900818 | 44 | 56 |
| 5 | 15 | 9.782174 | 10.217826 | 9.881380 | 10.118620 | 10.099206 | 9.900794 | 45 | 55 |
| 6 | 30 | 9.782215 | 10.217785 | 9.881445 | 10.118555 | 10.099230 | 9.900770 | 30 | 54 |
| 7 | 45 | 9.782257 | 10.217743 | 9.881511 | 10.118489 | 10.099254 | 9.900746 | 15 | 53 |
| 8 | 17 | 9.782298 | 10.217702 | 9.881576 | 10.118424 | 10.099278 | 9.900722 | 43 | 52 |
| 9 | 15 | 9.782340 | 10.217660 | 9.881642 | 10.118358 | 10.099302 | 9.900698 | 45 | 51 |
| 10 | 30 | 9.782381 | 10.217619 | 9.881708 | 10.118292 | 10.099326 | 9.900674 | 30 | 50 |
| 11 | 45 | 9.782423 | 10.217577 | 9.881773 | 10.118227 | 10.099350 | 9.900650 | 15 | 49 |
| 12 | 18 | 9.782464 | 10.217536 | 9.881839 | 10.118161 | 10.099374 | 9.900626 | 42 | 48 |
| 13 | 15 | 9.782506 | 10.217494 | 9.881904 | 10.118096 | 10.099398 | 9.900602 | 45 | 47 |
| 14 | 30 | 9.782547 | 10.217453 | 9.881970 | 10.118030 | 10.099422 | 9.900578 | 30 | 46 |
| 15 | 45 | 9.782589 | 10.217411 | 9.882035 | 10.117965 | 10.099447 | 9.900553 | 15 | 45 |
| 16 | 19 | 9.782630 | 10.217370 | 9.882101 | 10.117899 | 10.099471 | 9.900529 | 41 | 44 |
| 17 | 15 | 9.782671 | 10.217329 | 9.882166 | 10.117834 | 10.099495 | 9.900505 | 45 | 43 |
| 18 | 30 | 9.782713 | 10.217287 | 9.882232 | 10.117768 | 10.099519 | 9.900481 | 30 | 42 |
| 19 | 45 | 9.782754 | 10.217246 | 9.882297 | 10.117703 | 10.099543 | 9.900457 | 15 | 41 |
| 20 | 20 | 9.782796 | 10.217204 | 9.882363 | 10.117637 | 10.099567 | 9.900433 | 40 | 40 |
| 21 | 15 | 9.782837 | 10.217163 | 9.882428 | 10.117572 | 10.099591 | 9.900409 | 45 | 39 |
| 22 | 30 | 9.782879 | 10.217121 | 9.882494 | 10.117506 | 10.099615 | 9.900385 | 30 | 38 |
| 23 | 45 | 9.782920 | 10.217080 | 9.882559 | 10.117441 | 10.099639 | 9.900361 | 15 | 37 |
| 24 | 21 | 9.782961 | 10.217039 | 9.882625 | 10.117375 | 10.099663 | 9.900337 | 39 | 36 |
| 25 | 15 | 9.783003 | 10.216997 | 9.882690 | 10.117310 | 10.099687 | 9.900313 | 45 | 35 |
| 26 | 30 | 9.783044 | 10.216956 | 9.882756 | 10.117244 | 10.099712 | 9.900288 | 30 | 34 |
| 27 | 45 | 9.783085 | 10.216915 | 9.882821 | 10.117179 | 10.099736 | 9.900264 | 15 | 33 |
| 28 | 22 | 9.783127 | 10.216873 | 9.882887 | 10.117113 | 10.099760 | 9.900240 | 38 | 32 |
| 29 | 15 | 9.783168 | 10.216832 | 9.882952 | 10.117048 | 10.099784 | 9.900216 | 45 | 31 |
| 30 | 30 | 9.783209 | 10.216791 | 9.883017 | 10.116983 | 10.099808 | 9.900192 | 30 | 30 |
| 31 | 45 | 9.783251 | 10.216749 | 9.883083 | 10.116917 | 10.099832 | 9.900168 | 15 | 29 |
| 32 | 23 | 9.783292 | 10.216708 | 9.883148 | 10.116852 | 10.099856 | 9.900144 | 37 | 28 |
| 33 | 15 | 9.783334 | 10.216666 | 9.883214 | 10.116786 | 10.099880 | 9.900120 | 45 | 27 |
| 34 | 30 | 9.783375 | 10.216625 | 9.883279 | 10.116721 | 10.099905 | 9.900095 | 30 | 26 |
| 35 | 45 | 9.783416 | 10.216584 | 9.883345 | 10.116655 | 10.099929 | 9.900071 | 15 | 25 |
| 36 | 24 | 9.783457 | 10.216543 | 9.883410 | 10.116590 | 10.099953 | 9.900047 | 36 | 24 |
| 37 | 15 | 9.783499 | 10.216501 | 9.883476 | 10.116524 | 10.099977 | 9.900023 | 45 | 23 |
| 38 | 30 | 9.783540 | 10.216460 | 9.883541 | 10.116459 | 10.100001 | 9.899999 | 30 | 22 |
| 39 | 45 | 9.783581 | 10.216419 | 9.883607 | 10.116393 | 10.100025 | 9.899975 | 15 | 21 |
| 40 | 25 | 9.783623 | 10.216377 | 9.883672 | 10.116328 | 10.100049 | 9.899951 | 35 | 20 |
| 41 | 15 | 9.783664 | 10.216336 | 9.883737 | 10.116263 | 10.100074 | 9.899926 | 45 | 19 |
| 42 | 30 | 9.783705 | 10.216295 | 9.883803 | 10.116197 | 10.100098 | 9.899902 | 30 | 18 |
| 43 | 45 | 9.783746 | 10.216254 | 9.883868 | 10.116132 | 10.100122 | 9.899878 | 15 | 17 |
| 44 | 26 | 9.783788 | 10.216212 | 9.883934 | 10.116066 | 10.100146 | 9.899854 | 34 | 16 |
| 45 | 15 | 9.783829 | 10.216171 | 9.883999 | 10.116001 | 10.100170 | 9.899830 | 45 | 15 |
| 46 | 30 | 9.783870 | 10.216130 | 9.884065 | 10.115935 | 10.100194 | 9.899806 | 30 | 14 |
| 47 | 45 | 9.783911 | 10.216089 | 9.884130 | 10.115870 | 10.100219 | 9.899781 | 15 | 13 |
| 48 | 27 | 9.783953 | 10.216047 | 9.884196 | 10.115804 | 10.100243 | 9.899757 | 33 | 12 |
| 49 | 15 | 9.783994 | 10.216006 | 9.884261 | 10.115739 | 10.100267 | 9.899733 | 45 | 11 |
| 50 | 30 | 9.784035 | 10.215965 | 9.884326 | 10.115674 | 10.100291 | 9.899709 | 30 | 10 |
| 51 | 45 | 9.784076 | 10.215924 | 9.884392 | 10.115608 | 10.100315 | 9.899685 | 15 | 9 |
| 52 | 28 | 9.784118 | 10.215882 | 9.884457 | 10.115543 | 10.100340 | 9.899660 | 32 | 8 |
| 53 | 15 | 9.784159 | 10.215841 | 9.884523 | 10.115477 | 10.100364 | 9.899636 | 45 | 7 |
| 54 | 30 | 9.784200 | 10.215800 | 9.884588 | 10.115412 | 10.100388 | 9.899612 | 30 | 6 |
| 55 | 45 | 9.784241 | 10.215759 | 9.884653 | 10.115347 | 10.100412 | 9.899588 | 15 | 5 |
| 56 | 29 | 9.784282 | 10.215718 | 9.884719 | 10.115281 | 10.100436 | 9.899564 | 31 | 4 |
| 57 | 15 | 9.784324 | 10.215676 | 9.884784 | 10.115216 | 10.100461 | 9.899539 | 45 | 3 |
| 58 | 30 | 9.784365 | 10.215635 | 9.884850 | 10.115150 | 10.100485 | 9.899515 | 30 | 2 |
| 59 | 45 | 9.784406 | 10.215594 | 9.884915 | 10.115085 | 10.100509 | 0.899491 | 15 | 1 |
| 60 | 30 | 9.784447 | 10.215553 | 9.884980 | 10.115020 | 10.100533 | 9.899467 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 30m. | | | LOG. SINES. &c. | | | | 52 deg. | | |

| 2h 30m. | | | LOG. SINES, &c. (t.) | | | | 37 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.784447 | 10.215553 | 9.884980 | 10.115020 | 10.100533 | 9.899467 | 30 | 60 |
| 1 | 15 | 9.784488 | 10.215512 | 9.885046 | 10.114954 | 10.100558 | 9.899442 | 45 | 59 |
| 2 | 30 | 9.784529 | 10.215471 | 9.885111 | 10.114889 | 10.100582 | 9.899418 | 30 | 58 |
| 3 | 45 | 9.784571 | 10.215429 | 9.885177 | 10.114823 | 10.100606 | 9.899394 | 15 | 57 |
| 4 | 31 | 9.784612 | 10.215388 | 9.885242 | 10.114758 | 10.100630 | 9.899370 | 29 | 56 |
| 5 | 15 | 9.784653 | 10.215347 | 9.885307 | 10.114693 | 10.100655 | 9.899345 | 45 | 55 |
| 6 | 30 | 9.784694 | 10.215306 | 9.885373 | 10.114627 | 10.100679 | 9.899321 | 30 | 54 |
| 7 | 45 | 9.784735 | 10.215265 | 9.885438 | 10.114562 | 10.100703 | 9.899297 | 15 | 53 |
| 8 | 32 | 9.784776 | 10.215224 | 9.885503 | 10.114497 | 10.100727 | 9.899273 | 28 | 52 |
| 9 | 15 | 9.784817 | 10.215183 | 9.885569 | 10.114431 | 10.100752 | 9.899248 | 45 | 51 |
| 10 | 30 | 9.784858 | 10.215142 | 9.885634 | 10.114366 | 10.100776 | 9.899224 | 30 | 50 |
| 11 | 45 | 9.784899 | 10.215101 | 9.885700 | 10.114300 | 10.100800 | 9.899200 | 15 | 49 |
| 12 | 33 | 9.784941 | 10.215059 | 9.885765 | 10.114235 | 10.100824 | 9.899176 | 27 | 48 |
| 13 | 15 | 9.784982 | 10.215018 | 9.885830 | 10.114170 | 10.100849 | 9.899151 | 45 | 47 |
| 14 | 30 | 9.785023 | 10.214977 | 9.885896 | 10.114104 | 10.100873 | 9.899127 | 30 | 46 |
| 15 | 45 | 9.785064 | 10.214936 | 9.885961 | 10.114039 | 10.100897 | 9.899103 | 15 | 45 |
| 16 | 34 | 9.785105 | 10.214895 | 9.886026 | 10.113974 | 10.100922 | 9.899078 | 26 | 44 |
| 17 | 15 | 9 785146 | 10.214854 | 9.886092 | 10.113908 | 10.100946 | 9.899054 | 45 | 43 |
| 18 | 30 | 9.785187 | 10.214813 | 9.886157 | 10.113843 | 10.100970 | 9.899030 | 30 | 42 |
| 19 | 45 | 9.785228 | 10.214772 | 9.886222 | 10.113778 | 10.100995 | 9.899005 | 15 | 41 |
| 20 | 35 | 9.785269 | 10.214731 | 9.886288 | 10.113712 | 10.101019 | 9.898981 | 25 | 40 |
| 21 | 15 | 9.785310 | 10.214690 | 9.886353 | 10.113647 | 10.101043 | 9.898957 | 45 | 39 |
| 22 | 30 | 9.785351 | 10.214649 | 9.886418 | 10.113582 | 10.101067 | 9.898933 | 30 | 38 |
| 23 | 45 | 9.785392 | 10.214608 | 9.886484 | 10.113516 | 10.101092 | 9.898908 | 15 | 37 |
| 24 | 36 | 9.785433 | 10.214567 | 9.886549 | 10.113451 | 10.101116 | 9.898884 | 24 | 36 |
| 25 | 15 | 9.785474 | 10.214526 | 9.886614 | 10.113386 | 10.101140 | 9.898860 | 45 | 35 |
| 26 | 30 | 9.785515 | 10.214485 | 9.886680 | 10.113320 | 10.101165 | 9.898835 | 30 | 34 |
| 27 | 45 | 9.785556 | 10.214444 | 9.886745 | 10.113255 | 10.101189 | 9.898811 | 15 | 33 |
| 28 | 37 | 9.785597 | 10.214403 | 9.886810 | 10.113190 | 10.101213 | 9.898787 | 23 | 32 |
| 29 | 15 | 9.785638 | 10.214362 | 9.886876 | 10.113124 | 10.101238 | 9.898762 | 45 | 31 |
| 30 | 30 | 9.785679 | 10.214321 | 9.886941 | 10.113059 | 10.101262 | 9.898738 | 30 | 30 |
| 31 | 45 | 9.785720 | 10.214280 | 9.887006 | 10.112994 | 10.101286 | 9.898714 | 15 | 29 |
| 32 | 38 | 9.785761 | 10.214239 | 9.887072 | 10.112928 | 10.101311 | 9.898689 | 22 | 28 |
| 33 | 15 | 9.785802 | 10.214198 | 9.887137 | 10.112863 | 10.101335 | 9.898665 | 45 | 27 |
| 34 | 30 | 9.785843 | 10.214157 | 9.887202 | 10.112798 | 10.101359 | 9.898641 | 30 | 26 |
| 35 | 45 | 9.785884 | 10.214116 | 9.887268 | 10.112732 | 10.101384 | 9.898616 | 15 | 25 |
| 36 | 39 | 9.785925 | 10.214075 | 9.887333 | 10.112667 | 10.101408 | 9.898592 | 21 | 24 |
| 37 | 15 | 9.785966 | 10.214034 | 9.887398 | 10.112602 | 10.101433 | 9.898567 | 45 | 23 |
| 38 | 30 | 9.786007 | 10.213993 | 9.887464 | 10.112536 | 10.101457 | 9.898543 | 30 | 22 |
| 39 | 45 | 9.786048 | 10.213952 | 9.887529 | 10.112471 | 10.101481 | 9.898519 | 15 | 21 |
| 40 | 40 | 9.786089 | 10.213911 | 9.887594 | 10.112406 | 10.101506 | 9.898494 | 20 | 20 |
| 41 | 15 | 9.786129 | 10.213871 | 9.887659 | 10.112341 | 10.101530 | 9.898470 | 45 | 19 |
| 42 | 30 | 9.786170 | 10.213830 | 9.887725 | 10.112275 | 10.101554 | 9.898446 | 30 | 18 |
| 43 | 45 | 9.786211 | 10.213789 | 9.887790 | 10.112210 | 10.101579 | 9.898421 | 15 | 17 |
| 44 | 41 | 9.786252 | 10.213748 | 9.887855 | 10.112145 | 10.101603 | 9.898397 | 19 | 16 |
| 45 | 15 | 9.786293 | 10.213707 | 9.887921 | 10.112079 | 10.101628 | 9.898372 | 45 | 15 |
| 46 | 30 | 9.786334 | 10.213666 | 9.887986 | 10.112014 | 10.101652 | 9.898348 | 30 | 14 |
| 47 | 45 | 9.786375 | 10.213625 | 9.888051 | 10.111949 | 10.101676 | 9.898324 | 15 | 13 |
| 48 | 42 | 9.786416 | 10.213584 | 9.888116 | 10.111884 | 10.101701 | 9.898299 | 18 | 12 |
| 49 | 15 | 9.786456 | 10.213544 | 9.888182 | 10.111818 | 10.101725 | 9.898275 | 45 | 11 |
| 50 | 30 | 9.786497 | 10.213503 | 9.888247 | 10.111753 | 10.101750 | 9.898250 | 30 | 10 |
| 51 | 45 | 9.786538 | 10.213462 | 9.888312 | 10.111688 | 10.101774 | 9.898226 | 15 | 9 |
| 52 | 43 | 9.786579 | 10.213421 | 9.888377 | 10.111623 | 10.101799 | 9.898201 | 17 | 8 |
| 53 | 15 | 9.786620 | 10.213380 | 9.888443 | 10.111557 | 10.101823 | 9.898177 | 45 | 7 |
| 54 | 30 | 9.786661 | 10.213339 | 9.888508 | 10.111492 | 10.101847 | 9.898153 | 30 | 6 |
| 55 | 45 | 9.786702 | 10.213298 | 9.888573 | 10.111427 | 10.101872 | 9.898128 | 15 | 5 |
| 56 | 44 | 9.786742 | 10.213258 | 9.888639 | 10.111361 | 10.101896 | 9.898104 | 16 | 4 |
| 57 | 15 | 9.786783 | 10.213217 | 9.888704 | 10.111296 | 10.101921 | 9.898079 | 45 | 3 |
| 58 | 30 | 9.786824 | 10.213176 | 9.888769 | 10.111231 | 10.101945 | 9.898055 | 30 | 2 |
| 59 | 45 | 9.786865 | 10.213135 | 9.888834 | 10.111166 | 10.101970 | 9.898030 | 15 | 1 |
| 60 | 45 | 9.786906 | 10.213094 | 9.888900 | 10.111100 | 10.101994 | 9.898006 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 2h 31m. | | LOG. SINES, &c. (t.) | | | | | 37 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9 786906 | 10.213094 | 9.888900 | 10.111100 | 10.101994 | 9.898006 | 15 | 60 |
| 1 | 15 | 9.786946 | 10.213054 | 9.888965 | 10.111035 | 10.102018 | 9.897982 | 45 | 59 |
| 2 | 30 | 9.786987 | 10.213013 | 9.889030 | 10.110970 | 10.102043 | 9.897957 | 30 | 58 |
| 3 | 45 | 9.787028 | 10.212972 | 9.889095 | 10.110905 | 10.102067 | 9.897933 | 15 | 57 |
| 4 | 46 | 9.787069 | 10.212931 | 9.889160 | 10.110840 | 10.102092 | 9.897908 | 14 | 56 |
| 5 | 15 | 9.787109 | 10.212891 | 9.889226 | 10.110774 | 10.102116 | 9.897884 | 45 | 55 |
| 6 | 30 | 9.787150 | 10.212850 | 9.889291 | 10.110709 | 10.102141 | 9.897859 | 30 | 54 |
| 7 | 45 | 9.787191 | 10.212809 | 9.889356 | 10.110644 | 10.102165 | 9.897835 | 15 | 53 |
| 8 | 47 | 9.787232 | 10.212768 | 9 889421 | 10.110579 | 10.102190 | 9.897810 | 13 | 52 |
| 9 | 15 | 9.787272 | 10.212728 | 9.889487 | 10.110513 | 10.102214 | 9.897786 | 45 | 51 |
| 10 | 30 | 9.787313 | 10.212687 | 9.889552 | 10.110448 | 10.102239 | 9.897761 | 30 | 50 |
| 11 | 45 | 9.787354 | 10.212646 | 9.889617 | 10.110383 | 10.102263 | 9.897737 | 15 | 49 |
| 12 | 48 | 9.787395 | 10.212605 | 9.889682 | 10.110318 | 10.102288 | 9.897712 | 12 | 48 |
| 13 | 15 | 9.787435 | 10.212565 | 9.889747 | 10.110253 | 10.102312 | 9.897688 | 45 | 47 |
| 14 | 30 | 9.787476 | 10.212524 | 9.889813 | 10.110187 | 10.102337 | 9.897663 | 30 | 46 |
| 15 | 45 | 9.787517 | 10.212483 | 9.889878 | 10.110122 | 10.102361 | 9.897639 | 15 | 45 |
| 16 | 49 | 9.787557 | 10.212443 | 9.889943 | 10.110057 | 10.102386 | 9.897614 | 11 | 44 |
| 17 | 15 | 9.787598 | 10.212402 | 9.890008 | 10.109992 | 10.102410 | 9.897590 | 45 | 43 |
| 18 | 30 | 9.787639 | 10.212361 | 9.890074 | 10.109926 | 10.102435 | 9.897565 | 30 | 42 |
| 19 | 45 | 9.787679 | 10.212321 | 9.890139 | 10.109861 | 10.102459 | 9.897541 | 15 | 41 |
| 20 | 50 | 9.787720 | 10.212280 | 9.890204 | 10.109796 | 10.102484 | 9.897516 | 10 | 40 |
| 21 | 15 | 9.787761 | 10.212239 | 9.890269 | 10.109731 | 10.102508 | 9.897492 | 45 | 39 |
| 22 | 30 | 9.787801 | 10.212199 | 9.890334 | 10.109666 | 10.102533 | 9.897467 | 30 | 38 |
| 23 | 45 | 9.787842 | 10.212158 | 9.890399 | 10.109601 | 10.102557 | 9 897443 | 15 | 37 |
| 24 | 51 | 9.787883 | 10.212117 | 9.890465 | 10.109535 | 10.102582 | 9.897418 | 9 | 36 |
| 25 | 15 | 9.787923 | 10.212077 | 9.890530 | 10.109470 | 10.102607 | 9.897393 | 45 | 35 |
| 26 | 30 | 9.787964 | 10.212036 | 9.890595 | 10.109405 | 10.102631 | 9.897369 | 30 | 34 |
| 27 | 45 | 9.788005 | 10.211995 | 9.890660 | 10.109340 | 10.102656 | 9.897344 | 15 | 33 |
| 28 | 52 | 9.788045 | 10.211955 | 9.890725 | 10.109275 | 10.102680 | 9.897320 | 8 | 32 |
| 29 | 15 | 9.788086 | 10.211914 | 9.890791 | 10.109209 | 10.102705 | 9.897295 | 45 | 31 |
| 30 | 30 | 9.788126 | 10.211874 | 9.890856 | 10.109144 | 10.102729 | 9.897271 | 30 | 30 |
| 31 | 45 | 9.788167 | 10.211833 | 9.890921 | 10.109079 | 10.102754 | 9.897246 | 15 | 29 |
| 32 | 53 | 9.788208 | 10.211792 | 9.890986 | 10.109014 | 10.102778 | 9.897222 | 7 | 28 |
| 33 | 15 | 9.788248 | 10.211752 | 9.891051 | 10.108949 | 10.102803 | 9.897197 | 45 | 27 |
| 34 | 30 | 9.788289 | 10.211711 | 9.891116 | 10.108884 | 10.102828 | 9.897172 | 30 | 26 |
| 35 | 45 | 9.788329 | 10.211671 | 9.891182 | 10.108818 | 10.102852 | 9.897148 | 15 | 25 |
| 36 | 54 | 9.788370 | 10.211630 | 9.891247 | 10.108753 | 10.102877 | 9.897123 | 6 | 24 |
| 37 | 15 | 9.788411 | 10.211589 | 9.891312 | 10.108688 | 10.102901 | 9.897099 | 45 | 23 |
| 38 | 30 | 9.788451 | 10.211549 | 9.891377 | 10.108623 | 10.102926 | 9.897074 | 30 | 22 |
| 39 | 45 | 9.788492 | 10.211508 | 9.891442 | 10.108558 | 10.102951 | 9.897049 | 15 | 21 |
| 40 | 55 | 9.788532 | 10.211468 | 9.891507 | 10.108493 | 10.102975 | 9.897025 | 5 | 20 |
| 41 | 15 | 9.788573 | 10.211427 | 9.891572 | 10.108428 | 10.103000 | 9.897000 | 45 | 19 |
| 42 | 30 | 9.788613 | 10.211387 | 9.891638 | 10.108362 | 10.103024 | 9.896976 | 30 | 18 |
| 43 | 45 | 9.788654 | 10.211346 | 9.891703 | 10.108297 | 10.103049 | 9.896951 | 15 | 17 |
| 44 | 56. | 9.788694 | 10.211306 | 9.891768 | 10.108232 | 10.103074 | 9.896926 | 4 | 16 |
| 45 | 15 | 9.788735 | 10.211265 | 9.891833 | 10.108167 | 10.103098 | 9.896902 | 45 | 15 |
| 46 | 30 | 9.788775 | 10.211225 | 9.891898 | 10.108102 | 10.103123 | 9.896877 | 30 | 14 |
| 47 | 45 | 9.788816 | 10.211184 | 9.891963 | 10.108037 | 10.103147 | 9.896853 | 15 | 13 |
| 48 | 57 | 9.788856 | 10.211144 | 9.892028 | 10.107972 | 10.103172 | 9.896828 | 3 | 12 |
| 49 | 15 | 9.788897 | 10.211103 | 9.892094 | 10.107906 | 10.103197 | 9.896803 | 45 | 11 |
| 50 | 30 | 9.788937 | 10.211063 | 9.892159 | 10.107841 | 10.103221 | 9.896779 | 30 | 10 |
| 51 | 45 | 9.788978 | 10.211022 | 9.892224 | 10.107776 | 10.103246 | 9.896754 | 15 | 9 |
| 52 | 58 | 9.789018 | 10.210982 | 9.892289 | 10.107711 | 10.103271 | 9.896729 | 2 | 8 |
| 53 | 15 | 9.789059 | 10.210941 | 9.892354 | 10.107646 | 10.103295 | 9.896705 | 45 | 7 |
| 54 | 30 | 9.789099 | 10.210901 | 9.892419 | 10.107581 | 10.103320 | 9.896680 | 30 | 6 |
| 55 | 45 | 9.789140 | 10.210860 | 9.892484 | 10.107516 | 10.103345 | 9.896655 | 15 | 5 |
| 56 | 59 | 9.789180 | 10.210820 | 9.892549 | 10.107451 | 10.103369 | 9.896631 | 1 | 4 |
| 57 | 15 | 9.789221 | 10.210779 | 9.892614 | 10.107386 | 10.103394 | 9.896606 | 45 | 3 |
| 58 | 30 | 9.789261 | 10.210739 | 9.892680 | 10.107320 | 10.103419 | 9.896581 | 30 | 2 |
| 59 | 45 | 9.789302 | 10.210698 | 9.892745 | 10.107255 | 10.103443 | 9.896557 | 15 | 1 |
| 60 | 60 | 9.789342 | 10.210658 | 9.892810 | 10.107190 | 10.103468 | 9.896532 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec |
| 3h 28m. | | | | LOG. SINES, &c. | | | | 52 deg. | |

| 2h 32m. | | | LOG. SINES, &c. (t.) | | | | 38 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.789342 | 10.210658 | 9.892810 | 10.107190 | 10.103468 | 9.896532 | 60 | 60 |
| 1 | 15 | 9.789382 | 10.210618 | 9.892875 | 10.107125 | 10.103493 | 9.896507 | 45 | 59 |
| 2 | 30 | 9.789423 | 10.210577 | 9.892940 | 10.107060 | 10.103517 | 9.896483 | 30 | 58 |
| 3 | 45 | 9.789463 | 10.210537 | 9.893005 | 10.106995 | 10.103542 | 9.896458 | 15 | 57 |
| 4 | 1 | 9.789504 | 10.210496 | 9.893070 | 10.106930 | 10.103567 | 9.896433 | 59 | 56 |
| 5 | 15 | 9.789544 | 10.210456 | 9.893135 | 10.106865 | 10.103591 | 9.896409 | 45 | 55 |
| 6 | 30 | 9.789584 | 10.210416 | 9.893200 | 10.106800 | 10.103616 | 9.896384 | 30 | 54 |
| 7 | 45 | 9.789625 | 10.210375 | 9.893265 | 10.106735 | 10.103641 | 9.896359 | 15 | 53 |
| 8 | 2 | 9.789665 | 10.210335 | 9.893331 | 10.106669 | 10.103665 | 9.896335 | 58 | 52 |
| 9 | 15 | 9.789706 | 10.210294 | 9.893396 | 10.106604 | 10.103690 | 9.896310 | 45 | 51 |
| 10 | 30 | 9.789746 | 10.210254 | 9.893461 | 10.106539 | 10.103715 | 9.896285 | 30 | 50 |
| 11 | 45 | 9.789786 | 10.210214 | 9.893526 | 10.106474 | 10.103740 | 9.896260 | 15 | 49 |
| 12 | 3 | 9.789827 | 10.210173 | 9.893591 | 10.106409 | 10.103764 | 9.896236 | 57 | 48 |
| 13 | 15 | 9.789867 | 10.210133 | 9.893656 | 10.106344 | 10.103789 | 9.896211 | 45 | 47 |
| 14 | 30 | 9.789907 | 10.210093 | 9.893721 | 10.106279 | 10.103814 | 9.896186 | 30 | 46 |
| 15 | 45 | 9.789948 | 10.210052 | 9.893786 | 10.106214 | 10.103838 | 9.896162 | 15 | 45 |
| 16 | 4 | 9.789988 | 10.210012 | 9.893851 | 10.106149 | 10.103863 | 9.896137 | 56 | 44 |
| 17 | 15 | 9.790028 | 10.209972 | 9.893916 | 10.106084 | 10.103888 | 9.896112 | 45 | 43 |
| 18 | 30 | 9.790069 | 10.209931 | 9.893981 | 10.106019 | 10.103913 | 9.896087 | 30 | 42 |
| 19 | 45 | 9.790109 | 10.209891 | 9.894046 | 10.105954 | 10.103937 | 9.896063 | 15 | 41 |
| 20 | 5 | 9.790149 | 10.209851 | 9.894111 | 10.105889 | 10.103962 | 9.896038 | 55 | 40 |
| 21 | 15 | 9.790190 | 10.209810 | 9.894176 | 10.105824 | 10.103987 | 9.896013 | 45 | 39 |
| 22 | 30 | 9.790230 | 10.209770 | 9.894241 | 10.105759 | 10.104012 | 9.895988 | 30 | 38 |
| 23 | 45 | 9.790270 | 10.209730 | 9.894306 | 10.105694 | 10.104036 | 9.895964 | 15 | 37 |
| 24 | 6 | 9.790310 | 10.209690 | 9.894371 | 10.105629 | 10.104061 | 9.895939 | 54 | 36 |
| 25 | 15 | 9.790351 | 10.209649 | 9.894437 | 10.105563 | 10.104086 | 9.895914 | 45 | 35 |
| 26 | 30 | 9.790391 | 10.209609 | 9.894502 | 10.105498 | 10.104111 | 9.895889 | 30 | 34 |
| 27 | 45 | 9.790431 | 10.209569 | 9.894567 | 10.105433 | 10.104135 | 9.895865 | 15 | 33 |
| 28 | 7 | 9.790471 | 10.209529 | 9.894632 | 10.105368 | 10.104160 | 9.895840 | 53 | 32 |
| 29 | 15 | 9.790512 | 10.209488 | 9.894697 | 10.105303 | 10.104185 | 9.895815 | 45 | 31 |
| 30 | 30 | 9.790552 | 10.209448 | 9.894762 | 10.105238 | 10.104210 | 9.895790 | 30 | 30 |
| 31 | 45 | 9.790592 | 10.209408 | 9.894827 | 10.105173 | 10.104235 | 9.895765 | 15 | 29 |
| 32 | 8 | 9.790632 | 10.209368 | 9.894892 | 10.105108 | 10.104259 | 9.895741 | 52 | 28 |
| 33 | 15 | 9.790673 | 10.209327 | 9.894957 | 10.105043 | 10.104284 | 9.895716 | 45 | 27 |
| 34 | 30 | 9.790713 | 10.209287 | 9.895022 | 10.104978 | 10.104309 | 9.895691 | 30 | 26 |
| 35 | 45 | 9.790753 | 10.209247 | 9.895087 | 10.104913 | 10.104334 | 9.895666 | 15 | 25 |
| 36 | 9 | 9.790793 | 10.209207 | 9.895152 | 10.104848 | 10.104359 | 9.895641 | 51 | 24 |
| 37 | 15 | 9.790833 | 10.209167 | 9.895217 | 10.104783 | 10.104383 | 9.895617 | 45 | 23 |
| 38 | 30 | 9.790874 | 10.209126 | 9.895282 | 10.104718 | 10.104408 | 9.895592 | 30 | 22 |
| 39 | 45 | 9.790914 | 10.209086 | 9.895347 | 10.104653 | 10.104433 | 9.895567 | 15 | 21 |
| 40 | 10 | 9.790954 | 10.209046 | 9.895412 | 10.104588 | 10.104458 | 9.895542 | 50 | 20 |
| 41 | 15 | 9.790994 | 10.209006 | 9.895477 | 10.104523 | 10.104483 | 9.895517 | 45 | 19 |
| 42 | 30 | 9.791034 | 10.208966 | 9.895542 | 10.104458 | 10.104508 | 9.895492 | 30 | 18 |
| 43 | 45 | 9.791075 | 10.208925 | 9.895607 | 10.104393 | 10.104532 | 9.895468 | 15 | 17 |
| 44 | 11 | 9.791115 | 10.208885 | 9.895672 | 10.104328 | 10.104557 | 9.895443 | 49 | 16 |
| 45 | 15 | 9.791155 | 10.208845 | 9.895737 | 10.104263 | 10.104582 | 9.895418 | 45 | 15 |
| 46 | 30 | 9.791195 | 10.208805 | 9.895802 | 10.104198 | 10.104607 | 9.895393 | 30 | 14 |
| 47 | 45 | 9.791235 | 10.208765 | 9.895867 | 10.104133 | 10.104632 | 9.895368 | 15 | 13 |
| 48 | 12 | 9.791275 | 10.208725 | 9.895932 | 10.104068 | 10.104657 | 9.895343 | 48 | 12 |
| 49 | 15 | 9.791315 | 10.208685 | 9.895997 | 10.104003 | 10.104681 | 9.895319 | 45 | 11 |
| 50 | 30 | 9.791356 | 10.208644 | 9.896062 | 10.103938 | 10.104706 | 9.895294 | 30 | 10 |
| 51 | 45 | 9.791396 | 10.208604 | 9.896127 | 10.103873 | 10.104731 | 9.895269 | 15 | 9 |
| 52 | 13 | 9.791436 | 10.208564 | 9.896192 | 10.103808 | 10.104756 | 9.895244 | 47 | 8 |
| 53 | 15 | 9.791476 | 10.208524 | 9.896257 | 10.103743 | 10.104781 | 9.895219 | 45 | 7 |
| 54 | 30 | 9.791516 | 10.208484 | 9.896322 | 10.103678 | 10.104806 | 9.895194 | 30 | 6 |
| 55 | 45 | 9.791556 | 10.208444 | 9.896387 | 10.103613 | 10.104831 | 9.895169 | 15 | 5 |
| 56 | 14 | 9.791596 | 10.208404 | 9.896452 | 10.103548 | 10.104856 | 9.895144 | 46 | 4 |
| 57 | 15 | 9.791636 | 10.208364 | 9.896517 | 10.103483 | 10.104880 | 9.895120 | 45 | 3 |
| 58 | 30 | 9.791676 | 10.208324 | 9.896582 | 10.103418 | 10.104905 | 9.895095 | 30 | 2 |
| 59 | 45 | 9.791716 | 10.208284 | 9.896647 | 10.103353 | 10.104930 | 9.895070 | 15 | 1 |
| 60 | 15 | 9.791757 | 10.208243 | 9.896712 | 10.103288 | 10.104955 | 9.895045 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 8h 27m. | | | LOG. SINES, &c. | | | | 51 deg. | | |

| 2h 23m. | | LOG. SINES, &c. (t.) | | | | | 35 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.766598 | 10.233402 | 9.857270 | 10.142730 | 10.090672 | 9.909328 | 15 | 60 |
| 1 | 15 | 9.766642 | 10.233358 | 9.857337 | 10.142663 | 10.090695 | 9.909305 | 45 | 59 |
| 2 | 30 | 9.766686 | 10.233314 | 9.857404 | 10.142596 | 10.090717 | 9.909283 | 30 | 58 |
| 3 | 45 | 9.766730 | 10.233270 | 9.857470 | 10.142530 | 10.090740 | 9.909260 | 15 | 57 |
| 4 | 46 | 9.766774 | 10.233226 | 9.857537 | 10.142463 | 10.090763 | 9.909237 | 14 | 56 |
| 5 | 15 | 9.766818 | 10.233182 | 9.857603 | 10.142397 | 10.090786 | 9.909214 | 45 | 55 |
| 6 | 30 | 9.766862 | 10.233138 | 9.857670 | 10.142330 | 10.090808 | 9.909192 | 30 | 54 |
| 7 | 45 | 9.766905 | 10.233095 | 9.857736 | 10.142264 | 10.090831 | 9.909169 | 15 | 53 |
| 8 | 47 | 9.766949 | 10.233051 | 9.857803 | 10.142197 | 10.090854 | 9.909146 | 13 | 52 |
| 9 | 15 | 9.766993 | 10.233007 | 9.857870 | 10.142130 | 10.090877 | 9.909123 | 45 | 51 |
| 10 | 30 | 9.767037 | 10.232963 | 9.857936 | 10.142064 | 10.090899 | 9.909101 | 30 | 50 |
| 11 | 45 | 9.767081 | 10.232919 | 9.858003 | 10 141997 | 10.090922 | 9.909078 | 15 | 49 |
| 12 | 48 | 9.767124 | 10.232876 | 9.858069 | 10.141931 | 10.090945 | 9.909055 | 12 | 48 |
| 13 | 15 | 9.767168 | 10.232832 | 9.858136 | 10.141864 | 10.090968 | 9.909032 | 45 | 47 |
| 14 | 30 | 9.767212 | 10.232788 | 9.858202 | 10.141798 | 10.090991 | 9.909009 | 30 | 46 |
| 15 | 45 | 9.767256 | 10.232744 | 9.858269 | 10.141731 | 10.091013 | 9.908987 | 15 | 45 |
| 16 | 49 | 9.767300 | 10.232700 | 9.858336 | 10.141664 | 10.091036 | 9.908964 | 11 | 44 |
| 17 | 15 | 9.767343 | 10.232657 | 9.858402 | 10.141598 | 10.091059 | 9.908941 | 45 | 43 |
| 18 | 30 | 9.767387 | 10.232613 | 9.858469 | 10.141531 | 10.091082 | 9.908918 | 30 | 42 |
| 19 | 45 | 9.767431 | 10.232569 | 9.858535 | 10.141465 | 10.091105 | 9.908895 | 15 | 41 |
| 20 | 50 | 9.767475 | 10.232525 | 9.858602 | 10.141398 | 10.091127 | 9.908873 | 10 | 40 |
| 21 | 15 | 9.767518 | 10.232482 | 9.858668 | 10.141332 | 10.091150 | 9.908850 | 45 | 39 |
| 22 | 30 | 9.767562 | 10.232438 | 9.858735 | 10.141265 | 10.091173 | 9.908827 | 30 | 38 |
| 23 | 45 | 9.767606 | 10.232394 | 9.858801 | 10.141199 | 10.091196 | 9.908804 | 15 | 37 |
| 24 | 51 | 9.767649 | 10.232351 | 9.858868 | 10.141132 | 10.091219 | 9.908781 | 9 | 36 |
| 25 | 15 | 9.767693 | 10.232307 | 9.858934 | 10.141066 | 10.091241 | 9.908759 | 45 | 35 |
| 26 | 30 | 9.767737 | 10.232263 | 9.859001 | 10.140999 | 10.091264 | 9.908736 | 30 | 34 |
| 27 | 45 | 9.767780 | 10.232220 | 9.859068 | 10.140932 | 10.091287 | 9.908713 | 15 | 33 |
| 28 | 52 | 9.767824 | 10.232176 | 9.859134 | 10.140866 | 10.091310 | 9.908690 | 8 | 32 |
| 29 | 15 | 9 767868 | 10.232132 | 9.859201 | 10.140799 | 10.091333 | 9.908667 | 45 | 31 |
| 30 | 30 | 9.767912 | 10.232088 | 9.859267 | 10.140733 | 10.091356 | 9.908644 | 30 | 30 |
| 31 | 45 | 9.767955 | 10.232045 | 9.859334 | 10.140666 | 10.091378 | 9.908622 | 15 | 29 |
| 32 | 53 | 9 767999 | 10.232001 | 9.859400 | 10.140600 | 10.091401 | 9.908599 | 7 | 28 |
| 33 | 15 | 9.768043 | 10.231957 | 9.859467 | 10.140533 | 10.091424 | 9.908576 | 45 | 27 |
| 34 | 30 | 9.768086 | 10.231914 | 9.859533 | 10.140467 | 10.091447 | 9.908553 | 30 | 26 |
| 35 | 45 | 9.768130 | 10.231870 | 9 859600 | 10.140400 | 10.091470 | 9.908530 | 15 | 25 |
| 36 | 54 | 9.768173 | 10.231827 | 9.859666 | 10.140334 | 10.091493 | 9.908507 | 6 | 24 |
| 37 | 15 | 9.768217 | 10.231783 | 9.859733 | 10.140267 | 10.091516 | 9.908484 | 45 | 23 |
| 38 | 30 | 9.768261 | 10.231739 | 9.859799 | 10.140201 | 10.091538 | 9.908462 | 30 | 22 |
| 39 | 45 | 9.768304 | 10.231696 | 9.859866 | 10.140134 | 10.091561 | 9.908439 | 15 | 21 |
| 40 | 55 | 9.768348 | 10.231652 | 9.859932 | 10.140068 | 10.091584 | 9.908416 | 5 | 20 |
| 41 | 15 | 9.768392 | 10.231608 | 9.859999 | 10.140001 | 10.091607 | 9.908393 | 45 | 19 |
| 42 | 30 | 9.768435 | 10.231565 | 9.860065 | 10.139935 | 10.091630 | 9.908370 | 30 | 18 |
| 43 | 45 | 9.768479 | 10.231521 | 9.860131 | 10.139869 | 10.091653 | 9.908347 | 15 | 17 |
| 44 | 56 | 9.768522 | 10.231478 | 9.860198 | 10.139802 | 10.091676 | 9.908324 | 4 | 16 |
| 45 | 15 | 9.768566 | 10.231434 | 9 860264 | 10.139736 | 10.091699 | 9.908301 | 45 | 15 |
| 46 | 30 | 9.768609 | 10.231391 | 9.860331 | 10.139669 | 10.091722 | 9.908278 | 30 | 14 |
| 47 | 45 | 9.768653 | 10.231347 | 9.860397 | 10.139603 | 10.091744 | 9.908256 | 15 | 13 |
| 48 | 57 | 9.768697 | 10.231303 | 9.860464 | 10.139536 | 10.091767 | 9.908233 | 3 | 12 |
| 49 | 15 | 9.768740 | 10.231260 | 9.860530 | 10.139470 | 10.091790 | 9.908210 | 45 | 11 |
| 50 | 30 | 9.768784 | 10.231216 | 9.860597 | 10.139403 | 10.091813 | 9.908187 | 30 | 10 |
| 51 | 45 | 9.768827 | 10.231173 | 9.860663 | 10.139337 | 10.091836 | 9.908164 | 15 | 9 |
| 52 | 58 | 9.768871 | 10.231129 | 9.860730 | 10.139270 | 10.091859 | 9.908141 | 2 | 8 |
| 53 | 15 | 9.768914 | 10.231086 | 9.860796 | 10.139204 | 10.091882 | 9.908118 | 45 | 7 |
| 54 | 30 | 9.768958 | 10.231042 | 9.860862 | 10.139138 | 10.091905 | 9.908095 | 30 | 6 |
| 55 | 45 | 9.769001 | 10.230999 | 9.860929 | 10.139071 | 10.091928 | 9.908072 | 15 | 5 |
| 56 | 59 | 9.769045 | 10.230955 | 9.860995 | 10 139005 | 10.091951 | 9 908049 | 1 | 4 |
| 57 | 15 | 9.769088 | 10.230912 | 9.861062 | 10.138938 | 10.091974 | 9.908026 | 45 | 3 |
| 58 | 30 | 9.769132 | 10.230868 | 9.861128 | 10.138872 | 10.091997 | 9.908003 | 30 | 2 |
| 59 | 45 | 9.769175 | 10.230825 | 9.861195 | 10.138805 | 10.092019 | 9.907981 | 15 | 1 |
| 60 | 60 | 9.769219 | 10.230781 | 9.861261 | 10.138739 | 10.092042 | 9.907958 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 36m. | | | LOG. SINES, &c. | | | | 54 deg. | | |

| | | LOG. SINES, &c. (t.) | | | | 88 deg. | | |
|---|---|---|---|---|---|---|---|---|
| | | secant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| | | [illegible]0 | 9.900605 | 10.099395 | 10.106456 | 9.893544 | 30 | 60 |
| | | | 9.900670 | 10.099330 | 10.106481 | 9.893519 | 45 | 59 |
| | | | 9.900735 | 10.099265 | 10.106506 | 9.893494 | 30 | 58 |
| | | [illegible] | 9.900800 | 10.099200 | 10.106531 | 9.893469 | 15 | 57 |
| | | [illegible]2 | 9.900864 | 10.099136 | 10.106556 | 9.893444 | 29 | 56 |
| | | [illegible]052 | 9.900929 | 10.099071 | 10.106581 | 9.893419 | 45 | 55 |
| | | [illegible]05612 | 9.900994 | 10.099006 | 10.106606 | 9.893394 | 30 | 54 |
| | | [illegible].205573 | 9.901059 | 10.098941 | 10.106632 | 9.893368 | 15 | 53 |
| | | 10.205533 | 9.901124 | 10.098876 | 10.106657 | 9.893343 | 28 | 52 |
| | | 10.205493 | 9.901189 | 10.098811 | 10.106682 | 9.893318 | 45 | 51 |
| | | [illegible]6 | 10.205454 | 9.901253 | 10.098747 | 10.106707 | 9.893293 | 30 | 50 |
| | | [illegible]586 | 10.205414 | 9.901318 | 10.098682 | 10.106732 | 9.893268 | 15 | 49 |
| | | [illegible]11626 | 10.205374 | 9.901383 | 10.098617 | 10.106757 | 9.893243 | 27 | 48 |
| | | [illegible].794665 | 10.205335 | 9.901448 | 10.098552 | 10.106783 | 9.893217 | 45 | 47 |
| | | 9.794705 | 10.205295 | 9.901513 | 10.098487 | 10.106808 | 9.893192 | 30 | 46 |
| | | 9.794744 | 10.205256 | 9.901577 | 10.098423 | 10.106833 | 9.893167 | 15 | 45 |
| | | 9.794784 | 10.205216 | 9.901642 | 10.098358 | 10.106858 | 9.893142 | 26 | 44 |
| | 15 | 9.794824 | 10.205176 | 9.901707 | 10.098293 | 10.106883 | 9.893117 | 45 | 43 |
| | 30 | 9.794863 | 10.205137 | 9.901772 | 10.098228 | 10.106908 | 9.893092 | 30 | 42 |
| | 45 | 9.794903 | 10.205097 | 9.901836 | 10.098164 | 10.106934 | 9.893066 | 15 | 41 |
| 20 | 35 | 9.794942 | 10.205058 | 9.901901 | 10 098099 | 10.106959 | 9.893041 | 25 | 40 |
| 21 | 15 | 9.794982 | 10.205018 | 9.901966 | 10.098034 | 10.106984 | 9.893016 | 45 | 39 |
| 22 | 30 | 9.795022 | 10.204978 | 9.902031 | 10.097969 | 10.107009 | 9.892991 | 30 | 38 |
| 23 | 45 | 9.795061 | 10.204939 | 9.902096 | 10.097904 | 10.107034 | 9.892966 | 15 | 37 |
| 24 | 36 | 9.795101 | 10.204899 | 9.902160 | 10.097840 | 10.107060 | 9.892940 | 24 | 36 |
| 25 | 15 | 9.795140 | 10.204860 | 9.902225 | 10.097775 | 10.107085 | 9.892915 | 45 | 35 |
| 26 | 30 | 9.795180 | 10.204820 | 9.902290 | 10.097710 | 10.107110 | 9.892890 | 30 | 34 |
| 27 | 45 | 9.795219 | 10.204781 | 9.902355 | 10.097645 | 10.107135 | 9.892865 | 15 | 33 |
| 28 | 37 | 9.795259 | 10.204741 | 9.902419 | 10.097581 | 10.107161 | 9.892839 | 23 | 32 |
| 29 | 15 | 9.795298 | 10.204702 | 9.902484 | 10.097516 | 10.107186 | 9.892814 | 45 | 31 |
| 30 | 30 | 9.795338 | 10.204662 | 9.902549 | 10.097451 | 10.107211 | 9.892789 | 30 | 30 |
| 31 | 45 | 9.795378 | 10.204622 | 9.902614 | 10.097386 | 10.107236 | 9.892764 | 15 | 29 |
| 32 | 38 | 9.795417 | 10.204583 | 9.902679 | 10.097321 | 10.107262 | 9.892738 | 22 | 28 |
| 33 | 15 | 9.795457 | 10.204543 | 9.902743 | 10.097257 | 10.107287 | 9.892713 | 45 | 27 |
| 34 | 30 | 9.795496 | 10.204504 | 9.902808 | 10.097192 | 10.107312 | 9.892688 | 30 | 26 |
| 35 | 45 | 9.795536 | 10.204464 | 9.902873 | 10.097127 | 10.107337 | 9.892663 | 15 | 25 |
| 36 | 39 | 9.795575 | 10.204425 | 9.902938 | 10.097062 | 10.107363 | 9.892637 | 21 | 24 |
| 37 | 15 | 9.795615 | 10.204385 | 9.903002 | 10.096998 | 10.107388 | 9.892612 | 45 | 23 |
| 38 | 30 | 9.795654 | 10.204346 | 9.903067 | 10.096933 | 10.107413 | 9.892587 | 30 | 22 |
| 39 | 45 | 9.795694 | 10.204306 | 9.903132 | 10.096868 | 10.107438 | 9.892562 | 15 | 21 |
| 40 | 40 | 9.795733 | 10.204267 | 9.903197 | 10.096803 | 10.107464 | 9.892536 | 20 | 20 |
| 41 | 15 | 9.795772 | 10.204228 | 9.903261 | 10.096739 | 10.107489 | 9.892511 | 45 | 19 |
| 42 | 30 | 9.795812 | 10.204188 | 9.903326 | 10.096674 | 10.107514 | 9.892486 | 30 | 18 |
| 43 | 45 | 9.795851 | 10.204149 | 9.903391 | 10.096609 | 10.107539 | 9.892461 | 15 | 17 |
| 44 | 41 | 9.795891 | 10.204109 | 9.903455 | 10.096545 | 10.107565 | 9.892435 | 19 | 16 |
| 45 | 15 | 9.795930 | 10.204070 | 9.903520 | 10.096480 | 10.107590 | 9.892410 | 45 | 15 |
| 46 | 30 | 9.795970 | 10.204030 | 9.903585 | 10.096415 | 10.107615 | 9.892385 | 30 | 14 |
| 47 | 45 | 9.796009 | 10.203991 | 9.903650 | 10.096350 | 10.107641 | 9.892359 | 15 | 13 |
| 48 | 42 | 9.796049 | 10.203951 | 9 903714 | 10.096286 | 10.107666 | 9.892334 | 18 | 12 |
| 49 | 15 | 9.796088 | 10.203912 | 9.903779 | 10.096221 | 10.107691 | 9.892309 | 45 | 11 |
| 50 | 30 | 9.796127 | 10.203873 | 9.903844 | 10.096156 | 10.107716 | 9.892284 | 30 | 10 |
| 51 | 45 | 9.796167 | 10.203833 | 9.903909 | 10.096091 | 10.107742 | 9 892258 | 15 | 9 |
| 52 | 43 | 9.796206 | 10.203794 | 9.903973 | 10.096027 | 10.107767 | 9.892233 | 17 | 8 |
| 53 | 15 | 9.796246 | 10.203754 | 9.904038 | 10.095962 | 10.107792 | 9.892208 | 45 | 7 |
| 54 | 30 | 9.796285 | 10.203715 | 9.904103 | 10.095897 | 10.107818 | 9.892182 | 30 | 6 |
| 55 | 45 | 9.796324 | 10.203676 | 9.904167 | 10.095833 | 10.107843 | 9.892157 | 15 | 5 |
| 56 | 44 | 9.796364 | 10.203636 | 9.904232 | 10.095768 | 10.107868 | 9.892132 | 16 | 4 |
| 57 | 15 | 9.796403 | 10.203597 | 9.904297 | 10.095703 | 10.107894 | 9.892106 | 45 | 3 |
| 58 | 30 | 9.796442 | 10.203558 | 9.904362 | 10.095638 | 10.107919 | 9.892081 | 30 | 2 |
| 59 | 45 | 9.796482 | 10.203518 | 9.904426 | 10.095574 | 10.107944 | 9.892056 | 15 | 1 |
| 60 | 45 | 9.796521 | 10.203479 | 9.904491 | 10.095509 | 10.107970 | 9.892030 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 2h 25m. | | | LOG. SINES, &c. (t.) | | | | 36 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.771815 | 10.228185 | 9.865240 | 10.134760 | 10.093426 | 9.906574 | 45 | 60 |
| 1 | 15 | 9.771858 | 10.228142 | 9.865307 | 10.134693 | 10.093449 | 9.906551 | 45 | 59 |
| 2 | 30 | 9.771901 | 10.228099 | 9.865373 | 10.134627 | 10.093472 | 9.906528 | 30 | 58 |
| 3 | 45 | 9.771944 | 10.228056 | 9.865439 | 10.134561 | 10.093495 | 9.906505 | 15 | 57 |
| 4 | 16 | 9.771987 | 10.228013 | 9.865505 | 10.134495 | 10.093518 | 9.906482 | 44 | 56 |
| 5 | 15 | 9.772030 | 10.227970 | 9.865571 | 10.134429 | 10.093541 | 9.906459 | 45 | 55 |
| 6 | 30 | 9.772073 | 10.227927 | 9.865638 | 10.134362 | 10.093565 | 9.906435 | 30 | 54 |
| 7 | 45 | 9.772116 | 10.227884 | 9.865704 | 10.134296 | 10.093588 | 9.906412 | 15 | 53 |
| 8 | 17 | 9.772159 | 10.227841 | 9.865770 | 10.134230 | 10.093611 | 9.906389 | 43 | 52 |
| 9 | 15 | 9.772202 | 10.227798 | 9.865836 | 10.134164 | 10.093634 | 9.906366 | 45 | 51 |
| 10 | 30 | 9.772245 | 10.227755 | 9.865903 | 10.134097 | 10.093657 | 9.906343 | 30 | 50 |
| 11 | 45 | 9.772288 | 10.227712 | 9.865969 | 10.134031 | 10.093680 | 9.906320 | 15 | 49 |
| 12 | 18 | 9.772331 | 10.227669 | 9.866035 | 10.133965 | 10.093704 | 9.906296 | 42 | 48 |
| 13 | 15 | 9.772374 | 10.227626 | 9.866101 | 10.133899 | 10.093727 | 9.906273 | 45 | 47 |
| 14 | 30 | 9.772417 | 10.227583 | 9.866167 | 10.133833 | 10.093750 | 9.906250 | 30 | 46 |
| 15 | 45 | 9.772460 | 10.227540 | 9.866233 | 10.133767 | 10.093773 | 9.906227 | 15 | 45 |
| 16 | 19 | 9.772503 | 10.227497 | 9.866300 | 10.133700 | 10.093796 | 9.906204 | 41 | 44 |
| 17 | 15 | 9.772546 | 10.227454 | 9.866366 | 10.133634 | 10.093820 | 9.906180 | 45 | 43 |
| 18 | 30 | 9.772589 | 10.227411 | 9.866432 | 10.133568 | 10.093843 | 9.906157 | 30 | 42 |
| 19 | 45 | 9.772632 | 10.227368 | 9.866498 | 10.133502 | 10.093866 | 9.906134 | 15 | 41 |
| 20 | 20 | 9.772675 | 10.227325 | 9.866564 | 10.133436 | 10.093889 | 9.906111 | 40 | 40 |
| 21 | 15 | 9.772718 | 10.227282 | 9.866631 | 10.133369 | 10.093913 | 9.906087 | 45 | 39 |
| 22 | 30 | 9.772761 | 10.227239 | 9.866697 | 10.133303 | 10.093936 | 9.906064 | 30 | 38 |
| 23 | 45 | 9.772804 | 10.227196 | 9.866763 | 10.133237 | 10.093959 | 9.906041 | 15 | 37 |
| 24 | 21 | 9.772847 | 10.227153 | 9.866829 | 10.133171 | 10.093982 | 9.906018 | 39 | 36 |
| 25 | 15 | 9.772890 | 10.227110 | 9.866895 | 10.133105 | 10.094006 | 9.905994 | 45 | 35 |
| 26 | 30 | 9.772933 | 10.227067 | 9.866961 | 10.133039 | 10.094029 | 9.905971 | 30 | 34 |
| 27 | 45 | 9.772976 | 10.227024 | 9.867028 | 10.132972 | 10.094052 | 9.905948 | 15 | 33 |
| 28 | 22 | 9.773018 | 10.226982 | 9.867094 | 10.132906 | 10.094075 | 9.905925 | 38 | 32 |
| 29 | 15 | 9.773061 | 10.226939 | 9.867160 | 10.132840 | 10.094099 | 9.905901 | 45 | 31 |
| 30 | 30 | 9.773104 | 10.226896 | 9.867226 | 10.132774 | 10.094122 | 9.905878 | 30 | 30 |
| 31 | 45 | 9.773147 | 10.226853 | 9.867292 | 10.132708 | 10.094145 | 9.905855 | 15 | 29 |
| 32 | 23 | 9.773190 | 10.226810 | 9.867358 | 10.132642 | 10.094168 | 9.905832 | 37 | 28 |
| 33 | 15 | 9.773233 | 10.226767 | 9.867424 | 10.132576 | 10.094192 | 9.905808 | 45 | 27 |
| 34 | 30 | 9.773276 | 10.226724 | 9.867490 | 10.132510 | 10.094215 | 9.905785 | 30 | 26 |
| 35 | 45 | 9.773318 | 10.226682 | 9.867557 | 10.132443 | 10.094238 | 9.905762 | 15 | 25 |
| 36 | 24 | 9.773361 | 10.226639 | 9.867623 | 10.132377 | 10.094261 | 9.905739 | 36 | 24 |
| 37 | 15 | 9.773404 | 10.226596 | 9.867689 | 10.132311 | 10.094285 | 9.905715 | 45 | 23 |
| 38 | 30 | 9.773447 | 10.226553 | 9.867755 | 10.132245 | 10.094308 | 9.905692 | 30 | 22 |
| 39 | 45 | 9.773490 | 10.226510 | 9.867821 | 10.132179 | 10.094331 | 9.905669 | 15 | 21 |
| 40 | 25 | 9.773533 | 10.226467 | 9.867887 | 10.132113 | 10.094355 | 9.905645 | 35 | 20 |
| 41 | 15 | 9.773575 | 10.226425 | 9.867953 | 10.132047 | 10.094378 | 9.905622 | 45 | 19 |
| 42 | 30 | 9.773618 | 10.226382 | 9.868019 | 10.131981 | 10.094401 | 9.905599 | 30 | 18 |
| 43 | 45 | 9.773661 | 10.226339 | 9.868086 | 10.131914 | 10.094425 | 9.905575 | 15 | 17 |
| 44 | 26 | 9.773704 | 10.226296 | 9.868152 | 10.131848 | 10.094448 | 9.905552 | 34 | 16 |
| 45 | 15 | 9.773747 | 10.226253 | 9.868218 | 10.131782 | 10.094471 | 9.905529 | 45 | 15 |
| 46 | 30 | 9.773789 | 10.226211 | 9.868284 | 10.131716 | 10.094494 | 9.905506 | 30 | 14 |
| 47 | 45 | 9.773832 | 10.226168 | 9.868350 | 10.131650 | 10.094518 | 9.905482 | 15 | 13 |
| 48 | 27 | 9.773875 | 10.226125 | 9.868416 | 10.131584 | 10.094541 | 9.905459 | 33 | 12 |
| 49 | 15 | 9.773918 | 10.226082 | 9.868482 | 10.131518 | 10.094564 | 9.905436 | 45 | 11 |
| 50 | 30 | 9.773960 | 10.226040 | 9.868548 | 10.131452 | 10.094588 | 9.905412 | 30 | 10 |
| 51 | 45 | 9.774003 | 10.225997 | 9.868614 | 10.131386 | 10.094611 | 9.905389 | 15 | 9 |
| 52 | 28 | 9.774046 | 10.225954 | 9.868680 | 10.131320 | 10.094634 | 9.905366 | 32 | 8 |
| 53 | 15 | 9.774089 | 10.225911 | 9.868746 | 10.131254 | 10.094658 | 9.905342 | 45 | 7 |
| 54 | 30 | 9.774131 | 10.225869 | 9.868812 | 10.131188 | 10.094681 | 9.905319 | 30 | 6 |
| 55 | 45 | 9.774174 | 10.225826 | 9.868879 | 10.131121 | 10.094705 | 9.905295 | 15 | 5 |
| 56 | 29 | 9.774217 | 10.225783 | 9.868945 | 10.131055 | 10.094728 | 9.905272 | 31 | 4 |
| 57 | 15 | 9.774259 | 10.225741 | 9.869011 | 10.130989 | 10.094751 | 9.905249 | 45 | 3 |
| 58 | 30 | 9.774302 | 10.225698 | 9.869077 | 10.130923 | 10.094775 | 9.905225 | 30 | 2 |
| 59 | 45 | 9.774345 | 10.225655 | 9.869143 | 10.130857 | 10.094798 | 9.905202 | 15 | 1 |
| 60 | 30 | 9.774388 | 10.225612 | 9.869209 | 10.130791 | 10.094821 | 9.905179 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 34m. | | | LOG. SINES, &c. | | | | 53 deg. | | |

| 2h 26m. | | | LOG. SINES, &c. (t.) | | | | 36 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.774388 | 10.225612 | 9.869209 | 10.130791 | 10.094821 | 9.905179 | 30 | 60 |
| 1 | 15 | 9.774430 | 10.225570 | 9.869275 | 10.130725 | 10.094845 | 9.905155 | 45 | 59 |
| 2 | 30 | 9.774473 | 10.225527 | 9.869341 | 10.130659 | 10.094868 | 9.905132 | 30 | 58 |
| 3 | 45 | 9.774516 | 10.225484 | 9.869407 | 10.130593 | 10.094891 | 9.905109 | 15 | 57 |
| 4 | 31 | 9.774558 | 10.225442 | 9.869473 | 10.130527 | 10.094915 | 9.905085 | 29 | 56 |
| 5 | 15 | 9.774601 | 10.225399 | 9.869539 | 10.130461 | 10.094938 | 9.905062 | 45 | 55 |
| 6 | 30 | 9.774644 | 10.225356 | 9.869605 | 10.130395 | 10.094962 | 9.905038 | 30 | 54 |
| 7 | 45 | 9.774686 | 10.225314 | 9.869671 | 10.130329 | 10.094985 | 9.905015 | 15 | 53 |
| 8 | 32 | 9.774729 | 10.225271 | 9.869737 | 10.130263 | 10.095008 | 9.904992 | 28 | 52 |
| 9 | 15 | 9.774771 | 10.225229 | 9.869803 | 10.130197 | 10 095032 | 9.904968 | 45 | 51 |
| 10 | 30 | 9.774814 | 10.225186 | 9.869869 | 10.130131 | 10.095055 | 9.904945 | 30 | 50 |
| 11 | 45 | 9.774857 | 10.225143 | 9.869935 | 10.130065 | 10.095079 | 9.904921 | 15 | 49 |
| 12 | 33 | 9.774899 | 10.225101 | 9.870001 | 10.129999 | 10.095102 | 9.904898 | 27 | 48 |
| 13 | 15 | 9.774942 | 10.225058 | 9.870067 | 10.129933 | 10.095125 | 9.904875 | 45 | 47 |
| 14 | 30 | 9.774984 | 10.225016 | 9.870133 | 10.129867 | 10.095149 | 9.904851 | 30 | 46 |
| 15 | 45 | 9.775027 | 10.224973 | 9.870199 | 10.129801 | 10.095172 | 9.904828 | 15 | 45 |
| 16 | 34 | 9.775070 | 10.224930 | 9.870265 | 10.129735 | 10.095196 | 9.904804 | 26 | 44 |
| 17 | 15 | 9.775112 | 10.224888 | 9.870331 | 10.129669 | 10.095219 | 9.904781 | 45 | 43 |
| 18 | 30 | 9.775155 | 10.224845 | 9.870397 | 10.129603 | 10.095243 | 9.904757 | 30 | 42 |
| 19 | 45 | 9.775197 | 10.224803 | 9.870463 | 10.129537 | 10.095266 | 9.904734 | 15 | 41 |
| 20 | 35 | 9.775240 | 10.224760 | 9.870529 | 10.129471 | 10.095289 | 9.904711 | 25 | 40 |
| 21 | 15 | 9.775282 | 10.224718 | 9.870595 | 10.129405 | 10.095313 | 9.904687 | 45 | 39 |
| 22 | 30 | 9.775325 | 10.224675 | 9.870661 | 10.129339 | 10.095336 | 9.904664 | 30 | 38 |
| 23 | 45 | 9.775368 | 10.224632 | 9.870727 | 10.129273 | 10.095360 | 9.904640 | 15 | 37 |
| 24 | 36 | 9.775410 | 10.224590 | 9.870793 | 10.129207 | 10.095383 | 9.904617 | 24 | 36 |
| 25 | 15 | 9.775453 | 10.224547 | 9.870859 | 10.129141 | 10.095407 | 9.904593 | 45 | 35 |
| 26 | 30 | 9.775495 | 10.224505 | 9.870925 | 10.129075 | 10.095430 | 9.904570 | 30 | 34 |
| 27 | 45 | 9.775538 | 10.224462 | 9.870991 | 10.129009 | 10.095454 | 9.904546 | 15 | 33 |
| 28 | 37 | 9.775580 | 10.224420 | 9.871057 | 10.128943 | 10.095477 | 9.904523 | 23 | 32 |
| 29 | 15 | 9.775623 | 10.224377 | 9.871123 | 10.128877 | 10.095501 | 9.904499 | 45 | 31 |
| 30 | 30 | 9.775665 | 10.224335 | 9.871189 | 10.128811 | 10.095524 | 9.904476 | 30 | 30 |
| 31 | 45 | 9.775708 | 10.224292 | 9.871255 | 10.128745 | 10.095548 | 9.904452 | 15 | 29 |
| 32 | 38 | 9.775750 | 10.224250 | 9.871321 | 10.128679 | 10.095571 | 9.904429 | 22 | 28 |
| 33 | 15 | 9.775793 | 10.224207 | 9.871387 | 10.128613 | 10.095594 | 9.904406 | 45 | 27 |
| 34 | 30 | 9.775835 | 10.224165 | 9.871453 | 10.128547 | 10.095618 | 9.904382 | 30 | 26 |
| 35 | 45 | 9.775877 | 10.224123 | 9.871519 | 10.128481 | 10.095641 | 9.904359 | 15 | 25 |
| 36 | 39 | 9 775920 | 10.224080 | 9.871585 | 10.128415 | 10.095665 | 9.904335 | 21 | 24 |
| 37 | 15 | 9.775962 | 10.224038 | 9.871651 | 10.128349 | 10.095688 | 9.904312 | 45 | 23 |
| 38 | 30 | 9.776005 | 10.223995 | 9.871717 | 10.128283 | 10.095712 | 9.904288 | 30 | 22 |
| 39 | 45 | 9.776047 | 10.223953 | 9.871783 | 10.128217 | 10.095735 | 9.904265 | 15 | 21 |
| 40 | 40 | 9.776090 | 10.223910 | 9.871849 | 10.128151 | 10.095759 | 9.904241 | 20 | 20 |
| 41 | 15 | 9.776132 | 10.223868 | 9.871914 | 10.128086 | 10.095782 | 9.904218 | 45 | 19 |
| 42 | 30 | 9.776174 | 10.223826 | 9.871980 | 10.128020 | 10.095806 | 9.904194 | 30 | 18 |
| 43 | 45 | 9.776217 | 10.223783 | 9.872046 | 10.127954 | 10.095830 | 9.904170 | 15 | 17 |
| 44 | 41 | 9.776259 | 10.223741 | 9.872112 | 10.127888 | 10.095853 | 9.904147 | 19 | 16 |
| 45 | 15 | 9.776302 | 10.223698 | 9.872178 | 10.127822 | 10.095877 | 9.904123 | 45 | 15 |
| 46 | 30 | 9.776344 | 10.223656 | 9.872244 | 10.127756 | 10.095900 | 9.904100 | 30 | 14 |
| 47 | 45 | 9.776386 | 10.223614 | 9.872310 | 10.127690 | 10.095924 | 9.904076 | 45 | 13 |
| 48 | 42 | 9.776429 | 10.223571 | 9.872376 | 10.127624 | 10.095947 | 9.904053 | 18 | 12 |
| 49 | 15 | 9.776471 | 10.223529 | 9.872442 | 10.127558 | 10.095971 | 9.904029 | 45 | 11 |
| 50 | 30 | 9.776514 | 10.223486 | 9.872508 | 10.127492 | 10.095994 | 9.904006 | 30 | 10 |
| 51 | 45 | 9.776556 | 10.223444 | 9.872574 | 10.127426 | 10.096018 | 9.903982 | 15 | 9 |
| 52 | 43 | 9.776598 | 10.223402 | 9.872640 | 10.127360 | 10.096041 | 9.903959 | 17 | 8 |
| 53 | 15 | 9.776641 | 10.223359 | 9.872705 | 10.127295 | 10.096065 | 9.903935 | 45 | 7 |
| 54 | 30 | 9.776683 | 10.223317 | 9.872771 | 10.127229 | 10.096089 | 9.903911 | 30 | 6 |
| 55 | 45 | 9.776725 | 10.223275 | 9.872837 | 10.127163 | 10.096112 | 9.903888 | 15 | 5 |
| 56 | 44 | 9.776768 | 10.223232 | 9.872903 | 10.127097 | 10.096136 | 9.903864 | 16 | 4 |
| 57 | 15 | 9.776810 | 10.223190 | 9.872969 | 10.127031 | 10.096159 | 9.903841 | 45 | 3 |
| 58 | 30 | 9.776852 | 10.223148 | 9.873035 | 10.126965 | 10.096183 | 9.903817 | 30 | 2 |
| 59 | 45 | 9.776895 | 10.223105 | 9.873101 | 10.126899 | 10.096206 | 9.903794 | 15 | 1 |
| 60 | 45 | 9.776937 | 10.223063 | 9.873167 | 10.126833 | 10.096230 | 9.903770 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 33m. | | | LOG. SINES, &c. | | | | 53 deg. | | |

| 2h 27m. | | LOG. SINES, &c. (t.) | | | | | 36 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.776937 | 10.223063 | 9.873167 | 10.126833 | 10.096230 | 9.903770 | 15 | 60 |
| 1 | 15 | 9.776979 | 10.223021 | 9.873233 | 10.126767 | 10.096254 | 9.903746 | 45 | 59 |
| 2 | 30 | 9.777021 | 10.222979 | 9.873298 | 10.126702 | 10.096277 | 9.903723 | 30 | 58 |
| 3 | 45 | 9.777064 | 10.222936 | 9.873364 | 10.126636 | 10.096301 | 9.903699 | 15 | 57 |
| 4 | 46 | 9.777106 | 10.222894 | 9.873430 | 10.126570 | 10.096324 | 9.903676 | 14 | 56 |
| 5 | 15 | 9.777148 | 10.222852 | 9.873496 | 10.126504 | 10.096348 | 9.903652 | 45 | 55 |
| 6 | 30 | 9.777190 | 10.222810 | 9.873562 | 10.126438 | 10.096372 | 9.903628 | 30 | 54 |
| 7 | 45 | 9.777233 | 10.222767 | 9.873628 | 10.126372 | 10.096395 | 9.903605 | 15 | 53 |
| 8 | 47 | 9.777275 | 10.222725 | 9.873694 | 10.126306 | 10.096419 | 9.903581 | 13 | 52 |
| 9 | 15 | 9.777317 | 10.222683 | 9.873759 | 10.126241 | 10.096442 | 9.903558 | 45 | 51 |
| 10 | 30 | 9.777359 | 10.222641 | 9.873825 | 10.126175 | 10.096466 | 9.903534 | 30 | 50 |
| 11 | 45 | 9.777402 | 10.222598 | 9.873891 | 10.126109 | 10.096490 | 9.903510 | 15 | 49 |
| 12 | 48 | 9.777444 | 10.222556 | 9.873957 | 10.126043 | 10.096513 | 9.903487 | 12 | 48 |
| 13 | 15 | 9.777486 | 10.222514 | 9.874023 | 10.125977 | 10.096537 | 9.903463 | 45 | 47 |
| 14 | 30 | 9.777528 | 10.222472 | 9.874089 | 10.125911 | 10.096560 | 9.903440 | 30 | 46 |
| 15 | 45 | 9.777571 | 10.222429 | 9.874155 | 10.125845 | 10.096584 | 9.903416 | 15 | 45 |
| 16 | 49 | 9.777613 | 10.222387 | 9.874220 | 10.125780 | 10.096608 | 9.903392 | 11 | 44 |
| 17 | 15 | 9.777655 | 10.222345 | 9.874286 | 10 125714 | 10.096631 | 9.903369 | 45 | 43 |
| 18 | 30 | 9.777697 | 10.222303 | 9.874352 | 10.125648 | 10.096655 | 9.903345 | 30 | 42 |
| 19 | 45 | 9.777739 | 10.222261 | 9 874418 | 10.125582 | 10.096679 | 9.903321 | 15 | 41 |
| 20 | 50 | 9.777781 | 10.222219 | 9.874484 | 10.125516 | 10.096702 | 9.903298 | 10 | 40 |
| 21 | 15 | 9.777824 | 10.222176 | 9.874550 | 10.125450 | 10.096726 | 9.903274 | 45 | 39 |
| 22 | 30 | 9.777866 | 10.222134 | 9.874615 | 10.125385 | 10.096750 | 9.903250 | 30 | 38 |
| 23 | 45 | 9.777908 | 10.222092 | 9.874681 | 10.125319 | 10.096773 | 9.903227 | 15 | 37 |
| 24 | 51 | 9.777950 | 10.222050 | 9.874747 | 10.125253 | 10.096797 | 9.903203 | 9 | 36 |
| 25 | 15 | 9.777992 | 10.222008 | 9.874813 | 10.125187 | 10.096821 | 9.903179 | 45 | 35 |
| 26 | 30 | 9.778034 | 10.221966 | 9.874879 | 10.125121 | 10.096844 | 9.903156 | 30 | 34 |
| 27 | 45 | 9.778076 | 10.221924 | 9.874944 | 10.125056 | 10.096868 | 9.903132 | 15 | 33 |
| 28 | 52 | 9.778119 | 10.221881 | 9.875010 | 10.124990 | 10.096892 | 9.903108 | 8 | 32 |
| 29 | 15 | 9.778161 | 10.221839 | 9.875076 | 10.124924 | 10.096915 | 9.903085 | 45 | 31 |
| 30 | 30 | 9.778203 | 10.221797 | 9.875142 | 10.124858 | 10.096939 | 9.903061 | 30 | 30 |
| 31 | 45 | 9.778245 | 10.221755 | 9.875208 | 10.124792 | 10.096963 | 9.903037 | 15 | 29 |
| 32 | 53 | 9.778287 | .0.221713 | 9.875273 | 10.124727 | 10.096986 | 9.903014 | 7 | 28 |
| 33 | 15 | 9.778329 | 10.221671 | 9.875339 | 10.124661 | 10.097010 | 9.902990 | 45 | 27 |
| 34 | 30 | 9.778371 | 10.221629 | 9.875405 | 10.124595 | 10.097034 | 9.902966 | 30 | 26 |
| 35 | 45 | 9.778413 | 10.221587 | 9.875471 | 10.124529 | 10.097058 | 9.902942 | 15 | 25 |
| 36 | 54 | 9.778455 | 10.221545 | 9.875536 | 10.124464 | 10.097081 | 9.902919 | 6 | 24 |
| 37 | 15 | 9.778497 | 10.221503 | 9.875602 | 10.124398 | 10.097105 | 9.902895 | 45 | 23 |
| 38 | 30 | 9.778539 | 10.221461 | 9.875668 | 10.124332 | 10.097129 | 9.902871 | 30 | 22 |
| 39 | 45 | 9.778581 | 10.221419 | 9.875734 | 10.124266 | 10.097152 | 9.902848 | 15 | 21 |
| 40 | 55 | 9.778623 | 10.221377 | 9.875800 | 10.124200 | 10.097176 | 9.902824 | 5 | 20 |
| 41 | 15 | 9.778666 | 10.221334 | 9.875865 | 10.124135 | 10.097200 | 9.902800 | 45 | 19 |
| 42 | 30 | 9.778708 | 10.221292 | 9.875931 | 10.124069 | 10.097224 | 9.902776 | 30 | 18 |
| 43 | 45 | 9.778750 | 10.221250 | 9.875997 | 10.124003 | 10.097247 | 9.902753 | 15 | 17 |
| 44 | 56 | 9.778792 | 10.221208 | 9.876063 | 10.123937 | 10.097271 | 9.902729 | 4 | 16 |
| 45 | 15 | 9.778834 | 10.221166 | 9.876128 | 10.123872 | 10.097295 | 9.902705 | 45 | 15 |
| 46 | 30 | 9.778876 | 10.221124 | 9.876194 | 10.123806 | 10.097319 | 9.902681 | 30 | 14 |
| 47 | 45 | 9.778918 | 10.221082 | 9.876260 | 10.123740 | 10.097342 | 9.902658 | 15 | 13 |
| 48 | 57 | 9.778960 | 10.221040 | 9.876326 | 10.123674 | 10.097366 | 9.902634 | 3 | 12 |
| 49 | 15 | 9.779002 | 10.220998 | 9.876391 | 10.123609 | 10.097390 | 9.902610 | 45 | 11 |
| 50 | 30 | 9.779044 | 10.220956 | 9.876457 | 10.123543 | 10.097414 | 9.902586 | 30 | 10 |
| 51 | 45 | 9.779086 | 10.220914 | 9.876523 | 10.123477 | 10.097437 | 9.902563 | 15 | 9 |
| 52 | 58 | 9.779127 | 10.220873 | 9.876589 | 10.123411 | 10.097461 | 9.902539 | 2 | 8 |
| 53 | 15 | 9.779169 | 10.220831 | 9.876654 | 10.123346 | 10.097485 | 9.902515 | 45 | 7 |
| 54 | 30 | 9.779211 | 10.220789 | 9.876720 | 10.123280 | 10.097509 | 9.902491 | 30 | 6 |
| 55 | 45 | 9.779253 | 10.220747 | 9.876786 | 10.123214 | 10.097532 | 9.902468 | 15 | 5 |
| 56 | 59 | 9.779295 | 10.220705 | 9.876851 | 10.123149 | 10.097556 | 9.902444 | 1 | 4 |
| 57 | 15 | 9.779337 | 10.220663 | 9.876917 | 10.123083 | 10.097580 | 9.902420 | 45 | 3 |
| 58 | 30 | 9.779379 | 10.220621 | 9.876983 | 10.123017 | 10.097604 | 9.902396 | 30 | 2 |
| 59 | 45 | 9.779421 | 10 220579 | 9.877049 | 10.122951 | 10.097628 | 9.902372 | 15 | 1 |
| 60 | 60 | 9.779463 | 10.220537 | 9.877114 | 10.122886 | 10.097651 | 9.902349 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 32m. | | LOG. SINES, &c. | | | | | 53 deg. | | |

| 2h 28m. | | | LOG. SINES, &c. (t.) | | | | 37 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | |
| 0 | 0 | 9.779463 | 10.220537 | 9.877114 | 10.122886 | 10.097651 | 9.902349 | 60 | 60 |
| 1 | 15 | 9.779505 | 10.220495 | 9.877180 | 10.122820 | 10.097675 | 9.902325 | 45 | 59 |
| 2 | 30 | 9.779547 | 10.220453 | 9.877246 | 10.122754 | 10.097699 | 9.902301 | 30 | 58 |
| 3 | 45 | 9.779589 | 10.220411 | 9.877311 | 10.122689 | 10.097723 | 9.902277 | 15 | 57 |
| 4 | 1 | 9.779631 | 10.220369 | 9.877377 | 10.122623 | 10.097747 | 9.902253 | 59 | 56 |
| 5 | 15 | 9.779672 | 10.220328 | 9.877443 | 10.122557 | 10.097770 | 9.902230 | 45 | 55 |
| 6 | 30 | 9.779714 | 10.220286 | 9.877509 | 10.122491 | 10.097794 | 9.902206 | 30 | 54 |
| 7 | 45 | 9.779756 | 10.220244 | 9.877574 | 10.122426 | 10.097818 | 9.902182 | 15 | 53 |
| 8 | 2 | 9.779798 | 10.220202 | 9.877640 | 10.122360 | 10.097842 | 9.902158 | 58 | 52 |
| 9 | 15 | 9.779840 | 10.220160 | 9.877706 | 10.122294 | 10.097866 | 9.902134 | 45 | 51 |
| 10 | 30 | 9.779882 | 10.220118 | 9.877771 | 10.122229 | 10.097890 | 9.902110 | 30 | 50 |
| 11 | 45 | 9.779924 | 10.220076 | 9.877837 | 10.122163 | 10.097913 | 9.902087 | 15 | 49 |
| 12 | 3 | 9.779965 | 10.220035 | 9.877903 | 10.122097 | 10.097937 | 9.902063 | 57 | 48 |
| 13 | 15 | 9.780007 | 10.219993 | 9.877968 | 10.122032 | 10.097961 | 9.902039 | 45 | 47 |
| 14 | 30 | 9.780049 | 10.219951 | 9.878034 | 10.121966 | 10.097985 | 9.902015 | 30 | 46 |
| 15 | 45 | 9.780091 | 10.219909 | 9.878100 | 10.121900 | 10.098009 | 9.901991 | 15 | 45 |
| 16 | 4 | 9.780133 | 10.219867 | 9.878165 | 10.121835 | 10.098033 | 9.901967 | 56 | 44 |
| 17 | 15 | 9.780175 | 10.219825 | 9.878231 | 10.121769 | 10.098057 | 9.901943 | 45 | 43 |
| 18 | 30 | 9.780216 | 10.219784 | 9.878297 | 10.121703 | 10.098080 | 9.901920 | 30 | 42 |
| 19 | 45 | 9.780258 | 10.219742 | 9.878362 | 10.121638 | 10.098104 | 9.901896 | 15 | 41 |
| 20 | 5 | 9.780300 | 10.219700 | 9.878428 | 10.121572 | 10.098128 | 9.901872 | 55 | 40 |
| 21 | 15 | 9.780342 | 10.219658 | 9.878494 | 10.121506 | 10.098152 | 9.901848 | 45 | 39 |
| 22 | 30 | 9.780384 | 10.219616 | 9.878559 | 10.121441 | 10.098176 | 9.901824 | 30 | 38 |
| 23 | 45 | 9.780425 | 10.219575 | 9.878625 | 10.121375 | 10.098200 | 9.901800 | 15 | 37 |
| 24 | 6 | 9.780467 | 10.219533 | 9.878691 | 10.121309 | 10.098224 | 9.901776 | 54 | 36 |
| 25 | 15 | 9.780509 | 10.219491 | 9.878756 | 10.121244 | 10.098248 | 9.901752 | 45 | 35 |
| 26 | 30 | 9.780551 | 10.219449 | 9.878822 | 10.121178 | 10.098271 | 9.901729 | 30 | 34 |
| 27 | 45 | 9.780592 | 10.219408 | 9.878888 | 10.121112 | 10.098295 | 9.901705 | 15 | 33 |
| 28 | 7 | 9.780634 | 10.219366 | 9.878953 | 10.121047 | 10.098319 | 9.901681 | 53 | 32 |
| 29 | 15 | 9.780676 | 10.219324 | 9.879019 | 10.120981 | 10.098343 | 9.901657 | 45 | 31 |
| 30 | 30 | 9.780717 | 10.219283 | 9.879084 | 10.120916 | 10.098367 | 9.901633 | 30 | 30 |
| 31 | 45 | 9.780759 | 10 219241 | 9.879150 | 10.120850 | 10.098391 | 9.901609 | 15 | 29 |
| 32 | 8 | 9.780801 | 10.219199 | 9.879216 | 10.120784 | 10.098415 | 9.901585 | 52 | 28 |
| 33 | 15 | 9.780843 | 10.219157 | 9.879281 | 10.120719 | 10.098439 | 9.901561 | 45 | 27 |
| 34 | 30 | 9.780884 | 10.219116 | 9.879347 | 10.120653 | 10.098463 | 9.901537 | 30 | 26 |
| 35 | 45 | 9.780926 | 10.219074 | 9.879413 | 10.120587 | 10.098487 | 9.901513 | 15 | 25 |
| 36 | 9 | 9.780968 | 10.219032 | 9.879478 | 10.120522 | 10.098511 | 9.901489 | 51 | 24 |
| 37 | 15 | 9.781009 | 10.218991 | 9.879544 | 10.120456 | 10.098534 | 9.901466 | 45 | 23 |
| 38 | 30 | 9.781051 | 10.218949 | 9.879609 | 10.120391 | 10.098558 | 9.901442 | 30 | 22 |
| 29 | 45 | 9.781093 | 10.218907 | 9.879675 | 10.120325 | 10.098582 | 9.901418 | 15 | 21 |
| 40 | 10 | 9.781134 | 10.218866 | 9.879741 | 10.120259 | 10.098606 | 9.901394 | 50 | 20 |
| 41 | 15 | 9.781176 | 10.218824 | 9.879806 | 10.120194 | 10.098630 | 9.901370 | 45 | 19 |
| 42 | 30 | 9.781218 | 10.218782 | 9.879872 | 10.120128 | 10.098654 | 9.901346 | 30 | 18 |
| 43 | 45 | 9.781259 | 10.218741 | 9.879937 | 10.120063 | 10.098678 | 9.901322 | 15 | 17 |
| 44 | 11 | 9.781301 | 10.218699 | 9.880003 | 10.119997 | 10.098702 | 9.901298 | 49 | 16 |
| 45 | 15 | 9.781343 | 10.218657 | 9.880069 | 10.119931 | 10.098726 | 9.901274 | 45 | 15 |
| 46 | 30 | 9.781384 | 10.218616 | 9.880134 | 10.119866 | 10.098750 | 9.901250 | 30 | 14 |
| 47 | 45 | 9.781426 | 10.218574 | 9.880200 | 10.119800 | 10.098774 | 9.901226 | 15 | 13 |
| 48 | 12 | 9.781467 | 10.218533 | 9.880265 | 10.119735 | 10.098798 | 9.901202 | 48 | 12 |
| 49 | 15 | 9.781509 | 10.218491 | 9.880331 | 10.119669 | 10.098822 | 9.901178 | 45 | 11 |
| 50 | 30 | 9.781551 | 10.218449 | 9.880397 | 10.119603 | 10.098846 | 9.901154 | 30 | 10 |
| 51 | 45 | 9.781592 | 10.218408 | 9.880462 | 10.119538 | 10.098870 | 9.901130 | 15 | 9 |
| 52 | 13 | 9.781634 | 10.218366 | 9.880528 | 10.119472 | 10.098894 | 9.901106 | 47 | 8 |
| 53 | 15 | 9.781675 | 10.218325 | 9.880593 | 10.119407 | 10.098918 | 9.901082 | 45 | 7 |
| 54 | 30 | 9.781717 | 10.218283 | 9.880659 | 10.119341 | 10.098942 | 9.901058 | 30 | 6 |
| 55 | 45 | 9.781759 | 10.218241 | 9.880724 | 10.119276 | 10.098966 | 9.901034 | 15 | 5 |
| 56 | 14 | 9.781800 | 10.218200 | 9.880790 | 10.119210 | 10.098990 | 9.901010 | 46 | 4 |
| 57 | 15 | 9.781842 | 10.218158 | 9.880855 | 10.119145 | 10.099014 | 9.900986 | 45 | 3 |
| 58 | 30 | 9.781883 | 10.218117 | 9.880921 | 10.119079 | 10.099038 | 9.900962 | 30 | 2 |
| 59 | 45 | 9.781925 | 10.218075 | 9.880987 | 10.119013 | 10.099062 | 9.900938 | 15 | 1 |
| 60 | 15 | 9.781966 | 10.218034 | 9.881052 | 10.118948 | 10.099086 | 9.900914 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 31m. | | | LOG. SINES, &c. | | | | 52 deg. | | |

| 2h 29m. | | | LOG. SINES, &c. (t.) | | | 37 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | ″ |
| 0 | 15 | 9.781966 | 10.218034 | 9.881052 | 10.118948 | 10.099086 | 9.900914 | 45 | 60 |
| 1 | 15 | 9.782008 | 10.217992 | 9.881118 | 10.118882 | 10.099110 | 9.900890 | 45 | 59 |
| 2 | 30 | 9.782049 | 10.217951 | 9.881183 | 10.118817 | 10.099134 | 9.900866 | 30 | 58 |
| 3 | 45 | 9.782091 | 10.217909 | 9.881249 | 10.118751 | 10.099158 | 9.900842 | 15 | 57 |
| 4 | 16 | 9.782132 | 10.217868 | 9.881314 | 10.118686 | 10.099182 | 9.900818 | 44 | 56 |
| 5 | 15 | 9.782174 | 10.217826 | 9.881380 | 10.118620 | 10.099206 | 9.900794 | 45 | 55 |
| 6 | 30 | 9.782215 | 10.217785 | 9.881445 | 10.118555 | 10.099230 | 9.900770 | 30 | 54 |
| 7 | 45 | 9.782257 | 10.217743 | 9.881511 | 10.118489 | 10.099254 | 9.900746 | 15 | 53 |
| 8 | 17 | 9.782298 | 10.217702 | 9.881576 | 10.118424 | 10.099278 | 9.900722 | 43 | 52 |
| 9 | 15 | 9.782340 | 10.217660 | 9.881642 | 10.118358 | 10.099302 | 9.900698 | 45 | 51 |
| 10 | 30 | 9.782381 | 10.217619 | 9.881708 | 10.118292 | 10.099326 | 9.900674 | 30 | 50 |
| 11 | 45 | 9.782423 | 10.217577 | 9.881773 | 10.118227 | 10.099350 | 9.900650 | 15 | 49 |
| 12 | 18 | 9.782464 | 10.217536 | 9.881839 | 10.118161 | 10.099374 | 9.900626 | 42 | 48 |
| 13 | 15 | 9.782506 | 10.217494 | 9.881904 | 10.118096 | 10.099398 | 9.900602 | 45 | 47 |
| 14 | 30 | 9.782547 | 10.217453 | 9.881970 | 10.118030 | 10.099422 | 9.900578 | 30 | 46 |
| 15 | 45 | 9.782589 | 10.217411 | 9.882035 | 10.117965 | 10.099447 | 9.900553 | 15 | 45 |
| 16 | 19 | 9.782630 | 10.217370 | 9.882101 | 10.117899 | 10.099471 | 9.900529 | 41 | 44 |
| 17 | 15 | 9.782671 | 10.217329 | 9.882166 | 10.117834 | 10.099495 | 9.900505 | 45 | 43 |
| 18 | 30 | 9.782713 | 10.217287 | 9.882232 | 10.117768 | 10.099519 | 9.900481 | 30 | 42 |
| 19 | 45 | 9.782754 | 10.217246 | 9.882297 | 10.117703 | 10.099543 | 9.900457 | 15 | 41 |
| 20 | 20 | 9.782796 | 10.217204 | 9.882363 | 10.117637 | 10.099567 | 9.900433 | 40 | 40 |
| 21 | 15 | 9.782837 | 10.217163 | 9.882428 | 10.117572 | 10.099591 | 9.900409 | 45 | 39 |
| 22 | 30 | 9.782879 | 10.217121 | 9.882494 | 10.117506 | 10.099615 | 9.900385 | 30 | 38 |
| 23 | 45 | 9.782920 | 10.217080 | 9.882559 | 10.117441 | 10.099639 | 9.900361 | 15 | 37 |
| 24 | 21 | 9.782961 | 10.217039 | 9.882625 | 10.117375 | 10.099663 | 9.900337 | 39 | 36 |
| 25 | 15 | 9.783003 | 10.216997 | 9.882690 | 10.117310 | 10.099687 | 9.900313 | 45 | 35 |
| 26 | 30 | 9.783044 | 10.216956 | 9.882756 | 10.117244 | 10.099712 | 9.900288 | 30 | 34 |
| 27 | 45 | 9.783085 | 10.216915 | 9.882821 | 10.117179 | 10.099736 | 9.900264 | 15 | 33 |
| 28 | 22 | 9.783127 | 10.216873 | 9.882887 | 10.117113 | 10.099760 | 9.900240 | 38 | 32 |
| 29 | 15 | 9.783168 | 10.216832 | 9.882952 | 10.117048 | 10.099784 | 9.900216 | 45 | 31 |
| 30 | 30 | 9.783209 | 10.216791 | 9.883017 | 10.116983 | 10.099808 | 9.900192 | 30 | 30 |
| 31 | 45 | 9.783251 | 10.216749 | 9.883083 | 10.116917 | 10.099832 | 9.900168 | 15 | 29 |
| 32 | 23 | 9.783292 | 10.216708 | 9.883148 | 10.116852 | 10.099856 | 9.900144 | 37 | 28 |
| 33 | 15 | 9.783334 | 10.216666 | 9.883214 | 10.116786 | 10.099880 | 9.900120 | 45 | 27 |
| 34 | 30 | 9.783375 | 10.216625 | 9.883279 | 10.116721 | 10.099905 | 9.900095 | 30 | 26 |
| 35 | 45 | 9.783416 | 10.216584 | 9.883345 | 10.116655 | 10.099929 | 9.900071 | 15 | 25 |
| 36 | 24 | 9.783457 | 10.216543 | 9.883410 | 10.116590 | 10.099953 | 9.900047 | 36 | 24 |
| 37 | 15 | 9.783499 | 10.216501 | 9.883476 | 10.116524 | 10.099977 | 9.900023 | 45 | 23 |
| 38 | 30 | 9.783540 | 10.216460 | 9.883541 | 10.116459 | 10.100001 | 9.899999 | 30 | 22 |
| 39 | 45 | 9.783581 | 10.216419 | 9.883607 | 10.116393 | 10.100025 | 9.899975 | 15 | 21 |
| 40 | 25 | 9.783623 | 10.216377 | 9.883672 | 10.116328 | 10.100049 | 9.899951 | 35 | 20 |
| 41 | 15 | 9.783664 | 10.216336 | 9.883737 | 10.116263 | 10.100074 | 9.899926 | 45 | 19 |
| 42 | 30 | 9.783705 | 10.216295 | 9.883803 | 10.116197 | 10.100098 | 9.899902 | 30 | 18 |
| 43 | 45 | 9.783746 | 10.216254 | 9.883868 | 10.116132 | 10.100122 | 9.899878 | 15 | 17 |
| 44 | 26 | 9.783788 | 10.216212 | 9.883934 | 10.116066 | 10.100146 | 9.899854 | 34 | 16 |
| 45 | 15 | 9.783829 | 10.216171 | 9.883999 | 10.116001 | 10.100170 | 9.899830 | 45 | 15 |
| 46 | 30 | 9.783870 | 10.216130 | 9.884065 | 10.115935 | 10.100194 | 9.899806 | 30 | 14 |
| 47 | 45 | 9.783911 | 10.216089 | 9.884130 | 10.115870 | 10.100219 | 9.899781 | 15 | 13 |
| 48 | 27 | 9.783953 | 10.216047 | 9.884196 | 10.115804 | 10.100243 | 9.899757 | 33 | 12 |
| 49 | 15 | 9.783994 | 10.216006 | 9.884261 | 10.115739 | 10.100267 | 9.899733 | 45 | 11 |
| 50 | 30 | 9.784035 | 10.215965 | 9.884326 | 10.115674 | 10.100291 | 9.899709 | 30 | 10 |
| 51 | 45 | 9.784076 | 10.215924 | 9.884392 | 10.115608 | 10.100315 | 9.899685 | 15 | 9 |
| 52 | 28 | 9.784118 | 10.215882 | 9.884457 | 10.115543 | 10.100340 | 9.899660 | 32 | 8 |
| 53 | 15 | 9.784159 | 10.215841 | 9.884523 | 10.115477 | 10.100364 | 9.899636 | 45 | 7 |
| 54 | 30 | 9.784200 | 10.215800 | 9.884588 | 10.115412 | 10.100388 | 9.899612 | 30 | 6 |
| 55 | 45 | 9.784241 | 10.215759 | 9.884653 | 10.115347 | 10.100412 | 9.899588 | 15 | 5 |
| 56 | 29 | 9.784282 | 10.215718 | 9.884719 | 10.115281 | 10.100436 | 9.899564 | 31 | 4 |
| 57 | 15 | 9.784324 | 10.215676 | 9.884784 | 10.115216 | 10.100461 | 9.899539 | 45 | 3 |
| 58 | 30 | 9.784365 | 10.215635 | 9.884850 | 10.115150 | 10.100485 | 9.899515 | 30 | 2 |
| 59 | 45 | 9.784406 | 10.215594 | 9.884915 | 10.115085 | 10.100509 | 9.899491 | 15 | 1 |
| 60 | 30 | 9.784447 | 10.215553 | 9.884980 | 10.115020 | 10.100533 | 9.899467 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent | tangent. | cosecant. | sine. | ″ ′ | ″ |
| 3h 30m. | | | LOG. SINES, &c. | | | 52 deg. | | | |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 2h 30m. | | LOG. SINES, &c. (t.) | | | | | 37 deg. | |
| 0 | 30 | 9.784447 | 10.215553 | 9.884980 | 10.115020 | 10.100533 | 9.899467 | 30 | 60 |
| 1 | 15 | 9.784488 | 10.215512 | 9.885046 | 10.114954 | 10.100558 | 9.899442 | 45 | 59 |
| 2 | 30 | 9.784529 | 10.215471 | 9.885111 | 10.114889 | 10.100582 | 9.899418 | 30 | 58 |
| 3 | 45 | 9.784571 | 10.215429 | 9.885177 | 10.114823 | 10.100606 | 9.899394 | 15 | 57 |
| 4 | 31 | 9.784612 | 10.215388 | 9.885242 | 10.114758 | 10.100630 | 9.899370 | 29 | 56 |
| 5 | 15 | 9.784653 | 10.215347 | 9.885307 | 10.114693 | 10.100655 | 9.899345 | 45 | 55 |
| 6 | 30 | 9.784694 | 10.215306 | 9.885373 | 10.114627 | 10.100679 | 9.899321 | 30 | 54 |
| 7 | 45 | 9.784735 | 10.215265 | 9.885438 | 10.114562 | 10.100703 | 9.899297 | 15 | 53 |
| 8 | 32 | 9.784776 | 10.215224 | 9.885503 | 10.114497 | 10.100727 | 9.899273 | 28 | 52 |
| 9 | 15 | 9.784817 | 10.215183 | 9.885569 | 10.114431 | 10.100752 | 9.899248 | 45 | 51 |
| 10 | 30 | 9.784858 | 10.215142 | 9.885634 | 10.114366 | 10.100776 | 9.899224 | 30 | 50 |
| 11 | 45 | 9.784899 | 10.215101 | 9.885700 | 10.114300 | 10.100800 | 9.899200 | 15 | 49 |
| 12 | 33 | 9.784941 | 10.215059 | 9.885765 | 10.114235 | 10.100824 | 9.899176 | 27 | 48 |
| 13 | 15 | 9.784982 | 10.215018 | 9.885830 | 10.114170 | 10.100849 | 9.899151 | 45 | 47 |
| 14 | 30 | 9.785023 | 10.214977 | 9.885896 | 10.114104 | 10.100873 | 9.899127 | 30 | 46 |
| 15 | 45 | 9.785064 | 10.214936 | 9.885961 | 10.114039 | 10.100897 | 9.899103 | 15 | 45 |
| 16 | 34 | 9.785105 | 10.214895 | 9.886026 | 10.113974 | 10.100922 | 9.899078 | 26 | 44 |
| 17 | 15 | 9.785146 | 10.214854 | 9.886092 | 10.113908 | 10.100946 | 9.899054 | 45 | 43 |
| 18 | 30 | 9.785187 | 10.214813 | 9.886157 | 10.113843 | 10.100970 | 9.899030 | 30 | 42 |
| 19 | 45 | 9.785228 | 10.214772 | 9.886222 | 10.113778 | 10.100995 | 9.899005 | 15 | 41 |
| 20 | 35 | 9.785269 | 10.214731 | 9.886288 | 10.113712 | 10.101019 | 9.898981 | 25 | 40 |
| 21 | 15 | 9.785310 | 10.214690 | 9.886353 | 10.113647 | 10.101043 | 9.898957 | 45 | 39 |
| 22 | 30 | 9.785351 | 10.214649 | 9.886418 | 10.113582 | 10.101067 | 9.898933 | 30 | 38 |
| 23 | 45 | 9.785392 | 10.214608 | 9.886484 | 10.113516 | 10.101092 | 9.898908 | 15 | 37 |
| 24 | 36 | 9.785433 | 10.214567 | 9.886549 | 10.113451 | 10.101116 | 9.898884 | 24 | 36 |
| 25 | 15 | 9.785474 | 10.214526 | 9.886614 | 10.113386 | 10.101140 | 9.898860 | 45 | 35 |
| 26 | 30 | 9.785515 | 10.214485 | 9.886680 | 10.113320 | 10.101165 | 9.898835 | 30 | 34 |
| 27 | 45 | 9.785556 | 10.214444 | 9.886745 | 10.113255 | 10.101189 | 9.898811 | 15 | 33 |
| 28 | 37 | 9.785597 | 10.214403 | 9.886810 | 10.113190 | 10.101213 | 9.898787 | 23 | 32 |
| 29 | 15 | 9.785638 | 10.214362 | 9.886876 | 10.113124 | 10.101238 | 9.898762 | 45 | 31 |
| 30 | 30 | 9.785679 | 10.214321 | 9.886941 | 10.113059 | 10.101262 | 9.898738 | 30 | 30 |
| 31 | 45 | 9.785720 | 10.214280 | 9.887006 | 10.112994 | 10.101286 | 9.898714 | 15 | 29 |
| 32 | 38 | 9.785761 | 10.214239 | 9.887072 | 10.112928 | 10.101311 | 9.898689 | 22 | 28 |
| 33 | 15 | 9.785802 | 10.214198 | 9.887137 | 10.112863 | 10.101335 | 9.898665 | 45 | 27 |
| 34 | 30 | 9.785843 | 10.214157 | 9.887202 | 10.112798 | 10.101359 | 9.898641 | 30 | 26 |
| 35 | 45 | 9.785884 | 10.214116 | 9.887268 | 10.112732 | 10.101384 | 9.898616 | 15 | 25 |
| 36 | 39 | 9.785925 | 10.214075 | 9.887333 | 10.112667 | 10.101408 | 9.898592 | 21 | 24 |
| 37 | 15 | 9.785966 | 10.214034 | 9.887398 | 10.112602 | 10.101433 | 9.898567 | 45 | 23 |
| 38 | 30 | 9.786007 | 10.213993 | 9.887464 | 10.112536 | 10.101457 | 9.898543 | 30 | 22 |
| 39 | 45 | 9.786048 | 10.213952 | 9.887529 | 10.112471 | 10.101481 | 9.898519 | 15 | 21 |
| 40 | 40 | 9.786089 | 10.213911 | 9.887594 | 10.112406 | 10.101506 | 9.898494 | 20 | 20 |
| 41 | 15 | 9.786129 | 10.213871 | 9.887659 | 10.112341 | 10.101530 | 9.898470 | 45 | 19 |
| 42 | 30 | 9.786170 | 10.213830 | 9.887725 | 10.112275 | 10.101554 | 9.898446 | 30 | 18 |
| 43 | 45 | 9.786211 | 10.213789 | 9.887790 | 10.112210 | 10.101579 | 9.898421 | 15 | 17 |
| 44 | 41 | 9.786252 | 10.213748 | 9.887855 | 10.112145 | 10.101603 | 9.898397 | 19 | 16 |
| 45 | 15 | 9.786293 | 10.213707 | 9.887921 | 10.112079 | 10.101628 | 9.898372 | 45 | 15 |
| 46 | 30 | 9.786334 | 10.213666 | 9.887986 | 10.112014 | 10.101652 | 9.898348 | 30 | 14 |
| 47 | 45 | 9.786375 | 10.213625 | 9.888051 | 10.111949 | 10.101676 | 9.898324 | 15 | 13 |
| 48 | 42 | 9.786416 | 10.213584 | 9.888116 | 10.111884 | 10.101701 | 9.898299 | 18 | 12 |
| 49 | 15 | 9.786456 | 10.213544 | 9.888182 | 10.111818 | 10.101725 | 9.898275 | 45 | 11 |
| 50 | 30 | 9.786497 | 10.213503 | 9.888247 | 10.111753 | 10.101750 | 9.898250 | 30 | 10 |
| 51 | 45 | 9.786538 | 10.213462 | 9.888312 | 10.111688 | 10.101774 | 9.898226 | 15 | 9 |
| 52 | 43 | 9.786579 | 10.213421 | 9.888377 | 10.111623 | 10.101799 | 9.898201 | 17 | 8 |
| 53 | 15 | 9.786620 | 10.213380 | 9.888443 | 10.111557 | 10.101823 | 9.898177 | 45 | 7 |
| 54 | 30 | 9.786661 | 10.213339 | 9.888508 | 10.111492 | 10.101847 | 9.898153 | 30 | 6 |
| 55 | 45 | 9.786702 | 10.213298 | 9.888573 | 10.111427 | 10.101872 | 9.898128 | 15 | 5 |
| 56 | 44 | 9.786742 | 10.213258 | 9.888639 | 10.111361 | 10.101896 | 9.898104 | 16 | 4 |
| 57 | 15 | 9.786783 | 10.213217 | 9.888704 | 10.111296 | 10.101921 | 9.898079 | 45 | 3 |
| 58 | 30 | 9.786824 | 10.213176 | 9.888769 | 10.111231 | 10.101945 | 9.898055 | 30 | 2 |
| 59 | 45 | 9.786865 | 10.213135 | 9.888834 | 10.111166 | 10.101970 | 9.898030 | 15 | 1 |
| 60 | 45 | 9.786906 | 10.213094 | 9.888900 | 10.111100 | 10.101994 | 9.898006 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 3h 29m | | LOG. SINES, &c. | | | | | 52 deg. | |

| 2h 31m. | | | LOG. SINES, &c. (t.) | | | | 37 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9 786906 | 10.213094 | 9.888900 | 10.111100 | 10.101994 | 9.898006 | 15 | 60 |
| 1 | 15 | 9.786946 | 10.213054 | 9.888965 | 10.111035 | 10.102018 | 9.897982 | 45 | 59 |
| 2 | 30 | 9.786987 | 10.213013 | 9.889030 | 10.110970 | 10.102043 | 9.897957 | 30 | 58 |
| 3 | 45 | 9.787028 | 10.212972 | 9.889095 | 10.110905 | 10.102067 | 9.897933 | 15 | 57 |
| 4 | 46 | 9.787069 | 10.212931 | 9.889160 | 10.110840 | 10.102092 | 9 897908 | 14 | 56 |
| 5 | 15 | 9.787109 | 10.212891 | 9.889226 | 10.110774 | 10.102116 | 9.897884 | 45 | 55 |
| 6 | 30 | 9.787150 | 10.212850 | 9.889291 | 10.110709 | 10.102141 | 9.897859 | 30 | 54 |
| 7 | 45 | 9.787191 | 10.212809 | 9.889356 | 10.110644 | 10.102165 | 9.897835 | 15 | 53 |
| 8 | 47 | 9.787232 | 10.212768 | 9 889421 | 10.110579 | 10.102190 | 9.897810 | 13 | 52 |
| 9 | 15 | 9.787272 | 10.212728 | 9.889487 | 10.110513 | 10.102214 | 9.897786 | 45 | 51 |
| 10 | 30 | 9.787313 | 10.212687 | 9.889552 | 10.110448 | 10.102239 | 9.897761 | 30 | 50 |
| 11 | 45 | 9.787354 | 10.212646 | 9.889617 | 10.110383 | 10.102263 | 9.897737 | 15 | 49 |
| 12 | 48 | 9.787395 | 10.212605 | 9.889682 | 10.110318 | 10.102288 | 9.897712 | 12 | 48 |
| 13 | 15 | 9.787435 | 10.212565 | 9.889747 | 10.110253 | 10.102312 | 9.897688 | 45 | 47 |
| 14 | 30 | 9.787476 | 10.212524 | 9.889813 | 10.110187 | 10.102337 | 9.897663 | 30 | 46 |
| 15 | 45 | 9.787517 | 10.212483 | 9.889878 | 10.110122 | 10.102361 | 9.897639 | 15 | 45 |
| 16 | 49 | 9.787557 | 10.212443 | 9.889943 | 10.110057 | 10.102386 | 9.897614 | 11 | 44 |
| 17 | 15 | 9.787598 | 10.212402 | 9.890008 | 10.109992 | 10.102410 | 9.897590 | 45 | 43 |
| 18 | 30 | 9.787639 | 10.212361 | 9.890074 | 10.109926 | 10.102435 | 9.897565 | 30 | 42 |
| 19 | 45 | 9.787679 | 10.212321 | 9.890139 | 10.109861 | 10.102459 | 9.897541 | 15 | 41 |
| 20 | 50 | 9.787720 | 10.212280 | 9.890204 | 10.109796 | 10.102484 | 9.897516 | 10 | 40 |
| 21 | 15 | 9.787761 | 10.212239 | 9.890269 | 10.109731 | 10.102563 | 9.897492 | 45 | 39 |
| 22 | 30 | 9.787801 | 10.212199 | 9.890334 | 10.109666 | 10.102533 | 9.897467 | 30 | 38 |
| 23 | 45 | 9.787842 | 10.212158 | 9.890399 | 10.109601 | 10.102557 | 9 897443 | 15 | 37 |
| 24 | 51 | 9.787883 | 10.212117 | 9.890465 | 10.109535 | 10.102582 | 9.897418 | 9 | 36 |
| 25 | 15 | 9.787923 | 10.212077 | 9.890530 | 10.109470 | 10.102607 | 9.897393 | 45 | 35 |
| 26 | 30 | 9.787964 | 10.212036 | 9.890595 | 10.109405 | 10.102631 | 9.897369 | 30 | 34 |
| 27 | 45 | 9.788005 | 10.211995 | 9.890660 | 10.109340 | 10.102656 | 9.897344 | 15 | 33 |
| 28 | 52 | 9.788045 | 10.211955 | 9.890725 | 10.109275 | 10.102680 | 9.897320 | 8 | 32 |
| 29 | 15 | 9.788086 | 10.211914 | 9.890791 | 10.109209 | 10.102705 | 9.897295 | 45 | 31 |
| 30 | 30 | 9.788126 | 10.211874 | 9.890856 | 10.109144 | 10.102729 | 9.897271 | 30 | 30 |
| 31 | 45 | 9.788167 | 10.211833 | 9.890921 | 10.109079 | 10.102754 | 9.897246 | 15 | 29 |
| 32 | 53 | 9.788208 | 10.211792 | 9.890986 | 10.109014 | 10.102778 | 9.897222 | 7 | 28 |
| 33 | 15 | 9.788248 | 10.211752 | 9.891051 | 10.108949 | 10.102803 | 9.897197 | 45 | 27 |
| 34 | 30 | 9.788289 | 10.211711 | 9.891116 | 10.108884 | 10.102828 | 9.897172 | 30 | 26 |
| 35 | 45 | 9.788329 | 10.211671 | 9.891182 | 10.108818 | 10.102852 | 9.897148 | 15 | 25 |
| 36 | 54 | 9.788370 | 10.211630 | 9.891247 | 10.108753 | 10.102877 | 9.897123 | 6 | 24 |
| 37 | 15 | 9.788411 | 10.211589 | 9.891312 | 10.108688 | 10.102901 | 9.897099 | 45 | 23 |
| 38 | 30 | 9.788451 | 10.211549 | 9.891377 | 10.108623 | 10.102926 | 9.897074 | 30 | 22 |
| 39 | 45 | 9.788492 | 10.211508 | 9.891442 | 10.108558 | 10.102951 | 9.897049 | 15 | 21 |
| 40 | 55 | 9.788532 | 10.211468 | 9.891507 | 10.108493 | 10.102975 | 9.897025 | 5 | 20 |
| 41 | 15 | 9.788573 | 10.211427 | 9.891572 | 10.108428 | 10.103000 | 9.897000 | 45 | 19 |
| 42 | 30 | 9.788613 | 10.211387 | 9.891638 | 10.108362 | 10.103024 | 9.896976 | 30 | 18 |
| 43 | 45 | 9.788654 | 10.211346 | 9.891703 | 10.108297 | 10.103049 | 9.896951 | 15 | 17 |
| 44 | 56. | 9.788694 | 10.211306 | 9.891768 | 10.108232 | 10.103074 | 9.896926 | 4 | 16 |
| 45 | 15 | 9.788735 | 10.211265 | 9.891833 | 10.108167 | 10.103098 | 9.896902 | 45 | 15 |
| 46 | 30 | 9.788775 | 10.211225 | 9.891898 | 10.108102 | 10.103123 | 9.896877 | 30 | 14 |
| 47 | 45 | 9.788816 | 10.211184 | 9.891963 | 10.108037 | 10.103147 | 9.896853 | 15 | 13 |
| 48 | 57 | 9.788856 | 10.211144 | 9.892028 | 10.107972 | 10.103172 | 9.896828 | 3 | 12 |
| 49 | 15 | 9.788897 | 10.211103 | 9.892094 | 10.107906 | 10.103197 | 9.896803 | 45 | 11 |
| 50 | 30 | 9.788937 | 10.211063 | 9.892159 | 10.107841 | 10.103221 | 9.896779 | 30 | 10 |
| 51 | 45 | 9.788978 | 10.211022 | 9.892224 | 10.107776 | 10.103246 | 9.896754 | 15 | 9 |
| 52 | 58 | 9.789018 | 10.210982 | 9.892289 | 10.107711 | 10.103271 | 9.896729 | 2 | 8 |
| 53 | 15 | 9.789059 | 10.210941 | 9.892354 | 10.107646 | 10.103295 | 9.896705 | 45 | 7 |
| 54 | 30 | 9.789099 | 10.210901 | 9.892419 | 10.107581 | 10.103320 | 9.896680 | 30 | 6 |
| 55 | 45 | 9.789140 | 10.210860 | 9.892484 | 10.107516 | 10.103345 | 9.896655 | 15 | 5 |
| 56 | 59 | 9.789180 | 10.210820 | 9.892549 | 10.107451 | 10.103369 | 9.896631 | 1 | 4 |
| 57 | 15 | 9.789221 | 10.210779 | 9.892614 | 10.107386 | 10.103394 | 9.896606 | 45 | 3 |
| 58 | 30 | 9.789261 | 10.210739 | 9.892680 | 10.107320 | 10.103419 | 9.896581 | 30 | 2 |
| 59 | 45 | 9.789302 | 10.210698 | 9.892745 | 10.107255 | 10.103443 | 9.896557 | 15 | 1 |
| 60 | 60 | 9.789342 | 10.210658 | 9.892810 | 10.107190 | 10.103468 | 9.896532 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec |

| 3h 28m. | LOG. SINES, &c. | 52 deg. |
|---|---|---|

| 2h 32m. | | | LOG. SINES, &c. (t.) | | | | 38 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.789342 | 10.210658 | 9.892810 | 10.107190 | 10.103468 | 9.896532 | 60 | 60 |
| 1 | 15 | 9.789382 | 10.210618 | 9.892875 | 10.107125 | 10.103493 | 9.896507 | 45 | 59 |
| 2 | 30 | 9.789423 | 10.210577 | 9.892940 | 10.107060 | 10.103517 | 9.896483 | 30 | 58 |
| 3 | 45 | 9.789463 | 10.210537 | 9.893005 | 10.106995 | 10.103542 | 9.896458 | 15 | 57 |
| 4 | 1 | 9.789504 | 10.210496 | 9.893070 | 10.106930 | 10.103567 | 9.896433 | 59 | 56 |
| 5 | 15 | 9.789544 | 10.210456 | 9.893135 | 10.106865 | 10.103591 | 9.896409 | 45 | 55 |
| 6 | 30 | 9.789584 | 10.210416 | 9.893200 | 10.106800 | 10.103616 | 9.896384 | 30 | 54 |
| 7 | 45 | 9.789625 | 10.210375 | 9.893265 | 10.106735 | 10.103641 | 9.896359 | 15 | 53 |
| 8 | 2 | 9.789665 | 10.210335 | 9.893331 | 10.106669 | 10.103665 | 9.896335 | 58 | 52 |
| 9 | 15 | 9.789706 | 10.210294 | 9.893396 | 10.106604 | 10.103690 | 9.896310 | 45 | 51 |
| 10 | 30 | 9.789746 | 10.210254 | 9.893461 | 10.106539 | 10.103715 | 9.896285 | 30 | 50 |
| 11 | 45 | 9.789786 | 10.210214 | 9.893526 | 10.106474 | 10.103740 | 9.896260 | 15 | 49 |
| 12 | 3 | 9.789827 | 10.210173 | 9.893591 | 10.106409 | 10.103764 | 9.896236 | 57 | 48 |
| 13 | 15 | 9.789867 | 10.210133 | 9.893656 | 10.106344 | 10.103789 | 9.896211 | 45 | 47 |
| 14 | 30 | 9.789907 | 10.210093 | 9.893721 | 10.106279 | 10.103814 | 9.896186 | 30 | 46 |
| 15 | 45 | 9.789948 | 10.210052 | 9.893786 | 10.106214 | 10.103838 | 9.896162 | 15 | 45 |
| 16 | 4 | 9.789988 | 10.210012 | 9.893851 | 10.106149 | 10.103863 | 9.896137 | 56 | 44 |
| 17 | 15 | 9.790028 | 10.209972 | 9.893916 | 10.106084 | 10.103888 | 9.896112 | 45 | 43 |
| 18 | 30 | 9.790069 | 10.209931 | 9.893981 | 10.106019 | 10.103913 | 9.896087 | 30 | 42 |
| 19 | 45 | 9.790109 | 10.209891 | 9.894046 | 10.105954 | 10.103937 | 9.896063 | 15 | 41 |
| 20 | 5 | 9.790149 | 10.209851 | 9.894111 | 10.105889 | 10.103962 | 9.896038 | 55 | 40 |
| 21 | 15 | 9.790190 | 10.209810 | 9.894176 | 10.105824 | 10.103987 | 9.896013 | 45 | 39 |
| 22 | 30 | 9.790230 | 10.209770 | 9.894241 | 10.105759 | 10.104012 | 9.895988 | 30 | 38 |
| 23 | 45 | 9.790270 | 10.209730 | 9.894306 | 10.105694 | 10.104036 | 9.895964 | 15 | 37 |
| 24 | 6 | 9.790310 | 10.209690 | 9.894371 | 10.105629 | 10.104061 | 9.895939 | 54 | 36 |
| 25 | 15 | 9.790351 | 10.209649 | 9.894437 | 10.105563 | 10.104086 | 9.895914 | 45 | 35 |
| 26 | 30 | 9.790391 | 10.209609 | 9.894502 | 10.105498 | 10.104111 | 9.895889 | 30 | 34 |
| 27 | 45 | 9.790431 | 10.209569 | 9.894567 | 10.105433 | 10.104135 | 9.895865 | 15 | 33 |
| 28 | 7 | 9.790471 | 10.209529 | 9.894632 | 10.105368 | 10.104160 | 9.895840 | 53 | 32 |
| 29 | 15 | 9.790512 | 10.209488 | 9.894697 | 10.105303 | 10.104185 | 9.895815 | 45 | 31 |
| 30 | 30 | 9.790552 | 10.209448 | 9.894762 | 10.105238 | 10.104210 | 9.895790 | 30 | 30 |
| 31 | 45 | 9.790592 | 10.209408 | 9.894827 | 10.105173 | 10.104235 | 9.895765 | 15 | 29 |
| 32 | 8 | 9.790632 | 10.209368 | 9.894892 | 10.105108 | 10.104259 | 9.895741 | 52 | 28 |
| 33 | 15 | 9.790673 | 10.209327 | 9.894957 | 10.105043 | 10.104284 | 9.895716 | 45 | 27 |
| 34 | 30 | 9.790713 | 10.209287 | 9.895022 | 10.104978 | 10.104309 | 9.895691 | 30 | 26 |
| 35 | 45 | 9.790753 | 10.209247 | 9.895087 | 10.104913 | 10.104334 | 9.895666 | 15 | 25 |
| 36 | 9 | 9.790793 | 10.209207 | 9.895152 | 10.104848 | 10.104359 | 9.895641 | 51 | 24 |
| 37 | 15 | 9.790833 | 10.209167 | 9.895217 | 10.104783 | 10.104383 | 9.895617 | 45 | 23 |
| 38 | 30 | 9.790874 | 10.209126 | 9.895282 | 10.104718 | 10.104408 | 9.895592 | 30 | 22 |
| 39 | 45 | 9.790914 | 10.209086 | 9.895347 | 10.104653 | 10.104433 | 9.895567 | 15 | 21 |
| 40 | 10 | 9.790954 | 10.209046 | 9.895412 | 10.104588 | 10.104458 | 9.895542 | 50 | 20 |
| 41 | 15 | 9.790994 | 10.209006 | 9.895477 | 10.104523 | 10.104483 | 9.895517 | 45 | 19 |
| 42 | 30 | 9.791034 | 10.208966 | 9.895542 | 10.104458 | 10.104508 | 9.895492 | 30 | 18 |
| 43 | 45 | 9.791075 | 10.208925 | 9.895607 | 10.104393 | 10.104532 | 9.895468 | 15 | 17 |
| 44 | 11 | 9.791115 | 10.208885 | 9.895672 | 10.104328 | 10.104557 | 9.895443 | 49 | 16 |
| 45 | 15 | 9.791155 | 10.208845 | 9.895737 | 10.104263 | 10.104582 | 9.895418 | 45 | 15 |
| 46 | 30 | 9.791195 | 10.208805 | 9.895802 | 10.104198 | 10.104607 | 9.895393 | 30 | 14 |
| 47 | 45 | 9.791235 | 10.208765 | 9.895867 | 10.104133 | 10.104632 | 9.895368 | 15 | 13 |
| 48 | 12 | 9.791275 | 10.208725 | 9.895932 | 10.104068 | 10.104657 | 9.895343 | 48 | 12 |
| 49 | 15 | 9.791315 | 10.208685 | 9.895997 | 10.104003 | 10.104681 | 9.895319 | 45 | 11 |
| 50 | 30 | 9.791356 | 10.208644 | 9.896062 | 10.103938 | 10.104706 | 9.895294 | 30 | 10 |
| 51 | 45 | 9.791396 | 10.208604 | 9.896127 | 10.103873 | 10.104731 | 9.895269 | 15 | 9 |
| 52 | 13 | 9.791436 | 10.208564 | 9.896192 | 10.103808 | 10.104756 | 9.895244 | 47 | 8 |
| 53 | 15 | 9.791476 | 10.208524 | 9.896257 | 10.103743 | 10.104781 | 9.895219 | 45 | 7 |
| 54 | 30 | 9.791516 | 10.208484 | 9.896322 | 10.103678 | 10.104806 | 9.895194 | 30 | 6 |
| 55 | 45 | 9.791556 | 10.208444 | 9.896387 | 10.103613 | 10.104831 | 9.895169 | 15 | 5 |
| 56 | 14 | 9.791596 | 10.208404 | 9.896452 | 10.103548 | 10.104856 | 9.895144 | 46 | 4 |
| 57 | 15 | 9.791636 | 10.208364 | 9.896517 | 10.103483 | 10.104880 | 9.895120 | 45 | 3 |
| 58 | 30 | 9.791676 | 10.208324 | 9.896582 | 10.103418 | 10.104905 | 9.895095 | 30 | 2 |
| 59 | 45 | 9.791716 | 10.208284 | 9.896647 | 10.103353 | 10.104930 | 9.895070 | 15 | 1 |
| 60 | 15 | 9.791757 | 10.208243 | 9.896712 | 10.103288 | 10.104955 | 9.895045 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 8h 27m. | | | LOG. SINES, &c. | | | | 51 deg. | | |

| 2h 33m. | | | LOG. SINES, &c. (t.) | | | | 38 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.791757 | 10.208243 | 9.896712 | 10.103288 | 10.104955 | 9.895045 | 45 | 60 |
| 1 | 15 | 9.791797 | 10.208203 | 9.896777 | 10.103223 | 10.104980 | 9.895020 | 45 | 59 |
| 2 | 30 | 9.791837 | 10.208163 | 9.896841 | 10.103159 | 10.105005 | 9.894995 | 30 | 58 |
| 3 | 45 | 9.791877 | 10.208123 | 9.896906 | 10.103094 | 10.105030 | 9.894970 | 15 | 57 |
| 4 | 16 | 9.791917 | 10.208083 | 9.896971 | 10.103029 | 10.105055 | 9.894945 | 44 | 56 |
| 5 | 15 | 9.791957 | 10.208043 | 9.897036 | 10.102964 | 10.105080 | 9.894920 | 45 | 55 |
| 6 | 30 | 9.791997 | 10.208003 | 9 897101 | 10.102899 | 10.105105 | 9.894895 | 30 | 54 |
| 7 | 45 | 9.792037 | 10.207963 | 9.897166 | 10.102834 | 10.105129 | 9.894871 | 15 | 53 |
| 8 | 17 | 9.792077 | 10.207923 | 9.897231 | 10.102769 | 10.105154 | 9.894846 | 43 | 52 |
| 9 | 15 | 9.792117 | 10.207883 | 9.897296 | 10.102704 | 10.105179 | 9.894821 | 45 | 51 |
| 10 | 30 | 9.792157 | 10.207843 | 9.897361 | 10.102639 | 10.105204 | 9.894796 | 30 | 50 |
| 11 | 45 | 9.792197 | 10.207803 | 9.897426 | 10.102574 | 10.105229 | 9.894771 | 15 | 49 |
| 12 | 18 | 9.792237 | 10.207763 | 9.897491 | 10.102509 | 10.105254 | 9.894746 | 42 | 48 |
| 13 | 15 | 9.792277 | 10.207723 | 9.897556 | 10.102444 | 10.105279 | 9.894721 | 45 | 47 |
| 14 | 30 | 9.792317 | 10.207683 | 9.897621 | 10.102379 | 10.105304 | 9.894696 | 30 | 46 |
| 15 | 45 | 9.792357 | 10.207643 | 9.897686 | 10.102314 | 10.105329 | 9.894671 | 15 | 45 |
| 16 | 19 | 9.792397 | 10.207603 | 9.897751 | 10.102249 | 10.105354 | 9.894646 | 41 | 44 |
| 17 | 15 | 9.792437 | 10.207563 | 9.897816 | 10.102184 | 10.105379 | 9.894621 | 45 | 43 |
| 18 | 30 | 9.792477 | 10.207523 | 9.897880 | 10.102120 | 10.105404 | 9.894596 | 30 | 42 |
| 19 | 45 | 9.792517 | 10.207483 | 9.897945 | 10.102055 | 10.105429 | 9.894571 | 15 | 41 |
| 20 | 20 | 9.792557 | 10.207443 | 9.898010 | 10.101990 | 10.105454 | 9.894546 | 40 | 40 |
| 21 | 15 | 9.792597 | 10.207403 | 9.898075 | 10.101925 | 10.105479 | 9.894521 | 45 | 39 |
| 22 | 30 | 9.792636 | 10.207364 | 9.898140 | 10.101860 | 10.105504 | 9.894496 | 30 | 38 |
| 23 | 45 | 9.792676 | 10.207324 | 9.898205 | 10.101795 | 10.105529 | 9.894471 | 15 | 37 |
| 24 | 21 | 9.792716 | 10.207284 | 9.898270 | 10.101730 | 10.105554 | 9.894446 | 39 | 36 |
| 25 | 15 | 9.792756 | 10.207244 | 9.898335 | 10.101665 | 10.105579 | 9.894421 | 45 | 35 |
| 26 | 30 | 9.792796 | 10.207204 | 9.898400 | 10.101600 | 10.105604 | 9.894396 | 30 | 34 |
| 27 | 45 | 9.792836 | 10.207164 | 9.898465 | 10.101535 | 10.105629 | 9.894371 | 15 | 33 |
| 28 | 22 | 9.792876 | 10 207124 | 9.898530 | 10.101470 | 10.105654 | 9.894346 | 38 | 32 |
| 29 | 15 | 9.792916 | 10.207084 | 9.898594 | 10.101406 | 10.105679 | 9.894321 | 45 | 31 |
| 30 | 30 | 9.792956 | 10.207044 | 9.898659 | 10.101341 | 10.105704 | 9.894296 | 30 | 30 |
| 31 | 45 | 9.792996 | 10.207004 | 9.898724 | 10.101276 | 10.105729 | 9.894271 | 15 | 29 |
| 32 | 23 | 9.793035 | 10.206965 | 9.898789 | 10.101211 | 10.105754 | 9.894246 | 37 | 28 |
| 33 | 15 | 9.793075 | 10.206925 | 9.898854 | 10.101146 | 10.105779 | 9.894221 | 45 | 27 |
| 34 | 30 | 9.793115 | 10.206885 | 9.898919 | 10.101081 | 10.105804 | 9.894196 | 30 | 26 |
| 35 | 45 | 9.793155 | 10.206845 | 9.898984 | 10.101016 | 10.105829 | 9.894171 | 15 | 25 |
| 36 | 24 | 9.793195 | 10.206805 | 9.899049 | 10.100951 | 10.105854 | 9.894146 | 36 | 24 |
| 37 | 15 | 9.793235 | 10.206765 | 9.899114 | 10.100886 | 10.105879 | 9.894121 | 45 | 23 |
| 38 | 30 | 9.793275 | 10.206725 | 9.899178 | 10.100822 | 10.105904 | 9.894096 | 30 | 22 |
| 39 | 45 | 9.793314 | 10.206686 | 9.899243 | 10.100757 | 10.105929 | 9.894071 | 15 | 21 |
| 40 | 25 | 9.793354 | 10.206646 | 9.899308 | 10.100692 | 10.105954 | 9.894046 | . 35 | 20 |
| 41 | 15 | 9.793394 | 10.206606 | 9.899373 | 10.100627 | 10.105979 | 9.894021 | 45 | 19 |
| 42 | 30 | 9.793434 | 10.206566 | 9.899438 | 10.100562 | 10.106004 | 9.893996 | 30 | 18 |
| 43 | 45 | 9.793474 | 10.206526 | 9.899503 | 10.100497 | 10.106029 | 9.893971 | 15 | 17 |
| 44 | 26 | 9.793513 | 10.206487 | 9.899568 | 10.100432 | 10.106054 | 9.893946 | 34 | 16 |
| 45 | 15 | 9.793553 | 10.206447 | 9.899632 | 10.100368 | 10.106079 | 9.893921 | 45 | 15 |
| 46 | 30 | 9.793593 | 10.206407 | 9.899697 | 10.100303 | 10.106104 | 9.893896 | 30 | 14 |
| 47 | 45 | 9.793633 | 10.206367 | 9.899762 | 10.100238 | 10.106129 | 9.893871 | 15 | 13 |
| 48 | 27 | 9.793673 | 10.206327 | 9.899827 | 10.100173 | 10.106154 | 9.893846 | 33 | 12 |
| 49 | 15 | 9.793712 | 10.206288 | 9.899892 | 10.100108 | 10.106180 | 9.893820 | 45 | 11 |
| 50 | 30 | 9.793752 | 10.206248 | 9.899957 | 10.100043 | 10.106205 | 9.893795 | 30 | 10 |
| 51 | 45 | 9.793792 | 10.206208 | 9.900022 | 10.099978 | 10.106230 | 9.893770 | 15 | 9 |
| 52 | 28 | 9.793832 | 10.206168 | 9.900086 | 10.099914 | 10.106255 | 9.893745 | 32 | 8 |
| 53 | 15 | 9.793871 | 10.206129 | 9.900151 | 10.099849 | 10.106280 | 9.893720 | 45 | 7 |
| 54 | 30 | 9.793911 | 10.206089 | 9.900216 | 10.099784 | 10.106305 | 9.893695 | 30 | 6 |
| 55 | 45 | 9.793951 | 10.206049 | 9.900281 | 10.099719 | 10.106330 | 9.893670 | 15 | 5 |
| 56 | 29 | 9.793991 | 10.206009 | 9.900346 | 10.099654 | 10.106355 | 9.893645 | 31 | 4 |
| 57 | 15 | 9.794030 | 10.205970 | 9.900411 | 10.099589 | 10.106380 | 9.893620 | 45 | 3 |
| 58 | 30 | 9.794070 | 10.205930 | 9.900475 | 10.099525 | 10.106405 | 9.893595 | 30 | 2 |
| 59 | 45 | 9.794110 | 10.205890 | 9.900540 | 10.099460 | 10.106431 | 9.893569 | 15 | 1 |
| 60 | 30 | 9.794150 | 10.205850 | 9.900605 | 10.099395 | 10.106456 | 9.893544 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotang-nt. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 8h 26m. | | | LOG. SINES, &c. | | | | 51 deg. | | |

| 2h 24m. | | | LOG. SINES, &c. (t.) | | | | 88 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.794150 | 10.205850 | 9.900605 | 10.099395 | 10.106456 | 9.893544 | 30 | 60 |
| 1 | 15 | 9.794189 | 10.205811 | 9.900670 | 10.099330 | 10.106481 | 9.893519 | 45 | 59 |
| 2 | 30 | 9.794229 | 10.205771 | 9.900735 | 10.099265 | 10.106506 | 9.893494 | 30 | 58 |
| 3 | 45 | 9.794269 | 10.205731 | 9.900800 | 10.099200 | 10.106531 | 9.893469 | 15 | 57 |
| 4 | 31 | 9.794308 | 10.205692 | 9.900864 | 10.099136 | 10.106556 | 9.893444 | 29 | 56 |
| 5 | 15 | 9.794348 | 10.205652 | 9.900929 | 10.099071 | 10.106581 | 9.893419 | 45 | 55 |
| 6 | 30 | 9.794388 | 10.205612 | 9.900994 | 10.099006 | 10.106606 | 9.893394 | 30 | 54 |
| 7 | 45 | 9.794427 | 10.205573 | 9.901059 | 10.098941 | 10.106632 | 9.893368 | 15 | 53 |
| 8 | 32 | 9.794467 | 10.205533 | 9.901124 | 10.098876 | 10.106657 | 9.893343 | 28 | 52 |
| 9 | 15 | 9.794507 | 10.205493 | 9.901189 | 10.098811 | 10.106682 | 9.893318 | 45 | 51 |
| 10 | 30 | 9.794546 | 10.205454 | 9.901253 | 10.098747 | 10.106707 | 9.893293 | 30 | 50 |
| 11 | 45 | 9.794586 | 10.205414 | 9.901318 | 10.098682 | 10.106732 | 9.893268 | 15 | 49 |
| 12 | 33 | 9.794626 | 10.205374 | 9.901383 | 10.098617 | 10.106757 | 9.893243 | 27 | 48 |
| 13 | 15 | 9.794665 | 10.205335 | 9.901448 | 10.098552 | 10.106783 | 9.893217 | 45 | 47 |
| 14 | 30 | 9.794705 | 10.205295 | 9.901513 | 10.098487 | 10.106808 | 9.893192 | 30 | 46 |
| 15 | 45 | 9.794744 | 10.205256 | 9.901577 | 10.098423 | 10.106833 | 9.893167 | 15 | 45 |
| 16 | 34 | 9.794784 | 10.205216 | 9.901642 | 10.098358 | 10.106858 | 9.893142 | 26 | 44 |
| 17 | 15 | 9.794824 | 10.205176 | 9.901707 | 10.098293 | 10.106883 | 9.893117 | 45 | 43 |
| 18 | 30 | 9.794863 | 10.205137 | 9.901772 | 10.098228 | 10.106908 | 9.893092 | 30 | 42 |
| 19 | 45 | 9.794903 | 10.205097 | 9.901836 | 10.098164 | 10.106934 | 9.893066 | 15 | 41 |
| 20 | 35 | 9.794942 | 10.205058 | 9.901901 | 10 098099 | 10.106959 | 9.893041 | 25 | 40 |
| 21 | 15 | 9.794982 | 10.205018 | 9.901966 | 10.098034 | 10.106984 | 9.893016 | 45 | 39 |
| 22 | 30 | 9.795022 | 10.204978 | 9.902031 | 10.097969 | 10.107009 | 9.892991 | 30 | 38 |
| 23 | 45 | 9.795061 | 10.204939 | 9.902096 | 10.097904 | 10.107034 | 9.892966 | 15 | 37 |
| 24 | 36 | 9.795101 | 10.204899 | 9.902160 | 10.097840 | 10.107060 | 9.892940 | 24 | 36 |
| 25 | 15 | 9.795140 | 10.204860 | 9.902225 | 10.097775 | 10.107085 | 9.892915 | 45 | 35 |
| 26 | 30 | 9.795180 | 10.204820 | 9.902290 | 10.097710 | 10.107110 | 9.892890 | 30 | 34 |
| 27 | 45 | 9.795219 | 10.204781 | 9.902355 | 10.097645 | 10.107135 | 9.892865 | 15 | 33 |
| 28 | 37 | 9.795259 | 10.204741 | 9.902419 | 10.097581 | 10.107161 | 9.892839 | 23 | 32 |
| 29 | 15 | 9.795298 | 10.204702 | 9.902484 | 10.097516 | 10.107186 | 9.892814 | 45 | 31 |
| 30 | 30 | 9.795338 | 10.204662 | 9.902549 | 10.097451 | 10.107211 | 9.892789 | 30 | 30 |
| 31 | 45 | 9.795378 | 10.204622 | 9.902614 | 10.097386 | 10.107236 | 9.892764 | 15 | 29 |
| 32 | 38 | 9.795417 | 10.204583 | 9.902679 | 10.097321 | 10.107262 | 9.892738 | 22 | 28 |
| 33 | 15 | 9.795457 | 10.204543 | 9.902743 | 10.097257 | 10.107287 | 9.892713 | 45 | 27 |
| 34 | 30 | 9.795496 | 10.204504 | 9.902808 | 10.097192 | 10.107312 | 9.892688 | 30 | 26 |
| 35 | 45 | 9.795536 | 10.204464 | 9.902873 | 10.097127 | 10.107337 | 9.892663 | 15 | 25 |
| 36 | 39 | 9.795575 | 10.204425 | 9.902938 | 10.097062 | 10.107363 | 9.892637 | 21 | 24 |
| 37 | 15 | 9.795615 | 10.204385 | 9.903002 | 10.096998 | 10.107388 | 9.892612 | 45 | 23 |
| 38 | 30 | 9.795654 | 10.204346 | 9.903067 | 10.096933 | 10.107413 | 9.892587 | 30 | 22 |
| 39 | 45 | 9.795694 | 10.204306 | 9.903132 | 10.096868 | 10.107438 | 9.892562 | 15 | 21 |
| 40 | 40 | 9.795733 | 10.204267 | 9.903197 | 10.096803 | 10.107464 | 9.892536 | 20 | 20 |
| 41 | 15 | 9.795772 | 10.204228 | 9.903261 | 10.096739 | 10.107489 | 9.892511 | 45 | 19 |
| 42 | 30 | 9.795812 | 10.204188 | 9.903326 | 10.096674 | 10.107514 | 9.892486 | 30 | 18 |
| 43 | 45 | 9.795851 | 10.204149 | 9.903391 | 10.096609 | 10.107539 | 9.892461 | 15 | 17 |
| 44 | 41 | 9.795891 | 10.204109 | 9.903455 | 10.096545 | 10.107565 | 9.892435 | 19 | 16 |
| 45 | 15 | 9.795930 | 10.204070 | 9.903520 | 10.096480 | 10.107590 | 9.892410 | 45 | 15 |
| 46 | 30 | 9.795970 | 10.204030 | 9.903585 | 10.096415 | 10.107615 | 9.892385 | 30 | 14 |
| 47 | 45 | 9.796009 | 10.203991 | 9.903650 | 10.096350 | 10.107641 | 9.892359 | 15 | 13 |
| 48 | 42 | 9.796049 | 10.203951 | 9 903714 | 10.096286 | 10.107666 | 9.892334 | 18 | 12 |
| 49 | 15 | 9.796088 | 10.203912 | 9.903779 | 10.096221 | 10.107691 | 9.892309 | 45 | 11 |
| 50 | 30 | 9.796127 | 10.203873 | 9.903844 | 10.096156 | 10.107716 | 9.892284 | 30 | 10 |
| 51 | 45 | 9.796167 | 10.203833 | 9.903909 | 10.096091 | 10.107742 | 9 892258 | 15 | 9 |
| 52 | 43 | 9.796206 | 10.203794 | 9.903973 | 10.096027 | 10.107767 | 9.892233 | 17 | 8 |
| 53 | 15 | 9.796246 | 10.203754 | 9.904038 | 10.095962 | 10.107792 | 9.892208 | 45 | 7 |
| 54 | 30 | 9.796285 | 10.203715 | 9.904103 | 10.095897 | 10.107818 | 9.892182 | 30 | 6 |
| 55 | 45 | 9.796324 | 10.203676 | 9.904167 | 10.095833 | 10.107843 | 9.892157 | 15 | 5 |
| 56 | 44 | 9.796364 | 10.203636 | 9.904232 | 10.095768 | 10.107868 | 9.892132 | 16 | 4 |
| 57 | 15 | 9.796403 | 10.203597 | 9.904297 | 10.095703 | 10.107894 | 9.892106 | 45 | 3 |
| 58 | 30 | 9.796442 | 10.203558 | 9.904362 | 10.095638 | 10.107919 | 9.892081 | 30 | 2 |
| 59 | 45 | 9.796482 | 10.203518 | 9.904426 | 10.095574 | 10.107944 | 9.892056 | 15 | 1 |
| 60 | 45 | 9.796521 | 10.203479 | 9.904491 | 10.095509 | 10.107970 | 9.892030 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 25m. | | | LOG. SINES, &c. | | | | 51 deg. | | |

| 2h 35m. | | LOG. SINES, &c. (t.) | | | | | 38 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.796521 | 10.203479 | 9.904491 | 10.095509 | 10.107970 | 9.892030 | 15 | 60 |
| 1 | 15 | 9.796561 | 10.203439 | 9.904556 | 10.095444 | 10.107995 | 9.892005 | 45 | 59 |
| 2 | 30 | 9.796600 | 10.203400 | 9.904620 | 10.095380 | 10.108020 | 9.891980 | 30 | 58 |
| 3 | 45 | 9.796639 | 10.203361 | 9.904685 | 10.095315 | 10.108046 | 9.891954 | 15 | 57 |
| 4 | 46 | 9.796679 | 10.203321 | 9.904750 | 10.095250 | 10.108071 | 9.891929 | 14 | 56 |
| 5 | 15 | 9.796718 | 10.203282 | 9.904814 | 10.095186 | 10.108097 | 9.891903 | 45 | 55 |
| 6 | 30 | 9.796757 | 10.203243 | 9.904879 | 10.095121 | 10.108122 | 9.891878 | 30 | 54 |
| 7 | 45 | 9.796797 | 10.203203 | 9.904944 | 10.095056 | 10.108147 | 9.891853 | 15 | 53 |
| 8 | 47 | 9.796836 | 10.203164 | 9.905008 | 10.094992 | 10.108173 | 9.891827 | 13 | 52 |
| 9 | 15 | 9.796875 | 10.203125 | 9.905073 | 10.094927 | 10.108198 | 9.891802 | 45 | 51 |
| 10 | 30 | 9.796914 | 10.203086 | 9.905138 | 10.094862 | 10.108223 | 9.891777 | 30 | 50 |
| 11 | 45 | 9.796954 | 10.203046 | 9.905202 | 10.094798 | 10.108249 | 9.891751 | 15 | 49 |
| 12 | 48 | 9.796993 | 10.203007 | 9.905267 | 10.094733 | 10.108274 | 9.891726 | 12 | 48 |
| 13 | 15 | 9.797032 | 10.202968 | 9.905332 | 10.094668 | 10.108300 | 9.891700 | 45 | 47 |
| 14 | 30 | 9.797072 | 10.202928 | 9.905396 | 10.094604 | 10.108325 | 9.891675 | 30 | 46 |
| 15 | 45 | 9.797111 | 10.202889 | 9.905461 | 10.094539 | 10.108350 | 9.891650 | 15 | 45 |
| 16 | 49 | 9.797150 | 10.202850 | 9.905526 | 10.094474 | 10.108376 | 9.891624 | 11 | 44 |
| 17 | 15 | 9.797189 | 10.202811 | 9.905590 | 10.094410 | 10.108401 | 9.891599 | 45 | 43 |
| 18 | 30 | 9.797229 | 10.202771 | 9.905655 | 10.094345 | 10.108427 | 9.891573 | 30 | 42 |
| 19 | 45 | 9.797268 | 10.202732 | 9.905720 | 10.094280 | 10.108452 | 9.891548 | 15 | 41 |
| 20 | 50 | 9.797307 | 10.202693 | 9.905784 | 10.094216 | 10.108477 | 9.891523 | 10 | 40 |
| 21 | 15 | 9.797346 | 10.202654 | 9.905849 | 10.094151 | 10.108503 | 9.891497 | 45 | 39 |
| 22 | 30 | 9.797386 | 10.202614 | 9.905914 | 10.094086 | 10.108528 | 9.891472 | 30 | 38 |
| 23 | 45 | 9.797425 | 10.202575 | 9.905978 | 10.094022 | 10.108554 | 9.891446 | 15 | 37 |
| 24 | 51 | 9.797464 | 10.202536 | 9.906043 | 10.093957 | 10.108579 | 9.891421 | 9 | 36 |
| 25 | 15 | 9.797503 | 10.202497 | 9.906108 | 10.093892 | 10.108605 | 9.891395 | 45 | 35 |
| 26 | 30 | 9.797542 | 10.202458 | 9.906172 | 10.093828 | 10.108630 | 9.891370 | 30 | 34 |
| 27 | 45 | 9.797582 | 10.202418 | 9.906237 | 10.093763 | 10.108656 | 9.891344 | 15 | 33 |
| 28 | 52 | 9.797621 | 10.202379 | 9.906302 | 10.093698 | 10.108681 | 9.891319 | 8 | 32 |
| 29 | 15 | 9.797660 | 10.202340 | 9.906366 | 10.093634 | 10.108706 | 9.891294 | 45 | 31 |
| 30 | 30 | 9.797699 | 10.202301 | 9.906431 | 10.093569 | 10.108732 | 9.891268 | 30 | 30 |
| 31 | 45 | 9.797738 | 10.202262 | 9.906496 | 10.093504 | 10.108757 | 9.891243 | 15 | 29 |
| 32 | 53 | 9.797777 | 10.202223 | 9.906560 | 10.093440 | 10.108783 | 9.891217 | 7 | 28 |
| 33 | 15 | 9.797817 | 10 202183 | 9.906625 | 10.093375 | 10.108808 | 9.891192 | 45 | 27 |
| 34 | 30 | 9.797856 | 10 202144 | 9.906689 | 10.093311 | 10.108834 | 9.891166 | 30 | 26 |
| 35 | 45 | 9.797895 | 10.202105 | 9.906754 | 10.093246 | 10.108859 | 9.891141 | 15 | 25 |
| 36 | 54 | 9.797934 | 10.202066 | 9.906819 | 10.093181 | 10.108885 | 9.891115 | 6 | 24 |
| 37 | 15 | 9.797973 | 10.202027 | 9.906883 | 10.093117 | 10.108910 | 9.891090 | 45 | 23 |
| 38 | 30 | 9.798012 | 10.201988 | 9.906948 | 10.093052 | 10.108936 | 9.891064 | 30 | 22 |
| 39 | 45 | 9.798051 | 10.201949 | 9.907013 | 10.092987 | 10.108961 | 9.891039 | 15 | 21 |
| 40 | 55 | 9.798091 | 10.201909 | 9.907077 | 10.092923 | 10.108987 | 9.891013 | 5 | 20 |
| 41 | 15 | 9.798130 | 10.201870 | 9.907142 | 10.092858 | 10.109012 | 9.890988 | 45 | 19 |
| 42 | 30 | 9.798169 | 10.201831 | 9.907206 | 10.092794 | 10.109038 | 9.890962 | 30 | 18 |
| 43 | 45 | 9.798208 | 10.201792 | 9.907271 | 10.092729 | 10.109063 | 9.890937 | 15 | 17 |
| 44 | 56 | 9.798247 | 10.201753 | 9.907336 | 10.092664 | 10.109089 | 9.890911 | 4 | 16 |
| 45 | 15 | 9.798286 | 10.201714 | 9.907400 | 10.092600 | 10.109114 | 9.890886 | 45 | 15 |
| 46 | 30 | 9.798325 | 10.201675 | 9.907465 | 10.092535 | 10.109140 | 9.890860 | 30 | 14 |
| 47 | 45 | 9.798364 | 10.201636 | 9.907529 | 10.092471 | 10.109165 | 9.890835 | 15 | 13 |
| 48 | 57 | 9.798403 | 10.201597 | 9.907594 | 10.092406 | 10.109191 | 9.890809 | 3 | 12 |
| 49 | 15 | 9.798442 | 10.201558 | 9.907659 | 10.092341 | 10.109216 | 9.890784 | 45 | 11 |
| 50 | 30 | 9.798481 | 10.201519 | 9.907723 | 10.092277 | 10.109242 | 9.890758 | 30 | 10 |
| 51 | 45 | 9.798521 | 10.201479 | 9.907788 | 10.092212 | 10.109267 | 9.890733 | 15 | 9 |
| 52 | 58 | 9.798560 | 10.201440 | 9.907852 | 10.092148 | 10.109293 | 9.890707 | 2 | 8 |
| 53 | 15 | 9.798599 | 10.201401 | 9.907917 | 10.092083 | 10.109319 | 9.890681 | 45 | 7 |
| 54 | 30 | 9.798638 | 10.201362 | 9.907982 | 10.092018 | 10.109344 | 9.890656 | 30 | 6 |
| 55 | 45 | 9.798677 | 10.201323 | 9.908046 | 10.091954 | 10.109370 | 9.890630 | 15 | 5 |
| 56 | 59 | 9.798716 | 10.201284 | 9.908111 | 10.091889 | 10.109395 | 9.890605 | 1 | 4 |
| 57 | 15 | 9.798755 | 10.201245 | 9.908175 | 10.091825 | 10.109421 | 9.890579 | 45 | 3 |
| 58 | 30 | 9.798794 | 10.201206 | 9.908240 | 10.091760 | 10.109446 | 9.890554 | 30 | 2 |
| 59 | 45 | 9.798833 | 10.201167 | 9.908305 | 10.091695 | 10.109472 | 9.890528 | 15 | 1 |
| 60 | 60 | 9.798872 | 10.201128 | 9.908369 | 10.091631 | 10.109497 | 9.890503 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | | |

| 3h 24m. | LOG. SINES, &c. | 51 deg. |
|---|---|---|

| 2h 36m. | | LOG. SINES, &c. (t.) | | | | | 39 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ | sec. |
| 0 | 0 | 9.798872 | 10.201128 | 9.908369 | 10.091631 | 10.109497 | 9.890503 | 60 | 60 |
| 1 | 15 | 9.798911 | 10.201089 | 9.908434 | 10.091566 | 10.109523 | 9.890477 | 45 | 59 |
| 2 | 30 | 9.798950 | 10.201050 | 9.908498 | 10.091502 | 10.109549 | 9.890451 | 30 | 58 |
| 3 | 45 | 9.798989 | 10.201011 | 9.908563 | 10.091437 | 10.109574 | 9.890426 | 15 | 57 |
| 4 | 1 | 9.799028 | 10.200972 | 9.908627 | 10.091373 | 10.109600 | 9.890400 | 59 | 56 |
| 5 | 15 | 9.799067 | 10.200933 | 9.908692 | 10.091308 | 10.109625 | 9.890375 | 45 | 55 |
| 6 | 30 | 9.799106 | 10.200894 | 9.908757 | 10.091243 | 10.109651 | 9.890349 | 30 | 54 |
| 7 | 45 | 9.799145 | 10.200855 | 9.908821 | 10.091179 | 10.109677 | 9.890323 | 15 | 53 |
| 8 | 2 | 9.799184 | 10.200816 | 9.908886 | 10.091114 | 10.109702 | 9.890298 | 58 | 52 |
| 9 | 15 | 9.799223 | 10.200777 | 9.908950 | 10.091050 | 10.109728 | 9.890272 | 45 | 51 |
| 10 | 30 | 9.799261 | 10.200739 | 9.909015 | 10.090985 | 10.109753 | 9.890247 | 30 | 50 |
| 11 | 45 | 9.799300 | 10.200700 | 9.909079 | 10.090921 | 10.109779 | 9.890221 | 15 | 49 |
| 12 | 3 | 9.799339 | 10.200661 | 9.909144 | 10.090856 | 10.109805 | 9.890195 | 57 | 48 |
| 13 | 15 | 9.799378 | 10.200622 | 9.909208 | 10.090792 | 10.109830 | 9.890170 | 45 | 47 |
| 14 | 30 | 9.799417 | 10.200583 | 9.909273 | 10.090727 | 10.109856 | 9.890144 | 30 | 46 |
| 15 | 45 | 9.799456 | 10.200544 | 9.909338 | 10.090662 | 10.109882 | 9.890118 | 15 | 45 |
| 16 | 4 | 9.799495 | 10.200505 | 9.909402 | 10.090598 | 10.109907 | 9.890093 | 56 | 44 |
| 17 | 15 | 9.799534 | 10.200466 | 9.909467 | 10.090533 | 10.109933 | 9.890067 | 45 | 43 |
| 18 | 30 | 9.799573 | 10.200427 | 9.909531 | 10.090469 | 10.109958 | 9.890042 | 30 | 42 |
| 19 | 45 | 9.799612 | 10.200388 | 9.909596 | 10.090404 | 10.109984 | 9.890016 | 15 | 41 |
| 20 | 5 | 9.799651 | 10.200349 | 9.909660 | 10.090340 | 10.110010 | 9.889990 | 55 | 40 |
| 21 | 15 | 9.799690 | 10.200310 | 9.909725 | 10.090275 | 10.110035 | 9.889965 | 45 | 39 |
| 22 | 30 | 9.799728 | 10.200272 | 9.909789 | 10.090211 | 10.110061 | 9.889939 | 30 | 38 |
| 23 | 45 | 9.799767 | 10.200233 | 9.909854 | 10.090146 | 10.110087 | 9.889913 | 15 | 37 |
| 24 | 6 | 9.799806 | 10.200194 | 9.909918 | 10.090082 | 10.110112 | 9.889888 | 54 | 36 |
| 25 | 15 | 9.799845 | 10.200155 | 9.909983 | 10.090017 | 10.110138 | 9.889862 | 45 | 35 |
| 26 | 30 | 9.799884 | 10.200116 | 9.910047 | 10.089953 | 10.110164 | 9.889836 | 30 | 34 |
| 27 | 45 | 9.799923 | 10.200077 | 9.910112 | 10.089888 | 10.110189 | 9.889811 | 15 | 33 |
| 28 | 7 | 9.799962 | 10.200038 | 9.910177 | 10.089823 | 10.110215 | 9.889785 | 53 | 32 |
| 29 | 15 | 9.800000 | 10.200000 | 9.910241 | 10.089759 | 10.110241 | 9.889759 | 45 | 31 |
| 30 | 30 | 9.800039 | 10.199961 | 9.910306 | 10.089694 | 10.110266 | 9.889734 | 30 | 30 |
| 31 | 45 | 9.800078 | 10.199922 | 9.910370 | 10.089630 | 10.110292 | 9.889708 | 15 | 29 |
| 32 | 8 | 9.800117 | 10.199883 | 9.910435 | 10.089565 | 10.110318 | 9.889682 | 52 | 28 |
| 33 | 15 | 9.800156 | 10.199844 | 9.910499 | 10.089501 | 10.110344 | 9.889656 | 45 | 27 |
| 34 | 30 | 9.800194 | 10.199806 | 9.910564 | 10.089436 | 10.110369 | 9.889631 | 30 | 26 |
| 35 | 45 | 9.800233 | 10.199767 | 9.910628 | 10.089372 | 10.110395 | 9.889605 | 15 | 25 |
| 36 | 9 | 9.800272 | 10.199728 | 9.910693 | 10.089307 | 10.110421 | 9.889579 | 51 | 24 |
| 37 | 15 | 9.800311 | 10.199689 | 9.910757 | 10.089243 | 10.110446 | 9.889554 | 45 | 23 |
| 38 | 30 | 9.800350 | 10.199650 | 9.910822 | 10.089178 | 10.110472 | 9.889528 | 30 | 22 |
| 39 | 45 | 9.800388 | 10.199612 | 9.910886 | 10.089114 | 10.110498 | 9.889502 | 15 | 21 |
| 40 | 10 | 9.800427 | 10.199573 | 9.910951 | 10.089049 | 10.110524 | 9.889476 | 50 | 20 |
| 41 | 15 | 9.800466 | 10.199534 | 9.911015 | 10.088985 | 10.110549 | 9.889451 | 45 | 19 |
| 42 | 30 | 9.800505 | 10.199495 | 9.911080 | 10.088920 | 10.110575 | 9.889425 | 30 | 18 |
| 43 | 45 | 9.800543 | 10.199457 | 9.911144 | 10.088856 | 10.110601 | 9.889399 | 15 | 17 |
| 44 | 11 | 9.800582 | 10.199418 | 9.911209 | 10.088791 | 10.110626 | 9.889374 | 49 | 16 |
| 45 | 15 | 9.800621 | 10.199379 | 9.911273 | 10.088727 | 10.110652 | 9.889348 | 45 | 15 |
| 46 | 30 | 9.800660 | 10.199340 | 9.911338 | 10.088662 | 10.110678 | 9.889322 | 30 | 14 |
| 47 | 45 | 9.800698 | 10.199302 | 9.911402 | 10.088598 | 10.110704 | 9.889296 | 15 | 13 |
| 48 | 12 | 9.800737 | 10.199263 | 9.911467 | 10.088533 | 10.110729 | 9.889271 | 48 | 12 |
| 49 | 15 | 9.800776 | 10.199224 | 9.911531 | 10.088469 | 10.110755 | 9.889245 | 45 | 11 |
| 50 | 30 | 9.800815 | 10.199185 | 9.911596 | 10.088404 | 10.110781 | 9.889219 | 30 | 10 |
| 51 | 45 | 9.800853 | 10.199147 | 9.911660 | 10.088340 | 10.110807 | 9.889193 | 15 | 9 |
| 52 | 13 | 9.800892 | 10.199108 | 9.911724 | 10.088276 | 10.110833 | 9.889167 | 47 | 8 |
| 53 | 15 | 9.800931 | 10.199069 | 9.911789 | 10.088211 | 10.110858 | 9.889142 | 45 | 7 |
| 54 | 30 | 9.800969 | 10.199031 | 9.911853 | 10.088147 | 10.110884 | 9.889116 | 30 | 6 |
| 55 | 45 | 9.801008 | 10.198992 | 9.911918 | 10.088082 | 10.110910 | 9.889090 | 15 | 5 |
| 56 | 14 | 9.801047 | 10.198953 | 9.911982 | 10.088018 | 10.110936 | 9.889064 | 46 | 4 |
| 57 | 15 | 9.801085 | 10.198915 | 9.912047 | 10.087953 | 10.110961 | 9.889039 | 45 | 3 |
| 58 | 30 | 9.801124 | 10.198876 | 9.912111 | 10.087889 | 10.110987 | 9.889013 | 30 | 2 |
| 59 | 45 | 9.801163 | 10.198837 | 9.912176 | 10.087824 | 10.111013 | 9.888987 | 15 | 1 |
| 60 | 15 | 9.801201 | 10.198799 | 9.912240 | 10.087760 | 10.111039 | 9.888961 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 23m. | | LOG. SINES, &c. | | | | | 50 deg. | | |

| 2h 37m. | | LOG. SINES, &c. (t.) | | | | | 39 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ ′ | sec. |
| 0 | 15 | 9.801201 | 10.198799 | 9.912249 | 10.087760 | 10.111039 | 9.888961 | 45 | 60 |
| 1 | 15 | 9.801240 | 10.198760 | 9.912305 | 10.087695 | 10.111065 | 9.888935 | 45 | 59 |
| 2 | 30 | 9.801279 | 10.198721 | 9.912369 | 10.087631 | 10.111090 | 9.888910 | 30 | 58 |
| 3 | 45 | 9.801317 | 10.198683 | 9.912434 | 10.087566 | 10.111116 | 9.888884 | 15 | 57 |
| 4 | 16 | 9.801356 | 10.198644 | 9.912498 | 10.087502 | 10.111142 | 9.888858 | 44 | 56 |
| 5 | 15 | 9.801395 | 10.198605 | 9.912562 | 10.087438 | 10.111168 | 9.888832 | 45 | 55 |
| 6 | 30 | 9.801433 | 10.198567 | 9.912627 | 10.087373 | 10.111194 | 9.888806 | 30 | 54 |
| 7 | 45 | 9.801472 | 10.198528 | 9.912691 | 10.087309 | 10.111220 | 9.888780 | 15 | 53 |
| 8 | 17 | 9.801511 | 10.198489 | 9.912756 | 10.087244 | 10.111245 | 9.888755 | 43 | 52 |
| 9 | 15 | 9.801549 | 10.198451 | 9.912820 | 10.087180 | 10.111271 | 9.888729 | 45 | 51 |
| 10 | 30 | 9 801588 | 10.198412 | 9.912885 | 10.087115 | 10.111297 | 9.888703 | 30 | 50 |
| 11 | 45 | 9.801626 | 10.198374 | 9.912949 | 10.087051 | 10.111323 | 9.888677 | 15 | 49 |
| 12 | 18 | 9.801665 | 10.198335 | 9.913014 | 10.086986 | 10.111349 | 9.888651 | 42 | 48 |
| 13 | 15 | 9.801703 | 10.198297 | 9.913078 | 10.086922 | 10.111375 | 9.888625 | 45 | 47 |
| 14 | 30 | 9.801742 | 10.198258 | 9.913142 | 10.086858 | 10.111400 | 9.888600 | 30 | 46 |
| 15 | 45 | 9.801781 | 10.198219 | 9.913207 | 10.086793 | 10.111426 | 9.888574 | 15 | 45 |
| 16 | 19 | 9.801819 | 10.198181 | 9.913271 | 10.086729 | 10.111452 | 9.888548 | 41 | 44 |
| 17 | 15 | 9.801858 | 10.198142 | 9.913336 | 10.086664 | 10.111478 | 9.888522 | 45 | 43 |
| 18 | 30 | 9.801896 | 10.198104 | 9.913400 | 10.086600 | 10.111504 | 9.888496 | 30 | 42 |
| 19 | 45 | 9.801935 | 10.198065 | 9.913465 | 10.086535 | 10.111530 | 9.888470 | 15 | 41 |
| 20 | 20 | 9.801973 | 10.198027 | 9.913529 | 10.086471 | 10.111556 | 9.888444 | 40 | 40 |
| 21 | 15 | 9.802012 | 10.197988 | 9.913593 | 10.086407 | 10.111582 | 9.888418 | 45 | 39 |
| 22 | 30 | 9.802050 | 10.197950 | 9.913658 | 10.086342 | 10.111607 | 9.888393 | 30 | 38 |
| 23 | 45 | 9.802089 | 10.197911 | 9.913722 | 10.086278 | 10.111633 | 9.888367 | 15 | 37 |
| 24 | 21 | 9.802128 | 10.197872 | 9.913787 | 10.086213 | 10.111659 | 9.888341 | 39 | 36 |
| 25 | 15 | 9.802166 | 10.197834 | 9.913851 | 10.086149 | 10.111685 | 9.888315 | 45 | 35 |
| 26 | 30 | 9.802205 | 10.197795 | 9.913916 | 10.086084 | 10.111711 | 9.888289 | 30 | 34 |
| 27 | 45 | 9.802243 | 10.197757 | 9.913980 | 10.086020 | 10.111737 | 9.888263 | 15 | 33 |
| 28 | 22 | 9 802282 | 10.197718 | 9.914044 | 10.085956 | 10.111763 | 9.888237 | 38 | 32 |
| 29 | 15 | 9.802320 | 10.197680 | 9.914109 | 10.085891 | 10.111789 | 9.888211 | 45 | 31 |
| 30 | 30 | 9.802359 | 10.197641 | 9.914173 | 10.085827 | 10.111815 | 9.888185 | 30 | 30 |
| 31 | 45 | 9.802397 | 10.197603 | 9.914238 | 10.085762 | 10.111841 | 9.888159 | 15 | 29 |
| 32 | 23 | 9.802435 | 10.197565 | 9.914302 | 10.085698 | 10.111867 | 9.888133 | 37 | 28 |
| 33 | 15 | 9.802474 | 10.197526 | 9.914366 | 10.085634 | 10.111892 | 9.888108 | 45 | 27 |
| 34 | 30 | 9.802512 | 10.197488 | 9.914431 | 10.085569 | 10.111918 | 9.888082 | 30 | 26 |
| 35 | 45 | 9.802551 | 10.197449 | 9.914495 | 10.085505 | 10.111944 | 9.888056 | 15 | 25 |
| 36 | 24 | 9.802589 | 10.197411 | 9.914560 | 10.085440 | 10.111970 | 9.888030 | 36 | 24 |
| 37 | 15 | 9.802628 | 10.197372 | 9.914624 | 10.085376 | 10.111996 | 9.888004 | 45 | 23 |
| 38 | 30 | 9.802666 | 10.197334 | 9.914688 | 10.085312 | 10.112022 | 9.887978 | 30 | 22 |
| 39 | 45 | 9.802705 | 10.197295 | 9.914753 | 10.085247 | 10.112048 | 9.887952 | 15 | 21 |
| 40 | 25 | 9.802743 | 10.197257 | 9.914817 | 10.085183 | 10.112074 | 9.887926 | 35 | 20 |
| 41 | 15 | 9.802782 | 10.197218 | 9.914881 | 10.085119 | 10.112100 | 9.887900 | 45 | 19 |
| 42 | 30 | 9.802820 | 10.197180 | 9.914946 | 10.085054 | 10.112126 | 9.887874 | 30 | 18 |
| 43 | 45 | 9.802858 | 10.197142 | 9.915010 | 10.084990 | 10.112152 | 9.887848 | 15 | 17 |
| 44 | 26 | 9.802897 | 10.197103 | 9.915075 | 10.084925 | 10.112178 | 9.887822 | 34 | 16 |
| 45 | 15 | 9.802935 | 10.197065 | 9.915139 | 10.084861 | 10.112204 | 9.887796 | 45 | 15 |
| 46 | 30 | 9.802974 | 10.197026 | 9.915203 | 10.084797 | 10.112230 | 9.887770 | 30 | 14 |
| 47 | 45 | 9.803012 | 10.196988 | 9.915268 | 10.084732 | 10.112256 | 9.887744 | 15 | 13 |
| 48 | 27 | 9.803050 | 10.196950 | 9.915332 | 10.084668 | 10.112282 | 9.887718 | 33 | 12 |
| 49 | 15 | 9 803089 | 10.196911 | 9.915396 | 10.084604 | 10 112308 | 9.887692 | 45 | 11 |
| 50 | 30 | 9.803127 | 10.196873 | 9.915461 | 10.084539 | 10.112334 | 9.887666 | 30 | 10 |
| 51 | 45 | 9.803165 | 10.196835 | 9.915525 | 10.084475 | 10.112360 | 9.887640 | 15 | 9 |
| 52 | 28 | 9.803204 | 10.196796 | 9.915590 | 10.084410 | 10.112386 | 9.887614 | 32 | 8 |
| 53 | 15 | 9.803242 | 10.196758 | 9.915654 | 10.084346 | 10.112412 | 9.887588 | 45 | 7 |
| 54 | 30 | 9.803280 | 10.196720 | 9.915718 | 10.084282 | 10.112438 | 9.887562 | 30 | 6 |
| 55 | 45 | 9.803319 | 10.196681 | 9.915783 | 10.084217 | 10.112464 | 9.887536 | 15 | 5 |
| 56 | 29 | 9.803357 | 10.196643 | 9.915847 | 10.084153 | 10.112490 | 9.887510 | 31 | 4 |
| 57 | 15 | 9.803396 | 10.196604 | 9.915911 | 10.084089 | 10.112516 | 9.887484 | 45 | 3 |
| 58 | 30 | 9.803434 | 10.196566 | 9.915976 | 10.084024 | 10.112542 | 9.887458 | 30 | 2 |
| 59 | 45 | 9.803472 | 10.196528 | 9.916040 | 10.083960 | 10.112568 | 9.887432 | 15 | 1 |
| 60 | 30 | 9.803510 | 10.196490 | 9.916104 | 10.083896 | 10.112594 | 9.887406 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine | ′ ′ | sec. |

| 3h 22m. | LOG. SINES, &c. | 50 deg. |
|---|---|---|

| 2h 39m. | | | LOG. SINES, &c. (t.) | | | | 39 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.803510 | 10.196490 | 9.916104 | 10.083896 | 10.112594 | 9.887406 | 30 | 60 |
| 1 | 15 | 9.803549 | 10.196451 | 9.916169 | 10 083831 | 10.112620 | 9.887380 | 45 | 59 |
| 2 | 30 | 9.803587 | 10.196413 | 9.916233 | 10.083767 | 10.112646 | 9.887354 | 30 | 58 |
| 3 | 45 | 9.803625 | 10.196375 | 9.916297 | 10.083703 | 10.112672 | 9.887328 | 15 | 57 |
| 4 | 31 | 9.803664 | 10.196336 | 9.916362 | 10.083638 | 10.112698 | 9.887302 | 29 | 56 |
| 5 | 15 | 9.803702 | 10.196298 | 9.916426 | 10.083574 | 10.112724 | 9.887276 | 45 | 55 |
| 6 | 30 | 9.803740 | 10.196260 | 9.916490 | 10.083510 | 10.112750 | 9.887250 | 30 | 54 |
| 7 | 45 | 9.803779 | 10.196221 | 9.916555 | 10.083445 | 10.112776 | 9.887224 | 15 | 53 |
| 8 | 32 | 9.803817 | 10.196183 | 9.916619 | 10.083381 | 10.112802 | 9.887198 | 28 | 52 |
| 9 | 15 | 9.803855 | 10.196145 | 9.916683 | 10.083317 | 10.112828 | 9.887172 | 45 | 51 |
| 10 | 30 | 9.803893 | 10.196107 | 9.916748 | 10.083252 | 10.112855 | 9.887145 | 30 | 50 |
| 11 | 45 | 9.803932 | 10.196068 | 9.916812 | 10.083188 | 10.112881 | 9.887119 | 15 | 49 |
| 12 | 33 | 9.803970 | 10.196030 | 9.916876 | 10.083124 | 10.112907 | 9.887093 | 27 | 48 |
| 13 | 15 | 9.804008 | 10.195992 | 9.916941 | 10.083059 | 10.112933 | 9.887067 | 45 | 47 |
| 14 | 30 | 9.804046 | 10.195954 | 9.917005 | 10.082995 | 10.112959 | 9.887041 | 30 | 46 |
| 15 | 45 | 9.804085 | 10.195915 | 9.917069 | 10.082931 | 10 112985 | 9.887015 | 15 | 45 |
| 16 | 34 | 9.804123 | 10.195877 | 9.917134 | 10.082866 | 10.113011 | 9.886989 | 26 | 44 |
| 17 | 15 | 9.804161 | 10.195839 | 9.917198 | 10.082802 | 10.113037 | 9.886963 | 45 | 43 |
| 18 | 30 | 9.804199 | 10.195801 | 9.917262 | 10.082738 | 10.113063 | 9.886937 | 30 | 42 |
| 19 | 45 | 9.804237 | 10.195763 | 9.917327 | 10.082673 | 10.113089 | 9.886911 | 15 | 41 |
| 20 | 35 | 9.804276 | 10.195724 | 9.917391 | 10.082609 | 10.113115 | 9.886885 | 25 | 40 |
| 21 | 15 | 9.804314 | 10.195686 | 9.917455 | 10.082545 | 10.113142 | 9.886858 | 45 | 39 |
| 22 | 30 | 9.804352 | 10.195648 | 9.917520 | 10.082480 | 10.113168 | 9.886832 | 30 | 38 |
| 23 | 45 | 9.804390 | 10.195610 | 9.917584 | 10.082416 | 10.113194 | 9.886806 | 15 | 37 |
| 24 | 36 | 9.804428 | 10.195572 | 9.917648 | 10.082352 | 10.113220 | 9.886780 | 24 | 36 |
| 25 | 15 | 9.804467 | 10.195533 | 9.917713 | 10.082287 | 10.113246 | 9.886754 | 45 | 35 |
| 26 | 30 | 9.804505 | 10.195495 | 9.917777 | 10.082223 | 10.113272 | 9.886728 | 30 | 34 |
| 27 | 45 | 9.804543 | 10.195457 | 9.917841 | 10.082159 | 10.113298 | 9.886702 | 15 | 33 |
| 28 | 37 | 9.804581 | 10.195419 | 9.917905 | 10.082095 | 10.113324 | 9.886676 | 23 | 32 |
| 29 | 15 | 9.804619 | 10.195381 | 9.917970 | 10.082030 | 10.113351 | 9.886649 | 45 | 31 |
| 30 | 30 | 9.804657 | 10.195343 | 9.918034 | 10.081966 | 10.113377 | 9.886623 | 30 | 30 |
| 31 | 45 | 9.804695 | 10.195305 | 9.918098 | 10.081902 | 10.113403 | 9.886597 | 15 | 29 |
| 32 | 38 | 9.804734 | 10.195266 | 9.918163 | 10.081837 | 10.113429 | 9.886571 | 22 | 28 |
| 33 | 15 | 9.804772 | 10.195228 | 9 918227 | 10.081773 | 10.113455 | 9.886545 | 45 | 27 |
| 34 | 30 | 9.804810 | 10.195190 | 9.918291 | 10.081709 | 10.113481 | 9.886519 | 30 | 26 |
| 35 | 45 | 9.804848 | 10.195152 | 9.918355 | 10.081645 | 10.113508 | 9.886492 | 15 | 25 |
| 36 | 39 | 9.804886 | 10.195114 | 9.918420 | 10.081580 | 10.113534 | 9.886466 | 21 | 24 |
| 37 | 15 | 9.804924 | 10.195076 | 9.918484 | 10.081516 | 10.113560 | 9.886440 | 45 | 23 |
| 38 | 30 | 9.804962 | 10.195038 | 9.918548 | 10.081452 | 10.113586 | 9.886414 | 30 | 22 |
| 39 | 45 | 9.805000 | 10.195000 | 9.918613 | 10.081387 | 10.113612 | 9.886388 | 15 | 21 |
| 40 | 40 | 9.805038 | 10.194962 | 9.918677 | 10.081323 | 10.113638 | 9.886362 | 20 | 20 |
| 41 | 15 | 9.805077 | 10.194923 | 9.918741 | 10.081259 | 10.113665 | 9.886335 | 45 | 19 |
| 42 | 30 | 9.805115 | 10.194885 | 9.918805 | 10.081195 | 10.113691 | 9.886309 | 30 | 18 |
| 43 | 45 | 9.805153 | 10.194847 | 9.918870 | 10.081130 | 10.113717 | 9.886283 | 15 | 17 |
| 44 | 41 | 9.805191 | 10.194809 | 9.918934 | 10.081066 | 10.113743 | 9.886257 | 19 | 16 |
| 45 | 15 | 9.805229 | 10.194771 | 9.918998 | 10.081002 | 10.113769 | 9.886231 | 45 | 15 |
| 46 | 30 | 9.805267 | 10.194733 | 9.919063 | 10.080937 | 10.113796 | 9.886204 | 30 | 14 |
| 47 | 45 | 9.805305 | 10.194695 | 9.919127 | 10.080873 | 10 113822 | 9.886178 | 15 | 13 |
| 48 | 42 | 9.805343 | 10.194657 | 9.919191 | 10.080809 | 10.113848 | 9.886152 | 18 | 12 |
| 49 | 15 | 9.805381 | 10.194619 | 9.919255 | 10.080745 | 10.113874 | 9.886126 | 45 | 11 |
| 50 | 30 | 9.805419 | 10.194581 | 9.919320 | 10.080680 | 10.113901 | 9.886099 | 30 | 10 |
| 51 | 45 | 9.805457 | 10 194543 | 9.919384 | 10.080616 | 10.113927 | 9.886073 | 15 | 9 |
| 52 | 43 | 9.805495 | 10.194505 | 9.919448 | 10.080552 | 10.113953 | 9.886047 | 17 | 8 |
| 53 | 15 | 9.805533 | 10.194467 | 9.919512 | 10.080488 | 10.113979 | 9.886021 | 45 | 7 |
| 54 | 30 | 9.805571 | 10.194429 | 9.919577 | 10.080423 | 10.114006 | 9.885994 | 30 | 6 |
| 55 | 45 | 9.805609 | 10.194391 | 9.919641 | 10.080359 | 10.114032 | 9.885968 | 15 | 5 |
| 56 | 44 | 9.805647 | 10.194353 | 9.919705 | 10.080295 | 10 114058 | 9.885942 | 16 | 4 |
| 57 | 15 | 9.805685 | 10.194315 | 9.919769 | 10.080231 | 10.114084 | 9.885916 | 45 | 3 |
| 58 | 30 | 9.805723 | 10.194277 | 9.919834 | 10.080166 | 10.114111 | 9.885889 | 30 | 2 |
| 59 | 45 | 9.805761 | 10.194239 | 9.919898 | 10.080102 | 10.114137 | 9.885863 | 15 | 1 |
| 60 | 45 | 9.805799 | 10.194201 | 9.919962 | 10.080038 | 10.114163 | 9.885837 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 21m. | | | LOG. SINES, &c. | | | | 50 deg. | | |

| 2h 39m. | | LOG. SINES, &c. (t.) | | | | | 39 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | ″ |
| 0 | 45 | 9.805799 | 10.194201 | 9.919962 | 10.080038 | 10.114163 | 9.885837 | 15 | 60 |
| 1 | 15 | 9 805837 | 10.194163 | 9.920026 | 10.079974 | 10.114189 | 9.885811 | 45 | 59 |
| 2 | 30 | 9.805875 | 10.194125 | 9.920091 | 10.079909 | 10.114216 | 9.885784 | 30 | 58 |
| 3 | 45 | 9.805913 | 10.194087 | 9.920155 | 10.079845 | 10.114242 | 9.885758 | 15 | 57 |
| 4 | 46 | 9.805951 | 10.194049 | 9.920219 | 10.079781 | 10.114268 | 9.885732 | 14 | 56 |
| 5 | 15 | 9.805989 | 10.194011 | 9.920283 | 10.079717 | 10.114294 | 9.885706 | 45 | 55 |
| 6 | 30 | 9.806027 | 10 193973 | 9.920347 | 10.079653 | 10.114321 | 9.885679 | 30 | 54 |
| 7 | 45 | 9.806065 | 10.193935 | 9.920412 | 10.079588 | 10.114347 | 9.885653 | 15 | 53 |
| 8 | 47 | 9.806103 | 10.193897 | 9.920476 | 10.079524 | 10.114373 | 9.885627 | 13 | 52 |
| 9 | 15 | 9.806141 | 10.193859 | 9.920540 | 10.079460 | 10.114400 | 9.885600 | 45 | 51 |
| 10 | 30 | 9.806179 | 10.193821 | 9.920604 | 10.079396 | 10.114426 | 9.885574 | 30 | 50 |
| 11 | 45 | 9.806216 | 10.193784 | 9.920669 | 10.079331 | 10.114452 | 9.885548 | 15 | 49 |
| 12 | 48 | 9.806254 | 10.193746 | 9.920733 | 10.079267 | 10.114479 | 9.885521 | 12 | 48 |
| 13 | 15 | 9.806292 | 10.193708 | 9.920797 | 10.079203 | 10.114505 | 9.885495 | 45 | 47 |
| 14 | 30 | 9.806330 | 10.193670 | 9.920861 | 10.079139 | 10.114531 | 9.885469 | 30 | 46 |
| 15 | 45 | 9.806368 | 10.193632 | 9.920925 | 10.079075 | 10.114557 | 9.885443 | 15 | 45 |
| 16 | 49 | 9.806406 | 10.193594 | 9.920990 | 10.079010 | 10.114584 | 9.885416 | 11 | 44 |
| 17 | 15 | 9.806444 | 10.193556 | 9.921054 | 10.078946 | 10.114610 | 9.885390 | 45 | 43 |
| 18 | 30 | 9.806482 | 10.193518 | 9.921118 | 10.078882 | 10.114636 | 9.885364 | 30 | 42 |
| 19 | 45 | 9.806520 | 10.193480 | 9.921182 | 10.078818 | 10.114663 | 9.885337 | 15 | 41 |
| 20 | 50 | 9.806557 | 10.193443 | 9.921247 | 10.078753 | 10.114689 | 9.885311 | 10 | 40 |
| 21 | 15 | 9.806595 | 10.193405 | 9.921311 | 10.078689 | 10.114716 | 9.885284 | 45 | 39 |
| 22 | 30 | 9.806633 | 10.193367 | 9.921375 | 10.078625 | 10.114742 | 9.885258 | 30 | 38 |
| 23 | 45 | 9.806671 | 10.193329 | 9.921439 | 10.078561 | 10.114768 | 9.885232 | 15 | 37 |
| 24 | 51 | 9.806709 | 10.193291 | 9.921503 | 10.078497 | 10.114795 | 9.885205 | 9 | 36 |
| 25 | 15 | 9.806747 | 10.193253 | 9.921568 | 10.078432 | 10.114821 | 9.885179 | 45 | 35 |
| 26 | 30 | 9.806785 | 10.193215 | 9.921632 | 10.078368 | 10.114847 | 9.885153 | 30 | 34 |
| 27 | 45 | 9.806822 | 10.193178 | 9.921696 | 10.078304 | 10.114874 | 9.885126 | 15 | 33 |
| 28 | 52 | 9.806860 | 10.193140 | 9.921760 | 10.078240 | 10.114900 | 9.885100 | 8 | 32 |
| 29 | 15 | 9.806898 | 10.193102 | 9.921824 | 10.078176 | 10.114926 | 9.885074 | 45 | 31 |
| 30 | 30 | 9.806936 | 10.193064 | 9.921889 | 10.078111 | 10.114953 | 9.885047 | 30 | 30 |
| 31 | 45 | 9.806974 | 10.193026 | 9.921953 | 10.078047 | 10.114979 | 9.885021 | 15 | 29 |
| 32 | 53 | 9.807011 | 10.192989 | 9.922017 | 10.077983 | 10.115006 | 9.884994 | 7 | 28 |
| 33 | 15 | 9.807049 | 10.192951 | 9.922081 | 10.077919 | 10.115032 | 9.884968 | 45 | 27 |
| 34 | 30 | 9.807087 | 10.192913 | 9.922145 | 10.077855 | 10.115058 | 9.884942 | 30 | 26 |
| 35 | 45 | 9.807125 | 10.192875 | 9.922209 | 10.077791 | 10.115085 | 9.884915 | 15 | 25 |
| 36 | 54 | 9.807163 | 10.192837 | 9.922274 | 10.077726 | 10.115111 | 9.884889 | 6 | 24 |
| 37 | 15 | 9.807200 | 10.192800 | 9.922338 | 10.077662 | 10.115138 | 9.884862 | 45 | 23 |
| 38 | 30 | 9.807238 | 10.192762 | 9.922402 | 10.077598 | 10.115164 | 9.884836 | 30 | 22 |
| 39 | 45 | 9.807276 | 10.192724 | 9.922466 | 10.077534 | 10.115190 | 9.884810 | 15 | 21 |
| 40 | 55 | 9.807314 | 10.192686 | 9.922530 | 10.077470 | 10.115217 | 9.884783 | 5 | 20 |
| 41 | 15 | 9.807351 | 10.192649 | 9.922595 | 10.077405 | 10.115243 | 9.884757 | 45 | 19 |
| 42 | 30 | 9.807389 | 10.192611 | 9.922659 | 10.077341 | 10.115270 | 9.884730 | 30 | 18 |
| 43 | 45 | 9.807427 | 10.192573 | 9.922723 | 10.077277 | 10.115296 | 9.884704 | 15 | 17 |
| 44 | 56 | 9.807465 | 10.192535 | 9.922787 | 10.077213 | 10.115323 | 9.884677 | 4 | 16 |
| 45 | 15 | 9.807502 | 10.192498 | 9.922851 | 10.077149 | 10.115349 | 9.884651 | 45 | 15 |
| 46 | 30 | 9.807540 | 10.192460 | 9.922915 | 10.077085 | 10.115375 | 9.884625 | 30 | 14 |
| 47 | 45 | 9.807578 | 10.192422 | 9.922980 | 10.077020 | 10.115402 | 9.884598 | 15 | 13 |
| 48 | 57 | 9.807615 | 10.192385 | 9.923044 | 10.076956 | 10.115428 | 9.884572 | 3 | 12 |
| 49 | 15 | 9.807653 | 10.192347 | 9.923108 | 10.076892 | 10.115455 | 9.884545 | 45 | 11 |
| 50 | 30 | 9.807691 | 10.192309 | 9.923172 | 10.076828 | 10.115481 | 9.884519 | 30 | 10 |
| 51 | 45 | 9.807728 | 10.192272 | 9.923236 | 10.076764 | 10.115508 | 9.884492 | 15 | 9 |
| 52 | 58 | 9 807766 | 10.192234 | 9.923300 | 10.076700 | 10.115534 | 9.884466 | 2 | 8 |
| 53 | 15 | 9.807804 | 10.192196 | 9.923364 | 10.076636 | 10.115561 | 9.884439 | 45 | 7 |
| 54 | 30 | 9.807842 | 10.192158 | 9.923429 | 10.076571 | 10.115587 | 9.884413 | 30 | 6 |
| 55 | 45 | 9.807879 | 10.192121 | 9.923493 | 10.076507 | 10.115614 | 9.884386 | 15 | 5 |
| 56 | 59 | 9.807917 | 10.192083 | 9.923557 | 10.076443 | 10.115640 | 9 884360 | 1 | 4 |
| 57 | 15 | 9.807955 | 10.192045 | 9.923621 | 10.076379 | 10.115667 | 9.884333 | 45 | 3 |
| 58 | 30 | 9.807992 | 10.192008 | 9 923685 | 10.076315 | 10.115693 | 9.884307 | 30 | 2 |
| 59 | 45 | 9.808030 | 10.191970 | 9.923749 | 10.076251 | 10.115720 | 9.884280 | 15 | 1 |
| 60 | 60 | 9.808067 | 10.191933 | 9.923813 | 10.076187 | 10.115746 | 9.884254 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | ″ |
| 3h 20m. | | | LOG. SINES, &c. | | | | | 50 deg. | |

| 2h 40m. | | | LOG. SINES, &c. (t.) | | | | 40 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.808067 | 10.191933 | 9.923813 | 10.076187 | 10.115746 | 9.884254 | 60 | 60 |
| 1 | 15 | 9.808105 | 10.191895 | 9.923878 | 10.076122 | 10.115773 | 9.884227 | 45 | 59 |
| 2 | 30 | 9.808143 | 10.191857 | 9.923942 | 10.076058 | 10.115799 | 9.884201 | 30 | 58 |
| 3 | 45 | 9.808180 | 10.191820 | 9.924006 | 10.075994 | 10.115826 | 9.884174 | 15 | 57 |
| 4 | 1 | 9.808218 | 10.191782 | 9.924070 | 10.075930 | 10.115852 | 9.884148 | 59 | 56 |
| 5 | 15 | 9.808256 | 10.191744 | 9.924134 | 10.075866 | 10.115879 | 9.884121 | 45 | 55 |
| 6 | 30 | 9.808293 | 10.191707 | 9.924198 | 10.075802 | 10.115905 | 9.884095 | 30 | 54 |
| 7 | 45 | 9.808331 | 10.191669 | 9.924262 | 10.075738 | 10.115932 | 9.884068 | 15 | 53 |
| 8 | 2 | 9.808368 | 10.191632 | 9.924327 | 10.075673 | 10.115958 | 9.884042 | 58 | 52 |
| 9 | 15 | 9.808406 | 10.191594 | 9.924391 | 10.075609 | 10.115985 | 9.884015 | 45 | 51 |
| 10 | 30 | 9.808444 | 10.191556 | 9.924455 | 10.075545 | 10.116011 | 9.883989 | 30 | 50 |
| 11 | 45 | 9.808481 | 10.191519 | 9.924519 | 10.075481 | 10.116038 | 9.883962 | 15 | 49 |
| 12 | 3 | 9.808519 | 10.191481 | 9.924583 | 10.075417 | 10.116064 | 9.883936 | 57 | 48 |
| 13 | 15 | 9.808556 | 10.191444 | 9.924647 | 10.075353 | 10.116091 | 9.883909 | 45 | 47 |
| 14 | 30 | 9.808594 | 10.191406 | 9.924711 | 10.075289 | 10.116117 | 9.883883 | 30 | 46 |
| 15 | 45 | 9.808631 | 10.191369 | 9.924775 | 10.075225 | 10.116144 | 9.883856 | 15 | 45 |
| 16 | 4 | 9.808669 | 10.191331 | 9.924840 | 10.075160 | 10.116171 | 9.883829 | 56 | 44 |
| 17 | 15 | 9.808707 | 10.191293 | 9.924904 | 10.075096 | 10.116197 | 9.883803 | 45 | 43 |
| 18 | 30 | 9.808744 | 10.191256 | 9.924968 | 10.075032 | 10.116224 | 9.883776 | 30 | 42 |
| 19 | 45 | 9.808782 | 10.191218 | 9.925032 | 10.074968 | 10.116250 | 9.883750 | 15 | 41 |
| 20 | 5 | 9.808819 | 10.191181 | 9.925096 | 10.074904 | 10.116277 | 9.883723 | 55 | 40 |
| 21 | 15 | 9.808857 | 10.191143 | 9.925160 | 10.074840 | 10.116303 | 9.883697 | 45 | 39 |
| 22 | 30 | 9 808894 | 10.191106 | 9.925224 | 10.074776 | 10.116330 | 9.883670 | 30 | 38 |
| 23 | 45 | 9.808932 | 10.191068 | 9.925288 | 10.074712 | 10.116357 | 9.883643 | 15 | 37 |
| 24 | 6 | 9.808969 | 10.191031 | 9.925352 | 10.074648 | 10.116383 | 9.883617 | 54 | 36 |
| 25 | 15 | 9.809007 | 10.190993 | 9.925416 | 10.074584 | 10.116410 | 9.883590 | 45 | 35 |
| 26 | 30 | 9.809044 | 10.190956 | 9.925481 | 10.074519 | 10.116436 | 9.883564 | 30 | 34 |
| 27 | 45 | 9.809082 | 10.190918 | 9.925545 | 10.074455 | 10.116463 | 9.883537 | 15 | 33 |
| 28 | 7 | 9.809119 | 10.190881 | 9.925609 | 10.074391 | 10.116490 | 9.883510 | 53 | 32 |
| 29 | 15 | 9.809157 | 10.190843 | 9.925673 | 10.074327 | 10.116516 | 9.883484 | 45 | 31 |
| 30 | 30 | 9.809194 | 10.190806 | 9.925737 | 10.074263 | 10.116543 | 9.883457 | 30 | 30 |
| 31 | 45 | 9.809232 | 10.190768 | 9.925801 | 10.074199 | 10.116570 | 9.883430 | 15 | 29 |
| 32 | 8 | 9.809269 | 10.190731 | 9.925865 | 10.074135 | 10.116596 | 9.883404 | 52 | 28 |
| 33 | 15 | 9.809307 | 10.190693 | 9.925929 | 10.074071 | 10.116623 | 9.883377 | 45 | 27 |
| 34 | 30 | 9.809344 | 10.190656 | 9.925993 | 10.074007 | 10.116649 | 9.883351 | 30 | 26 |
| 35 | 45 | 9.809381 | 10.190619 | 9.926057 | 10.073943 | 10.116676 | 9.883324 | 15 | 25 |
| 36 | 9 | 9.809419 | 10.190581 | 9.926121 | 10.073879 | 10.116703 | 9.883297 | 51 | 24 |
| 37 | 15 | 9.809456 | 10.190544 | 9.926186 | 10.073814 | 10.116729 | 9.883271 | 45 | 23 |
| 38 | 30 | 9.809494 | 10.190506 | 9.926250 | 10.073750 | 10.116756 | 9.883244 | 30 | 22 |
| 39 | 45 | 9.809531 | 10.190469 | 9.926314 | 10.073686 | 10.116783 | 9.883217 | 15 | 21 |
| 40 | 10 | 9.809569 | 10.190431 | 9.926378 | 10.073622 | 10.116809 | 9.883191 | 50 | 20 |
| 41 | 15 | 9.809606 | 10.190394 | 9.926442 | 10.073558 | 10.116836 | 9.883164 | 45 | 19 |
| 42 | 30 | 9 809643 | 10.190357 | 9.926506 | 10.073494 | 10.116863 | 9.883137 | 30 | 18 |
| 43 | 45 | 9.809681 | 10.190319 | 9.926570 | 10.073430 | 10.116889 | 9.883111 | 15 | 17 |
| 44 | 11 | 9.809718 | 10.190282 | 9.926634 | 10.073366 | 10.116916 | 9.883084 | 49 | 16 |
| 45 | 15 | 9.809756 | 10.190244 | 9.926698 | 10.073302 | 10.116943 | 9.883057 | 45 | 15 |
| 46 | 30 | 9.809793 | 10.190207 | 9.926762 | 10.073238 | 10.116969 | 9.883031 | 30 | 14 |
| 47 | 45 | 9.809830 | 10.190170 | 9.926826 | 10.073174 | 10.116996 | 9.883004 | 15 | 13 |
| 48 | 12 | 9.809868 | 10.190132 | 9.926890 | 10.073110 | 10.117023 | 9.882977 | 48 | 12 |
| 49 | 15 | 9.809905 | 10.190095 | 9.926954 | 10.073046 | 10.117049 | 9.882951 | 45 | 11 |
| 50 | 30 | 9.809942 | 10.190058 | 9.927018 | 10.072982 | 10.117076 | 9.882924 | 30 | 10 |
| 51 | 45 | 9.809980 | 10.190020 | 9.927083 | 10.072917 | 10.117103 | 9.882897 | 15 | 9 |
| 52 | 13 | 9.810017 | 10.189983 | 9.927147 | 10.072853 | 10.117129 | 9.882871 | 47 | 8 |
| 53 | 15 | 9.810055 | 10.189945 | 9.927211 | 10.072789 | 10.117156 | 9.882844 | 45 | 7 |
| 54 | 30 | 9.810092 | 10.189908 | 9.927275 | 10.072725 | 10.117183 | 9.882817 | 30 | 6 |
| 55 | 45 | 9.810129 | 10.189871 | 9.927339 | 10.072661 | 10.117210 | 9.882790 | 15 | 5 |
| 56 | 14 | 9.810167 | 10.189833 | 9.927403 | 10.072597 | 10.117236 | 9.882764 | 46 | 4 |
| 57 | 15 | 9.810204 | 10.189796 | 9.927467 | 10.072533 | 10.117263 | 9.882737 | 45 | 3 |
| 58 | 30 | 9.810241 | 10.189759 | 9.927531 | 10.072469 | 10.117290 | 9.882710 | 30 | 2 |
| 59 | 45 | 9.810278 | 10.189722 | 9.927595 | 10.072405 | 10.117316 | 9.882684 | 15 | 1 |
| 60 | 15 | 9.810316 | 10.189684 | 9.927659 | 10.072341 | 10.117343 | 9.882657 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 19m | | | LOG. SINES, &c. | | | | 49 deg. | | |

| 2h 41m. | | | LOG. SINES, &c. (t.) | | | | 40 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.810316 | 10.189684 | 9.927659 | 10.072341 | 10.117343 | 9.882657 | 45 | 60 |
| 1 | 15 | 9.810353 | 10.189647 | 9.927723 | 10.072277 | 10.117370 | 9.882630 | 45 | 59 |
| 2 | 30 | 9 810390 | 10.189610 | 9.927787 | 10.072213 | 10.117397 | 9.882603 | 30 | 58 |
| 3 | 45 | 9.810428 | 10.189572 | 9.927851 | 10.072149 | 10.117423 | 9.882577 | 15 | 57 |
| 4 | 16 | 9.810465 | 10.189535 | 9.927915 | 10.072085 | 10.117450 | 9.882550 | 44 | 56 |
| 5 | 15 | 9.810502 | 10.189498 | 9.927979 | 10.072021 | 10.117477 | 9.882523 | 45 | 55 |
| 6 | 30 | 9.810540 | 10.189460 | 9.928043 | 10.071957 | 10.117504 | 9.882496 | 30 | 54 |
| 7 | 45 | 9.810577 | 10.189423 | 9.928107 | 10.071893 | 10.117530 | 9.882470 | 15 | 53 |
| 8 | 17 | 9.810614 | 10.189386 | 9.928171 | 10.071829 | 10.117557 | 9.882443 | 43 | 52 |
| 9 | 15 | 9.810651 | 10.189349 | 9.928235 | 10.071765 | 10.117584 | 9.882416 | 45 | 51 |
| 10 | 30 | 9.810689 | 10.189311 | 9.928299 | 10.071701 | 10.117611 | 9.882389 | 30 | 50 |
| 11 | 45 | 9.810726 | 10.189274 | 9.928363 | 10.071637 | 10.117638 | 9.882362 | 15 | 49 |
| 12 | 18 | 9.810763 | 10.189237 | 9.928427 | 10.071573 | 10.117664 | 9.882336 | 42 | 48 |
| 13 | 15 | 9.810800 | 10.189200 | 9.928491 | 10.071509 | 10.117691 | 9.882309 | 45 | 47 |
| 14 | 30 | 9.810838 | 10.189162 | 9.928555 | 10.071445 | 10.117718 | 9.882282 | 30 | 46 |
| 15 | 45 | 9.810875 | 10.189125 | 9.928619 | 10.071381 | 10.117745 | 9.882255 | 15 | 45 |
| 16 | 19 | 9.810912 | 10.189088 | 9.928683 | 10.071317 | 10.117772 | 9.882228 | 41 | 44 |
| 17 | 15 | 9.810949 | 10.189051 | 9.928747 | 10.071253 | 10.117798 | 9.882202 | 45 | 43 |
| 18 | 30 | 9.810986 | 10.189014 | 9.928812 | 10.071188 | 10.117825 | 9.882175 | 30 | 42 |
| 19 | 45 | 9.811024 | 10.188976 | 9.928876 | 10.071124 | 10.117852 | 9.882148 | 15 | 41 |
| 20 | 20 | 9.811061 | 10.188939 | 9.928940 | 10.071060 | 10.117879 | 9.882121 | 40 | 40 |
| 21 | 15 | 9.811098 | 10.188902 | 9.929004 | 10.070996 | 10.117906 | 9.882094 | 45 | 39 |
| 22 | 30 | 9.811135 | 10.188865 | 9.929068 | 10.070932 | 10.117932 | 9.882068 | 30 | 38 |
| 23 | 45 | 9.811172 | 10.188828 | 9.929132 | 10.070868 | 10.117959 | 9.882041 | 15 | 37 |
| 24 | 21 | 9.811210 | 10.188790 | 9.929196 | 10.070804 | 10.117986 | 9.882014 | 39 | 36 |
| 25 | 15 | 9.811247 | 10.188753 | 9.929260 | 10.070740 | 10.118013 | 9.881987 | 45 | 35 |
| 26 | 30 | 9.811284 | 10.188716 | 9.929324 | 10.070676 | 10.118040 | 9.881960 | 30 | 34 |
| 27 | 45 | 9.811321 | 10.188679 | 9.929388 | 10.070612 | 10.118067 | 9.881933 | 15 | 33 |
| 28 | 22 | 9.811358 | 10.188642 | 9.929452 | 10.070548 | 10.118093 | 9.881907 | 38 | 32 |
| 29 | 15 | 9.811395 | 10.188605 | 9.929516 | 10.070484 | 10.118120 | 9.881880 | 45 | 31 |
| 30 | 30 | 9.811433 | 10.188567 | 9.929580 | 10.070420 | 10.118147 | 9.881853 | 30 | 30 |
| 31 | 45 | 9.811470 | 10.188530 | 9.929644 | 10.070356 | 10.118174 | 9.881826 | 15 | 29 |
| 32 | 23 | 9.811507 | 10.188493 | 9.929708 | 10.070292 | 10.118201 | 9.881799 | 37 | 28 |
| 33 | 15 | 9.811544 | 10.188456 | 9.929772 | 10.070228 | 10.118228 | 9.881772 | 45 | 27 |
| 34 | 30 | 9.811581 | 10.188419 | 9.929836 | 10.070164 | 10.118255 | 9.881745 | 30 | 26 |
| 35 | 45 | 9.811618 | 10.188382 | 9.929900 | 10.070100 | 10.118281 | 9.881719 | 15 | 25 |
| 36 | 24 | 9.811655 | 10.188345 | 9.929964 | 10.070036 | 10.118308 | 9.881692 | 36 | 24 |
| 37 | 15 | 9.811692 | 10.188308 | 9.930028 | 10.069972 | 10.118335 | 9.881665 | 45 | 23 |
| 38 | 30 | 9.811730 | 10.188270 | 9.930092 | 10.069908 | 10.118362 | 9.881638 | 30 | 22 |
| 39 | 45 | 9.811767 | 10.188233 | 9.930156 | 10.069844 | 10.118389 | 9.881611 | 15 | 21 |
| 40 | 25 | 9.811804 | 10.188196 | 9.930219 | 10.069781 | 10.118416 | 9.881584 | 35 | 20 |
| 41 | 15 | 9.811841 | 10.188159 | 9.930283 | 10.069717 | 10.118443 | 9.881557 | 45 | 19 |
| 42 | 30 | 9.811878 | 10.188122 | 9.930347 | 10.069653 | 10.118470 | 9.881530 | 30 | 18 |
| 43 | 45 | 9.811915 | 10.188085 | 9.930411 | 10.069589 | 10.118497 | 9.881503 | 15 | 17 |
| 44 | 26 | 9.811952 | 10.188048 | 9.930475 | 10.069525 | 10.118523 | 9.881477 | 34 | 16 |
| 45 | 15 | 9.811989 | 10.188011 | 9.930539 | 10.069461 | 10.118550 | 9.881450 | 45 | 15 |
| 46 | 30 | 9.812026 | 10.187974 | 9.930603 | 10.069397 | 10.118577 | 9.881423 | 30 | 14 |
| 47 | 45 | 9.812063 | 10.187937 | 9.930667 | 10.069333 | 10.118604 | 9.881396 | 15 | 13 |
| 48 | 27 | 9.812100 | 10.187900 | 9.930731 | 10.069269 | 10.118631 | 9.881369 | 33 | 12 |
| 49 | 15 | 9.812137 | 10.187863 | 9.930795 | 10.069205 | 10.118658 | 9.881342 | 45 | 11 |
| 50 | 30 | 9.812174 | 10.187826 | 9.930859 | 10.069141 | 10.118685 | 9.881315 | 30 | 10 |
| 51 | 45 | 9.812211 | 10.187789 | 9.930923 | 10.069077 | 10.118712 | 9.881288 | 15 | 9 |
| 52 | 28 | 9.812248 | 10.187752 | 9.930987 | 10.069013 | 10.118739 | 9.881261 | 32 | 8 |
| 53 | 15 | 9.812285 | 10.187715 | 9.931051 | 10.068949 | 10.118766 | 9.881234 | 45 | 7 |
| 54 | 30 | 9.812322 | 10.187678 | 9 931115 | 10.068885 | 10.118793 | 9.881207 | 30 | 6 |
| 55 | 45 | 9.812359 | 10.187641 | 9.931179 | 10.068821 | 10.118820 | 9.881180 | 15 | 5 |
| 56 | 29 | 9.812396 | 10.187604 | 9.931243 | 10.068757 | 10.118847 | 9.881153 | 31 | 4 |
| 57 | 15 | 9.812433 | 10.187567 | 9.931307 | 10.068693 | 10.118874 | 9.881126 | 45 | 3 |
| 58 | 30 | 9.812470 | 10.187530 | 9.931371 | 10.068629 | 10.118901 | 9.881099 | 30 | 2 |
| 59 | 45 | 9.812507 | 10.187493 | 9.931435 | 10.068565 | 10.118928 | 9.881072 | 15 | 1 |
| 60 | 30 | 9.812544 | 10.187456 | 9.931499 | 10.068501 | 10.118955 | 9.881045 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 18m. | | | LOG. SINES, &c. | | | | 49 deg. | | |

| 2h 42m. | | | LOG. SINES, &c. (t.) | | | | 40 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.812544 | 10.187456 | 9.931499 | 10.068501 | 10.118955 | 9.881045 | 30 | 00 |
| 1 | 15 | 9.812581 | 10.187419 | 9.931563 | 10.068437 | 10.118982 | 9.881018 | 45 | 59 |
| 2 | 30 | 9.812618 | 10.187382 | 9.931627 | 10.068373 | 10.119008 | 9.880992 | 30 | 58 |
| 3 | 45 | 9.812655 | 10.187345 | 9.931691 | 10.068309 | 10.119035 | 9.880965 | 15 | 57 |
| 4 | 31 | 9.812692 | 10.187308 | 9.931755 | 10.068245 | 10.119062 | 9.880938 | 29 | 56 |
| 5 | 15 | 9.812729 | 10.187271 | 9.931819 | 10.068181 | 10.119089 | 9.880911 | 45 | 55 |
| 6 | 30 | 9.812766 | 10.187234 | 9.931883 | 10.068117 | 10.119116 | 9.880884 | 30 | 54 |
| 7 | 45 | 9.812803 | 10.187197 | 9.931946 | 10.068054 | 10.119143 | 9.880857 | 15 | 53 |
| 8 | 32 | 9.812840 | 10.187160 | 9.932010 | 10.067990 | 10.119170 | 9.880830 | 28 | 52 |
| 9 | 15 | 9.812877 | 10.187123 | 9.932074 | 10.067926 | 10.119197 | 9.880803 | 45 | 51 |
| 10 | 30 | 9.812914 | 10.187086 | 9.932138 | 10.067862 | 10.119224 | 9.880776 | 30 | 50 |
| 11 | 45 | 9.812951 | 10.187049 | 9.932202 | 10.067798 | 10.119251 | 9.880749 | 15 | 49 |
| 12 | 33 | 9.812988 | 10.187012 | 9.932266 | 10.067734 | 10.119279 | 9.880721 | 27 | 48 |
| 13 | 15 | 9.813025 | 10.186975 | 9.932330 | 10.067670 | 10.119306 | 9.880694 | 45 | 47 |
| 14 | 30 | 9.813062 | 10.186938 | 9.932394 | 10.067606 | 10.119333 | 9.880667 | 30 | 46 |
| 15 | 45 | 9.813098 | 10.186902 | 9.932458 | 10.067542 | 10.119360 | 9.880640 | 15 | 45 |
| 16 | 34 | 9.813135 | 10.186865 | 9.932522 | 10.067478 | 10.119387 | 9.880613 | 26 | 44 |
| 17 | 15 | 9.813172 | 10.186828 | 9.932586 | 10.067414 | 10.119414 | 9.880586 | 45 | 43 |
| 18 | 30 | 9.813209 | 10.186791 | 9.932650 | 10.067350 | 10.119441 | 9.880559 | 30 | 42 |
| 19 | 45 | 9.813246 | 10.186754 | 9.932714 | 10.067286 | 10.119468 | 9.880532 | 15 | 41 |
| 20 | 35 | 9.813283 | 10.186717 | 9.932778 | 10.067222 | 10.119495 | 9.880505 | 25 | 40 |
| 21 | 15 | 9.813320 | 10.186680 | 9.932842 | 10.067158 | 10.119522 | 9.880478 | 45 | 39 |
| 22 | 30 | 9.813357 | 10.186643 | 9.932905 | 10.067095 | 10.119549 | 9.880451 | 30 | 38 |
| 23 | 45 | 9.813393 | 10.186607 | 9.932969 | 10.067031 | 10.119576 | 9.880424 | 15 | 37 |
| 24 | 36 | 9.813430 | 10.186570 | 9.933033 | 10.066967 | 10.119603 | 9.880397 | 24 | 36 |
| 25 | 15 | 9.813467 | 10.186533 | 9.933097 | 10.066903 | 10.119630 | 9.880370 | 45 | 35 |
| 26 | 30 | 9.813504 | 10.186496 | 9.933161 | 10.066839 | 10.119657 | 9.880343 | 30 | 34 |
| 27 | 45 | 9.813541 | 10.186459 | 9.933225 | 10.066775 | 10.119684 | 9.880316 | 15 | 33 |
| 28 | 37 | 9.813578 | 10.186422 | 9.933289 | 10.066711 | 10.119711 | 9.880289 | 23 | 32 |
| 29 | 15 | 9.813614 | 10.186386 | 9.933353 | 10.066647 | 10.119738 | 9.880262 | 45 | 31 |
| 30 | 30 | 9.813651 | 10.186349 | 9.933417 | 10.066583 | 10.119766 | 9.880234 | 30 | 30 |
| 31 | 45 | 9.813688 | 10.186312 | 9.933481 | 10.066519 | 10.119793 | 9.880207 | 15 | 29 |
| 32 | 38 | 9.813725 | 10.186275 | 9.933545 | 10.066455 | 10.119820 | 9.880180 | 22 | 28 |
| 33 | 15 | 9.813762 | 10.186238 | 9.933609 | 10.066391 | 10.119847 | 9.880153 | 45 | 27 |
| 34 | 30 | 9.813799 | 10.186201 | 9.933672 | 10.066328 | 10.119874 | 9.880126 | 30 | 26 |
| 35 | 45 | 9.813835 | 10.186165 | 9.933736 | 10.066264 | 10.119901 | 9.880099 | 15 | 25 |
| 36 | 39 | 9.813872 | 10.186128 | 9.933800 | 10.066200 | 10.119928 | 9.880072 | 21 | 24 |
| 37 | 15 | 9.813909 | 10.186091 | 9.933864 | 10.066136 | 10.119955 | 9.880045 | 45 | 23 |
| 38 | 30 | 9.813946 | 10.186054 | 9.933928 | 10.066072 | 10.119982 | 9.880018 | 30 | 22 |
| 39 | 45 | 9.813982 | 10.186018 | 9.933992 | 10.066008 | 10.120010 | 9.879990 | 15 | 21 |
| 40 | 40 | 9.814019 | 10.185981 | 9.934056 | 10.065944 | 10.120037 | 9.879963 | 20 | 20 |
| 41 | 15 | 9.814056 | 10.185944 | 9.934120 | 10.065880 | 10.120064 | 9.879936 | 45 | 19 |
| 42 | 30 | 9.814093 | 10.185907 | 9.934184 | 10.065816 | 10.120091 | 9.879909 | 30 | 18 |
| 43 | 45 | 9.814129 | 10.185871 | 9.934247 | 10.065753 | 10.120118 | 9.879882 | 15 | 17 |
| 44 | 41 | 9.814166 | 10.185834 | 9.934311 | 10.065689 | 10.120145 | 9.879855 | 19 | 16 |
| 45 | 15 | 9.814203 | 10.185797 | 9.934375 | 10.065625 | 10.120172 | 9.879828 | 45 | 15 |
| 46 | 30 | 9.814240 | 10.185760 | 9.934439 | 10.065561 | 10.120200 | 9.879800 | 30 | 14 |
| 47 | 45 | 9.814276 | 10.185724 | 9.934503 | 10.065497 | 10.120227 | 9.879773 | 15 | 13 |
| 48 | 42 | 9.814313 | 10.185687 | 9.934567 | 10.065433 | 10.120254 | 9.879746 | 18 | 12 |
| 49 | 15 | 9.814350 | 10.185650 | 9.934631 | 10.065369 | 10.120281 | 9.879719 | 45 | 11 |
| 50 | 30 | 9.814387 | 10.185613 | 9.934695 | 10.065305 | 10.120308 | 9.879692 | 30 | 10 |
| 51 | 45 | 9.814423 | 10.185577 | 9.934759 | 10.065241 | 10.120335 | 9.879665 | 15 | 9 |
| 52 | 43 | 9.814460 | 10.185540 | 9.934822 | 10.065178 | 10.120363 | 9.879637 | 17 | 8 |
| 53 | 15 | 9.814497 | 10.185503 | 9.934886 | 10.065114 | 10.120390 | 9.879610 | 45 | 7 |
| 54 | 30 | 9.814533 | 10.185467 | 9.934950 | 10.065050 | 10.120417 | 9.879583 | 30 | 6 |
| 55 | 45 | 9.814570 | 10.185430 | 9.935014 | 10.064986 | 10.120444 | 9.879556 | 15 | 5 |
| 56 | 44 | 9.814607 | 10.185393 | 9.935078 | 10.064922 | 10.120471 | 9.879529 | 16 | 4 |
| 57 | 15 | 9.814643 | 10.185357 | 9.935142 | 10.064858 | 10.120499 | 9.879501 | 45 | 3 |
| 58 | 30 | 9.814680 | 10.185320 | 9.935206 | 10.064794 | 10.120526 | 9.879474 | 30 | 2 |
| 59 | 45 | 9.814717 | 10.185283 | 9.935270 | 10.064730 | 10.120553 | 9.879447 | 15 | 1 |
| 60 | 45 | 9.814753 | 10.185247 | 9.935333 | 10.064667 | 10.120580 | 9.879420 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 17m. | LOG. SINES, &c. | 49 deg. |
|---|---|---|

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | $2^h\ 43^m$. | | LOG. SINES, &c. (t.) | | | | | 40 deg | |
| 0 | 45 | 9.814753 | 10.185247 | 9.935333 | 10.064667 | 10.120580 | 9.879420 | 15 | 60 |
| 1 | 15 | 9.814790 | 10.185210 | 9.935397 | 10.064603 | 10.120607 | 9.879393 | 45 | 59 |
| 2 | 30 | 9.814827 | 10.185173 | 9.935461 | 10.064539 | 10.120635 | 9.879365 | 30 | 58 |
| 3 | 45 | 9.814863 | 10.185137 | 9.935525 | 10.064475 | 10.120662 | 9.879338 | 15 | 57 |
| 4 | 46 | 9.814900 | 10.185100 | 9.935589 | 10.064411 | 10.120689 | 9.879311 | 14 | 56 |
| 5 | 15 | 9.814937 | 10.185063 | 9.935653 | 10.064347 | 10.120716 | 9.879284 | 45 | 55 |
| 6 | 30 | 9.814973 | 10.185027 | 9.935717 | 10.064283 | 10.120744 | 9.879256 | 30 | 54 |
| 7 | 45 | 9.815010 | 10.184990 | 9.935780 | 10.064220 | 10.120771 | 9.879229 | 15 | 53 |
| 8 | 47 | 9.815046 | 10.184954 | 9.935844 | 10.064156 | 10.120798 | 9.879202 | 13 | 52 |
| 9 | 15 | 9.815083 | 10.184917 | 9.935908 | 10.064092 | 10.120825 | 9.879175 | 45 | 51 |
| 10 | 30 | 9.815120 | 10.184880 | 9.935972 | 10.064028 | 10.120852 | 9.879148 | 30 | 50 |
| 11 | 45 | 9.815156 | 10.184844 | 9.936036 | 10.063964 | 10.120880 | 9.879120 | 15 | 49 |
| 12 | 48 | 9.815193 | 10.184807 | 9.936100 | 10.063900 | 10.120907 | 9.879093 | 12 | 48 |
| 13 | 15 | 9.815229 | 10.184771 | 9.936164 | 10.063836 | 10.120934 | 9.879066 | 45 | 47 |
| 14 | 30 | 9.815266 | 10.184734 | 9.936227 | 10.063773 | 10.120962 | 9.879038 | 30 | 46 |
| 15 | 45 | 9.815303 | 10.184697 | 9.936291 | 10.063709 | 10.120989 | 9.879011 | 15 | 45 |
| 16 | 49 | 9.815339 | 10.184661 | 9.936355 | 10.063645 | 10.121016 | 9.878984 | 11 | 44 |
| 17 | 15 | 9.815376 | 10.184624 | 9.936419 | 10.063581 | 10.121043 | 9.878957 | 45 | 43 |
| 18 | 30 | 9.815412 | 10.184588 | 9.936483 | 10.063517 | 10.121071 | 9.878929 | 30 | 42 |
| 19 | 45 | 9.815449 | 10.184551 | 9.936547 | 10.063453 | 10.121098 | 9.878902 | 15 | 41 |
| 20 | 50 | 9.815485 | 10.184515 | 9.936610 | 10.063390 | 10.121125 | 9.878875 | 10 | 40 |
| 21 | 15 | 9.815522 | 10.184478 | 9.936674 | 10.063326 | 10.121153 | 9.878847 | 45 | 39 |
| 22 | 30 | 9.815558 | 10.184442 | 9.936738 | 10.063262 | 10.121180 | 9.878820 | 30 | 38 |
| 23 | 45 | 9.815595 | 10.184405 | 9.936802 | 10.063198 | 10.121207 | 9.878793 | 15 | 37 |
| 24 | 51 | 9.815631 | 10.184369 | 9.936866 | 10.063134 | 10.121234 | 9.878766 | 9 | 36 |
| 25 | 15 | 9.815668 | 10 184332 | 9.936930 | 10.063070 | 10.121262 | 9.878738 | 45 | 35 |
| 26 | 30 | 9.815704 | 10.184296 | 9.936994 | 10.063006 | 10.121289 | 9.878711 | 30 | 34 |
| 27 | 45 | 9.815741 | 10.184259 | 9.937057 | 10.062943 | 10.121316 | 9.878684 | 15 | 33 |
| 28 | 52 | 9.815778 | 10.184222 | 9.937121 | 10.062879 | 10.121344 | 9.878656 | 8 | 32 |
| 29 | 15 | 9.815814 | 10.184186 | 9.937185 | 10.062815 | 10.121371 | 9.878629 | 45 | 31 |
| 30 | 30 | 9.815851 | 10.184149 | 9.937249 | 10.062751 | 10.121398 | 9.878602 | 30 | 30 |
| 31 | 45 | 9.815887 | 10.184113 | 9.937313 | 10.062687 | 10.121426 | 9.878574 | 15 | 29 |
| 32 | 53 | 9.815923 | 10.184077 | 9.937376 | 10.062624 | 10.121453 | 9.878547 | 7 | 28 |
| 33 | 15 | 9.815960 | 10.184040 | 9.937440 | 10.062560 | 10.121480 | 9.878520 | 45 | 27 |
| 34 | 30 | 9.815996 | 10.184004 | 9.937504 | 10.062496 | 10.121508 | 9.878492 | 30 | 26 |
| 35 | 45 | 9.816033 | 10.183967 | 9.937568 | 10.062432 | 10.121535 | 9.878465 | 15 | 25 |
| 36 | 54 | 9.816069 | 10.183931 | 9.937632 | 10.062368 | 10.121562 | 9.878438 | 6 | 24 |
| 37 | 15 | 9.816106 | 10.183894 | 9.937696 | 10.062304 | 10.121590 | 9.878410 | 45 | 23 |
| 38 | 30 | 9.816142 | 10.183858 | 9.937759 | 10.062241 | 10.121617 | 9.878383 | 30 | 22 |
| 39 | 45 | 9.816179 | 10.183821 | 9.937823 | 10.062177 | 10.121645 | 9 878355 | 15 | 21 |
| 40 | 55 | 9.816215 | 10.183785 | 9.937887 | 10.062113 | 10.121672 | 9.878328 | 5 | 20 |
| 41 | 15 | 9.816252 | 10.183748 | 9.937951 | 10.062049 | 10.121699 | 9.878301 | 45 | 19 |
| 42 | 30 | 9.816288 | 10.183712 | 9.938015 | 10.061985 | 10.121727 | 9.878273 | 30 | 18 |
| 43 | 45 | 9.816324 | 10.183676 | 9.938078 | 10.061922 | 10.121754 | 9.878246 | 15 | 17 |
| 44 | 56 | 9.816361 | 10.183639 | 9.938142 | 10.061858 | 10.121781 | 9.878219 | 4 | 16 |
| 45 | 15 | 9.816397 | 10.183603 | 9.938206 | 10.061794 | 10.121809 | 9.878191 | 45 | 15 |
| 46 | 30 | 9.816434 | 10.183566 | 9.938270 | 10.061730 | 10.121836 | 9.878164 | 30 | 14 |
| 47 | 45 | 9.816470 | 10.183530 | 9.938334 | 10.061666 | 10.121864 | 9.878136 | 15 | 13 |
| 48 | 57 | 9.816507 | 10.183493 | 9.938397 | 10.061603 | 10.121891 | 9.878109 | 3 | 12 |
| 49 | 15 | 9.816543 | 10.183457 | 9.938461 | 10.061539 | 10.121918 | 9.878082 | 45 | 11 |
| 50 | 30 | 9 816579 | 10.183421 | 9.938525 | 10.061475 | 10.121946 | 9.878054 | 30 | 10 |
| 51 | 45 | 9.816616 | 10.183384 | 9.938589 | 10.061411 | 10.121973 | 9.878027 | 15 | 9 |
| 52 | 58 | 9.816652 | 10.183348 | 9.938653 | 10.061347 | 10.122001 | 9.877999 | 2 | 8 |
| 53 | 15 | 9.816688 | 10.183312 | 9.938716 | 10.061284 | 10.122028 | 9.877972 | 45 | 7 |
| 54 | 30 | 9.816725 | 10.183275 | 9.938780 | 10.061220 | 10.122056 | 9.877944 | 30 | 6 |
| 55 | 45 | 9.816761 | 10.183239 | 9.938844 | 10.061156 | 10.122083 | 9.877917 | 15 | 5 |
| 56 | 59 | 9.816797 | 10.183203 | 9.938908 | 10.061092 | 10.122110 | 9.877890 | 1 | 4 |
| 57 | 15 | 9.816834 | 10.183166 | 9.938972 | 10.061028 | 10.122138 | 9.877862 | 45 | 3 |
| 58 | 30 | 9.816870 | 10.183130 | 9.939035 | 10.060965 | 10.122165 | 9.877835 | 30 | 2 |
| 59 | 45 | 9.816907 | 10.183093 | 9.939099 | 10.060901 | 10.122193 | 9.877807 | 15 | 1 |
| 60 | 60 | 9.816943 | 10.183057 | 9.939163 | 10.060837 | 10.122220 | 9.877780 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | $3^h\ 16^m$. | | LOG. SINES, &c. | | | | | 49 deg. | |

| 2h 44m | | | LOG. SINES, &c. (t.) | | | | 41 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.816943 | 10.183057 | 9.939163 | 10.060837 | 10.122220 | 9.877780 | 60 | 60 |
| 1 | 15 | 9.816979 | 10.183021 | 9.939227 | 10.060773 | 10.122248 | 9.877752 | 45 | 59 |
| 2 | 30 | 9.817016 | 10.182984 | 9.939291 | 10.060709 | 10.122275 | 9.877725 | 30 | 58 |
| 3 | 45 | 9.817052 | 10.182948 | 9.939354 | 10.060646 | 10.122303 | 9.877697 | 15 | 57 |
| 4 | 1 | 9.817088 | 10.182912 | 9.939418 | 10.060582 | 10.122330 | 9.877670 | 59 | 56 |
| 5 | 15 | 9.817124 | 10.182876 | 9.939482 | 10.060518 | 10.122358 | 9.877642 | 45 | 55 |
| 6 | 30 | 9.817161 | 10.182839 | 9.939546 | 10.060454 | 10.122385 | 9.877615 | 30 | 54 |
| 7 | 45 | 9.817197 | 10.182803 | 9.939609 | 10.060391 | 10.122412 | 9.877588 | 15 | 53 |
| 8 | 2 | 9.817233 | 10.182767 | 9.939673 | 10.060327 | 10.122440 | 9.877560 | 58 | 52 |
| 9 | 15 | 9.817270 | 10.182730 | 9.939737 | 10.060263 | 10.122467 | 9.877533 | 45 | 51 |
| 10 | 30 | 9.817306 | 10.182694 | 9.939801 | 10.060199 | 10.122495 | 9.877505 | 30 | 50 |
| 11 | 45 | 9.817342 | 10.182658 | 9.939865 | 10.060135 | 10.122522 | 9.877478 | 15 | 49 |
| 12 | 3 | 9.817378 | 10.182622 | 9.939928 | 10.060072 | 10.122550 | 9.877450 | 57 | 48 |
| 13 | 15 | 9.817415 | 10.182585 | 9.939992 | 10.060008 | 10.122577 | 9.877423 | 45 | 47 |
| 14 | 30 | 9.817451 | 10.182549 | 9.940056 | 10.059944 | 10.122605 | 9.877395 | 30 | 46 |
| 15 | 45 | 9.817487 | 10.182513 | 9.940120 | 10.059880 | 10.122632 | 9.877368 | 15 | 45 |
| 16 | 4 | 9.817523 | 10.182477 | 9.940183 | 10.059817 | 10.122660 | 9.877340 | 56 | 44 |
| 17 | 15 | 9.817560 | 10.182440 | 9.940247 | 10.059753 | 10.122687 | 9.877313 | 45 | 43 |
| 18 | 30 | 9.817596 | 10.182404 | 9.940311 | 10.059689 | 10.122715 | 9.877285 | 30 | 42 |
| 19 | 45 | 9.817632 | 10.182368 | 9.940375 | 10.059625 | 10.122743 | 9.877257 | 15 | 41 |
| 20 | 5 | 9.817668 | 10.182332 | 9.940438 | 10.059562 | 10.122770 | 9.877230 | 55 | 40 |
| 21 | 15 | 9.817705 | 10.182295 | 9.940502 | 10.059498 | 10.122798 | 9.877202 | 45 | 39 |
| 22 | 30 | 9.817741 | 10.182259 | 9.940566 | 10.059434 | 10.122825 | 9.877175 | 30 | 38 |
| 23 | 45 | 9.817777 | 10.182223 | 9.940630 | 10.059370 | 10.122853 | 9.877147 | 15 | 37 |
| 24 | 6 | 9.817813 | 10.182187 | 9.940694 | 10.059306 | 10.122880 | 9.877120 | 54 | 36 |
| 25 | 15 | 9.817849 | 10.182151 | 9.940757 | 10.059243 | 10.122908 | 9.877092 | 45 | 35 |
| 26 | 30 | 9.817886 | 10.182114 | 9.940821 | 10.059179 | 10.122935 | 9.877065 | 30 | 34 |
| 27 | 45 | 9.817922 | 10.182078 | 9.940885 | 10.059115 | 10.122963 | 9.877037 | 15 | 33 |
| 28 | 7 | 9.817958 | 10.182042 | 9.940949 | 10.059051 | 10.122990 | 9.877010 | 53 | 32 |
| 29 | 15 | 9.817994 | 10.182006 | 9.941012 | 10.058988 | 10.123018 | 9.876982 | 45 | 31 |
| 30 | 30 | 9.818030 | 10.181970 | 9.941076 | 10.058924 | 10.123046 | 9.876954 | 30 | 30 |
| 31 | 45 | 9.818067 | 10.181933 | 9.941140 | 10.058860 | 10.123073 | 9.876927 | 15 | 29 |
| 32 | 8 | 9.818103 | 10.181897 | 9.941204 | 10.058796 | 10.123101 | 9.876899 | 52 | 28 |
| 33 | 15 | 9.818139 | 10.181861 | 9.941267 | 10.058733 | 10.123128 | 9.876872 | 45 | 27 |
| 34 | 30 | 9.818175 | 10.181825 | 9.941331 | 10.058669 | 10.123156 | 9.876844 | 30 | 26 |
| 35 | 45 | 9.818211 | 10.181789 | 9.941395 | 10.058605 | 10.123184 | 9.876816 | 15 | 25 |
| 36 | 9 | 9.818247 | 10.181753 | 9.941458 | 10.058542 | 10.123211 | 9.876789 | 51 | 24 |
| 37 | 15 | 9.818283 | 10.181717 | 9.941522 | 10.058478 | 10.123239 | 9.876761 | 45 | 23 |
| 38 | 30 | 9.818320 | 10.181680 | 9.941586 | 10.058414 | 10.123266 | 9.876734 | 30 | 22 |
| 39 | 45 | 9.818356 | 10.181644 | 9.941650 | 10.058350 | 10.123294 | 9.876706 | 15 | 21 |
| 40 | 10 | 9.818392 | 10.181608 | 9.941713 | 10.058287 | 10.123322 | 9.876678 | 50 | 20 |
| 41 | 15 | 9.818428 | 10.181572 | 9.941777 | 10.058223 | 10.123349 | 9.876651 | 45 | 19 |
| 42 | 30 | 9.818464 | 10.181536 | 9.941841 | 10.058159 | 10.123377 | 9.876623 | 30 | 18 |
| 43 | 45 | 9.818500 | 10.181500 | 9.941905 | 10.058095 | 10.123404 | 9.876596 | 15 | 17 |
| 44 | 11 | 9.818536 | 10.181464 | 9.941968 | 10.058032 | 10.123432 | 9.876568 | 49 | 16 |
| 45 | 15 | 9.818572 | 10.181428 | 9.942032 | 10.057968 | 10.123460 | 9.876540 | 45 | 15 |
| 46 | 30 | 9.818609 | 10.181391 | 9.942096 | 10.057904 | 10.123487 | 9.876513 | 30 | 14 |
| 47 | 45 | 9.818645 | 10.181355 | 9.942160 | 10.057840 | 10.123515 | 9.876485 | 15 | 13 |
| 48 | 12 | 9.818681 | 10.181319 | 9.942223 | 10.057777 | 10.123543 | 9.876457 | 48 | 12 |
| 49 | 15 | 9.818717 | 10.181283 | 9.942287 | 10.057713 | 10.123570 | 9.876430 | 45 | 11 |
| 50 | 30 | 9.818753 | 10.181247 | 9.942351 | 10.057649 | 10.123598 | 9.876402 | 30 | 10 |
| 51 | 45 | 9.818789 | 10.181211 | 9.942414 | 10.057586 | 10.123626 | 9.876374 | 15 | 9 |
| 52 | 13 | 9.818825 | 10.181175 | 9.942478 | 10.057522 | 10.123653 | 9.876347 | 47 | 8 |
| 53 | 15 | 9.818861 | 10.181139 | 9.942542 | 10.057458 | 10.123681 | 9.876319 | 45 | 7 |
| 54 | 30 | 9.818897 | 10.181103 | 9.942606 | 10.057394 | 10.123709 | 9.876291 | 30 | 6 |
| 55 | 45 | 9.818933 | 10.181067 | 9.942669 | 10.057331 | 10.123736 | 9.876264 | 15 | 5 |
| 56 | 14 | 9.818969 | 10.181031 | 9.942733 | 10.057267 | 10.123764 | 9.876236 | 46 | 4 |
| 57 | 15 | 9.819005 | 10.180995 | 9.942797 | 10.057203 | 10.123792 | 9.876208 | 45 | 3 |
| 58 | 30 | 9.819041 | 10.180959 | 9.942860 | 10.057140 | 10.123819 | 9.876181 | 30 | 2 |
| 59 | 45 | 9.819077 | 10.180923 | 9.942924 | 10.057076 | 10.123847 | 9.876153 | 15 | 1 |
| 60 | 15 | 9.819113 | 10.180887 | 9.942988 | 10.057012 | 10.123875 | 9.876125 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 15m. | LOG. SINES, &c. | 48 deg. |
|---|---|---|

| 2h 45m. | | | | LOG. SINES, &c. (t.) | | | 41 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ′ | sec. |
| 0 | 15 | 9.819113 | 10.180887 | 9.942988 | 10.057012 | 10.123875 | 9.876125 | 45 | 60 |
| 1 | 15 | 9.819149 | 10.180851 | 9.943052 | 10.056948 | 10.123902 | 9.876098 | 45 | 59 |
| 2 | 30 | 9.819185 | 10.180815 | 9.943115 | 10.056885 | 10.123930 | 9.876070 | 30 | 58 |
| 3 | 45 | 9.819221 | 10.180779 | 9.943179 | 10.056821 | 10.123958 | 9.876042 | 15 | 57 |
| 4 | 16 | 9.819257 | 10.180743 | 9.943243 | 10.056757 | 10.123986 | 9.876014 | 44 | 56 |
| 5 | 15 | 9.819293 | 10.180707 | 9.943306 | 10.056694 | 10.124013 | 9.875987 | 45 | 55 |
| 6 | 30 | 9.819329 | 10.180671 | 9.943370 | 10.056630 | 10.124041 | 9.875959 | 30 | 54 |
| 7 | 45 | 9.819365 | 10.180635 | 9.943434 | 10.056566 | 10.124069 | 9.875931 | 15 | 53 |
| 8 | 17 | 9.819401 | 10.180599 | 9.943498 | 10.056502 | 10.124096 | 9.875904 | 43 | 52 |
| 9 | 15 | 9.819437 | 10.180563 | 9.943561 | 10.056439 | 10 124124 | 9.875876 | 45 | 51 |
| 10 | 30 | 9.819473 | 10.180527 | 9.943625 | 10.056375 | 10.124152 | 9.875848 | 30 | 50 |
| 11 | 45 | 9.819509 | 10.180491 | 9.943689 | 10.056311 | 10.124180 | 9.875820 | 15 | 49 |
| 12 | 18 | 9.819545 | 10.180455 | 9.943752 | 10.056248 | 10.124207 | 9.875793 | 42 | 48 |
| 13 | 15 | 9.819581 | 10.180419 | 9.943816 | 10.056184 | 10.124235 | 9.875765 | 45 | 47 |
| 14 | 30 | 9.819617 | 10.180383 | 9.943880 | 10.056120 | 10.124263 | 9.875737 | 30 | 46 |
| 15 | 45 | 9.819653 | 10.180347 | 9.943943 | 10.056057 | 10.124291 | 9.875709 | 15 | 45 |
| 16 | 19 | 9.819689 | 10.180311 | 9.944007 | 10.055993 | 10.124318 | 9.875682 | 41 | 44 |
| 17 | 15 | 9.819725 | 10.180275 | 9.944071 | 10.055929 | 10.124346 | 9.875654 | 45 | 43 |
| 18 | 30 | 9.819761 | 10.180239 | 9.944134 | 10.055866 | 10.124374 | 9.875626 | 30 | 42 |
| 19 | 45 | 9.819797 | 10.180203 | 9.944198 | 10.055802 | 10.124402 | 9.875598 | 15 | 41 |
| 20 | 20 | 9.819832 | 10.180168 | 9.944262 | 10.055738 | 10.124429 | 9.875571 | 40 | 40 |
| 21 | 15 | 9.819868 | 10.180132 | 9.944326 | 10.055674 | 10.124457 | 9.875543 | 45 | 39 |
| 22 | 30 | 9.819904 | 10.180096 | 9.944389 | 10.055611 | 10.124485 | 9.875515 | 30 | 38 |
| 23 | 45 | 9.819940 | 10.180060 | 9.944453 | 10.055547 | 10.124513 | 9.875487 | 15 | 37 |
| 24 | 21 | 9.819976 | 10.180024 | 9.944517 | 10.055483 | 10.124541 | 9.875459 | 39 | 36 |
| 25 | 15 | 9.820012 | 10.179988 | 9.944580 | 10.055420 | 10.124568 | 9.875432 | 45 | 35 |
| 26 | 30 | 9.820048 | 10.179952 | 9.944644 | 10.055356 | 10 124596 | 9.875404 | 30 | 34 |
| 27 | 45 | 9.820084 | 10.179916 | 9.944708 | 10.055292 | 10..24624 | 9 875376 | 15 | 33 |
| 28 | 22 | 9.820120 | 10.179880 | 9.944771 | 10.055229 | 10.124652 | 9.875348 | 38 | 32 |
| 29 | 15 | 9.820155 | 10.179845 | 9.944835 | 10.055165 | 10.124680 | 9.875320 | 45 | 31 |
| 30 | 30 | 9.820191 | 10.179809 | 9.944899 | 10.055101 | 10.124707 | 9.875293 | 30 | 30 |
| 31 | 45 | 9.820227 | 10.179773 | 9.944962 | 10.055038 | 10.124735 | 9.875265 | 15 | 29 |
| 32 | 23 | 9.820263 | 10.179737 | 9.945026 | 10.054974 | 10.124763 | 9.875237 | 37 | 28 |
| 33 | 15 | 9.820299 | 10.179701 | 9.945090 | 10.054910 | 10.124791 | 9.875209 | 45 | 27 |
| 34 | 30 | 9.820335 | 10.179665 | 9.945153 | 10.054847 | 10.124819 | 9.875181 | 30 | 26 |
| 35 | 45 | 9.820370 | 10.179630 | 9.945217 | 10.054783 | 10.124847 | 9.875153 | 15 | 25 |
| 36 | 24 | 9.820406 | 10.179594 | 9.945281 | 10.054719 | 10.124874 | 9.875126 | 36 | 24 |
| 37 | 15 | 9.820442 | 10.179558 | 9.945344 | 10.054656 | 10.124902 | 9.875098 | 45 | 23 |
| 38 | 30 | 9.820478 | 10.179522 | 9.945408 | 10.054592 | 10.124930 | 9.875070 | 30 | 22 |
| 39 | 45 | 9.820514 | 10.179486 | 9.945472 | 10.054528 | 10.124958 | 9.875042 | 15 | 21 |
| 40 | 25 | 9.820550 | 10.179450 | 9.945535 | 10.054465 | 10.124986 | 9.875014 | 35 | 20 |
| 41 | 15 | 9.820585 | 10.179415 | 9.945599 | 10.054401 | 10.125014 | 9.874986 | 45 | 19 |
| 42 | 30 | 9.820621 | 10.179379 | 9.945663 | 10.054337 | 10.125042 | 9.874958 | 30 | 18 |
| 43 | 45 | 9.820657 | 10.179343 | 9.945726 | 10.054274 | 10.125069 | 9.874931 | 15 | 17 |
| 44 | 26 | 9.820693 | 10.179307 | 9.945790 | 10.054210 | 10.125097 | 9.874903 | 34 | 16 |
| 45 | 15 | 9.820728 | 10.179272 | 9.945854 | 10.054146 | 10.125125 | 9.874875 | 45 | 15 |
| 46 | 30 | 9.820764 | 10.179236 | 9.945917 | 10.054083 | 10.125153 | 9.874847 | 30 | 14 |
| 47 | 45 | 9.820800 | 10.179200 | 9.945981 | 10.054019 | 10.125181 | 9.874819 | 15 | 13 |
| 48 | 27 | 9.820836 | 10.179164 | 9.946045 | 10.053955 | 10.125209 | 9.874791 | 33 | 12 |
| 49 | 15 | 9.820872 | 10.179128 | 9.946108 | 10.053892 | 10.125237 | 9.874763 | 45 | 11 |
| 50 | 30 | 9.820907 | 10.179093 | 9.946172 | 10.053828 | 10.125265 | 9.874735 | 30 | 10 |
| 51 | 45 | 9.820943 | 10.179057 | 9.946236 | 10.053764 | 10.125293 | 9.874707 | 15 | 9 |
| 52 | 28 | 9.820979 | 10.179021 | 9.946299 | 10.053701 | 10.125321 | 9.874679 | 32 | 8 |
| 53 | 15 | 9.821015 | 10.178985 | 9.946363 | 10.053637 | 10.125348 | 9.874652 | 45 | 7 |
| 54 | 30 | 9.821050 | 10.178950 | 9.946427 | 10.053573 | 10.125376 | 9.874624 | 30 | 6 |
| 55 | 45 | 9.821086 | 10.178914 | 9.946490 | 10.053510 | 10.125404 | 9.874596 | 15 | 5 |
| 56 | 29 | 9.821122 | 10.178878 | 9.946554 | 10.053446 | 10.125432 | 9.874568 | 31 | 4 |
| 57 | 15 | 9.821157 | 10.178843 | 9.946617 | 10.053383 | 10.125460 | 9.874540 | 45 | 3 |
| 58 | 30 | 9.821193 | 10.178807 | 9.946681 | 10.053319 | 10.125488 | 9.874512 | 30 | 2 |
| 59 | 45 | 9.821229 | 10.178771 | 9.946745 | 10.053255 | 10.125516 | 9.874484 | 15 | 1 |
| 60 | 30 | 9.821265 | 10.178735 | 9.946808 | 10.053192 | 10.125544 | 9.874456 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ′ | sec. |

| 3h 14m. | LOG. SINES, &c. | 48 deg. |
|---|---|---|

| 2h 46m. | | | LOG. SINES, &c. (t.) | | | | 41 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.821265 | 10.178735 | 9.946808 | 10.053192 | 10.125544 | 9.874456 | 30 | 60 |
| 1 | 15 | 9.821300 | 10.178700 | 9.946872 | 10.053128 | 10.125572 | 9.874428 | 45 | 59 |
| 2 | 30 | 9.821336 | 10.178664 | 9.946936 | 10.053064 | 10.125600 | 9.874400 | 30 | 58 |
| 3 | 45 | 9.821372 | 10.178628 | 9.946999 | 10.053001 | 10.125628 | 9.874372 | 15 | 57 |
| 4 | 31 | 9.821407 | 10.178593 | 9.947063 | 10.052937 | 10.125656 | 9.874344 | 29 | 56 |
| 5 | 15 | 9.821443 | 10.178557 | 9.947127 | 10.052873 | 10.125684 | 9.874316 | 45 | 55 |
| 6 | 30 | 9.821479 | 10.178521 | 9.947190 | 10.052810 | 10.125712 | 9.874288 | 30 | 54 |
| 7 | 45 | 9.821514 | 10.178486 | 9.947254 | 10.052746 | 10.125740 | 9.874260 | 15 | 53 |
| 8 | 32 | 9.821550 | 10.178450 | 9.947317 | 10.052683 | 10.125768 | 9.874232 | 28 | 52 |
| 9 | 15 | 9.821586 | 10.178414 | 9.947381 | 10.052619 | 10.125796 | 9.874204 | 45 | 51 |
| 10 | 30 | 9.821621 | 10.178379 | 9.947445 | 10.052555 | 10.125824 | 9.874176 | 30 | 50 |
| 11 | 45 | 9.821657 | 10.178343 | 9.947508 | 10.052492 | 10.125852 | 9.874148 | 15 | 49 |
| 12 | 33 | 9.821693 | 10.178307 | 9.947572 | 10.052428 | 10.125880 | 9.874120 | 27 | 48 |
| 13 | 15 | 9.821728 | 10.178272 | 9.947636 | 10.052364 | 10.125908 | 9.874092 | 45 | 47 |
| 14 | 30 | 9.821764 | 10.178236 | 9.947699 | 10.052301 | 10.125935 | 9.874065 | 30 | 46 |
| 15 | 45 | 9.821799 | 10.178201 | 9.947763 | 10.052237 | 10.125963 | 9.874037 | 15 | 45 |
| 16 | 34 | 9.821835 | 10.178165 | 9.947826 | 10.052174 | 10.125992 | 9.874008 | 26 | 44 |
| 17 | 15 | 9.821871 | 10.178129 | 9.947890 | 10.052110 | 10.126020 | 9.873980 | 45 | 43 |
| 18 | 30 | 9.821906 | 10.178094 | 9.947954 | 10.052046 | 10.126048 | 9.873952 | 30 | 42 |
| 19 | 45 | 9.821942 | 10.178058 | 9.948017 | 10.051983 | 10.126076 | 9.873924 | 15 | 41 |
| 20 | 35 | 9.821977 | 10.178023 | 9.948081 | 10.051919 | 10.126104 | 9.873896 | 25 | 40 |
| 21 | 15 | 9.822013 | 10.177987 | 9.948145 | 10.051855 | 10.126132 | 9.873868 | 45 | 39 |
| 22 | 30 | 9.822049 | 10.177951 | 9.948208 | 10.051792 | 10.126160 | 9.873840 | 30 | 38 |
| 23 | 45 | 9.822084 | 10.177916 | 9.948272 | 10.051728 | 10.126188 | 9.873812 | 15 | 37 |
| 24 | 36 | 9.822120 | 10.177880 | 9.948335 | 10.051665 | 10.126216 | 9.873784 | 24 | 36 |
| 25 | 15 | 9.822155 | 10.177845 | 9.948399 | 10.051601 | 10.126244 | 9.873756 | 45 | 35 |
| 26 | 30 | 9.822191 | 10.177809 | 9.948463 | 10.051537 | 10.126272 | 9.873728 | 30 | 34 |
| 27 | 45 | 9.822226 | 10.177774 | 9.948526 | 10.051474 | 10.126300 | 9.873700 | 15 | 33 |
| 28 | 37 | 9.822262 | 10.177738 | 9.948590 | 10.051410 | 10.126328 | 9.873672 | 23 | 32 |
| 29 | 15 | 9.822298 | 10.177702 | 9.948653 | 10.051347 | 10.126356 | 9.873644 | 45 | 31 |
| 30 | 30 | 9.822333 | 10.177667 | 9.948717 | 10.051283 | 10.126384 | 9.873616 | 30 | 30 |
| 31 | 45 | 9.822369 | 10.177631 | 9.948781 | 10.051219 | 10.126412 | 9.873588 | 15 | 29 |
| 32 | 38 | 9.822404 | 10.177596 | 9.948844 | 10.051156 | 10.126440 | 9.873560 | 22 | 28 |
| 33 | 15 | 9.822440 | 10.177560 | 9.948908 | 10.051092 | 10.126468 | 9.873532 | 45 | 27 |
| 34 | 30 | 9.822475 | 10.177525 | 9.948971 | 10.051029 | 10.126496 | 9.873504 | 30 | 26 |
| 35 | 45 | 9.822511 | 10.177489 | 9.949035 | 10.050965 | 10.126524 | 9.873476 | 15 | 25 |
| 36 | 39 | 9.822546 | 10.177454 | 9.949099 | 10.050901 | 10.126552 | 9.873448 | 21 | 24 |
| 37 | 15 | 9.822582 | 10.177418 | 9.949162 | 10.050838 | 10.126581 | 9.873419 | 45 | 23 |
| 38 | 30 | 9.822617 | 10.177383 | 9.949226 | 10.050774 | 10.126609 | 9.873391 | 30 | 22 |
| 39 | 45 | 9.822653 | 10.177347 | 9.949289 | 10.050711 | 10.126637 | 9.873363 | 15 | 21 |
| 40 | 40 | 9.822688 | 10.177312 | 9.949353 | 10.050647 | 10.126665 | 9.873335 | 20 | 20 |
| 41 | 15 | 9.822724 | 10.177276 | 9.949417 | 10.050583 | 10.126693 | 9.873307 | 45 | 19 |
| 42 | 30 | 9.822759 | 10.177241 | 9.949480 | 10.050520 | 10.126721 | 9.873279 | 30 | 18 |
| 43 | 45 | 9.822795 | 10.177205 | 9.949544 | 10.050456 | 10.126749 | 9.873251 | 15 | 17 |
| 44 | 41 | 9.822830 | 10.177170 | 9.949607 | 10.050393 | 10.126777 | 9.873223 | 19 | 16 |
| 45 | 15 | 9.822866 | 10.177134 | 9.949671 | 10.050329 | 10.126805 | 9.873195 | 45 | 15 |
| 46 | 30 | 9.822901 | 10.177099 | 9.949735 | 10.050265 | 10.126834 | 9.873166 | 30 | 14 |
| 47 | 45 | 9.822937 | 10.177063 | 9.949798 | 10.050202 | 10.126862 | 9.873138 | 15 | 13 |
| 48 | 42 | 9.822972 | 10.177028 | 9.949862 | 10.050138 | 10.126890 | 9.873110 | 18 | 12 |
| 49 | 15 | 9.823007 | 10.176993 | 9.949925 | 10.050075 | 10.126918 | 9.873082 | 45 | 11 |
| 50 | 30 | 9.823043 | 10.176957 | 9.949989 | 10.050011 | 10.126946 | 9.873054 | 30 | 10 |
| 51 | 45 | 9.823078 | 10.176922 | 9.950053 | 10.049947 | 10.126974 | 9.873026 | 15 | 9 |
| 52 | 43 | 9.823114 | 10.176886 | 9.950116 | 10.049884 | 10.127002 | 9.872998 | 17 | 8 |
| 53 | 15 | 9.823149 | 10.176851 | 9.950180 | 10.049820 | 10.127031 | 9.872969 | 45 | 7 |
| 54 | 30 | 9.823185 | 10.176815 | 9.950243 | 10.049757 | 10.127059 | 9.872941 | 30 | 6 |
| 55 | 45 | 9.823220 | 10.176780 | 9.950307 | 10.049693 | 10.127087 | 9.872913 | 15 | 5 |
| 56 | 44 | 9.823255 | 10.176745 | 9.950370 | 10.049630 | 10.127115 | 9.872885 | 16 | 4 |
| 57 | 15 | 9.823291 | 10.176709 | 9.950434 | 10.049566 | 10.127143 | 9.872857 | 45 | 3 |
| 58 | 30 | 9.823326 | 10.176674 | 9.950498 | 10.049502 | 10.127171 | 9.872829 | 30 | 2 |
| 59 | 45 | 9.823362 | 10.176638 | 9.950561 | 10.049439 | 10.127200 | 9.872800 | 15 | 1 |
| 60 | 45 | 9.823397 | 10.176603 | 9.950625 | 10.049375 | 10.127228 | 9.872772 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 2h 47m. | | LOG. SINES, &c. (t.) | | | | 41 deg | | |
| 0 | 45 | 9.823397 | 10.176603 | 9.950625 | 10.049375 | 10.127228 | 9.872772 | 15 | 60 |
| 1 | 15 | 9.823432 | 10.176568 | 9.950688 | 10.049312 | 10.127256 | 9.872744 | 45 | 59 |
| 2 | 30 | 9.823468 | 10.176532 | 9.950752 | 10.049248 | 10.127284 | 9.872716 | 30 | 58 |
| 3 | 45 | 9.823503 | 10.176497 | 9.950815 | 10.049185 | 10.127312 | 9.872688 | 15 | 57 |
| 4 | 46 | 9.823539 | 10.176461 | 9.950879 | 10.049121 | 10.127341 | 9.872659 | 14 | 56 |
| 5 | 15 | 9.823574 | 10.176426 | 9.950943 | 10.049057 | 10.127369 | 9.872631 | 45 | 55 |
| 6 | 30 | 9.823609 | 10.176391 | 9.951006 | 10.048994 | 10.127397 | 9.872603 | 30 | 54 |
| 7 | 45 | 9.823645 | 10.176355 | 9.951070 | 10.048930 | 10.127425 | 9.872575 | 15 | 53 |
| 8 | 47 | 9.823680 | 10.176320 | 9.951133 | 10.048867 | 10.127453 | 9.872547 | 13 | 52 |
| 9 | 15 | 9.823715 | 10.176285 | 9.951197 | 10.048803 | 10.127482 | 9.872518 | 45 | 51 |
| 10 | 30 | 9.823751 | 10.176249 | 9.951260 | 10.048740 | 10.127510 | 9.872490 | 30 | 50 |
| 11 | 45 | 9.823786 | 10.176214 | 9.951324 | 10.048676 | 10.127538 | 9.872462 | 15 | 49 |
| 12 | 48 | 9.823821 | 10.176179 | 9.951388 | 10.048612 | 10.127566 | 9.872434 | 12 | 48 |
| 13 | 15 | 9.823857 | 10.176143 | 9.951451 | 10.048549 | 10.127595 | 9.872405 | 45 | 47 |
| 14 | 30 | 9.823892 | 10.176108 | 9.951515 | 10.048485 | 10.127623 | 9.872377 | 30 | 46 |
| 15 | 45 | 9.823927 | 10.176073 | 9.951578 | 10.048422 | 10.127651 | 9.872349 | 15 | 45 |
| 16 | 49 | 9.823963 | 10.176037 | 9.951642 | 10.048358 | 10.127679 | 9.872321 | 11 | 44 |
| 17 | 15 | 9.823998 | 10.176002 | 9.951705 | 10.048295 | 10.127708 | 9.872292 | 45 | 43 |
| 18 | 30 | 9.824033 | 10.175967 | 9.951769 | 10.048231 | 10.127736 | 9.872264 | 30 | 42 |
| 19 | 45 | 9.824068 | 10.175932 | 9.951833 | 10.048167 | 10.127764 | 9.872236 | 15 | 41 |
| 20 | 50 | 9.824104 | 10.175896 | 9.951896 | 10.048104 | 10.127792 | 9.872208 | 10 | 40 |
| 21 | 15 | 9.824139 | 10.175861 | 9.951960 | 10.048040 | 10.127821 | 9.872179 | 45 | 39 |
| 22 | 30 | 9.824174 | 10.175826 | 9.952023 | 10.047977 | 10.127849 | 9.872151 | 30 | 38 |
| 23 | 45 | 9.824210 | 10.175790 | 9.952087 | 10.047913 | 10.127877 | 9.872123 | 15 | 37 |
| 24 | 51 | 9.824245 | 10.175755 | 9.952150 | 10.047850 | 10.127906 | 9.872094 | 9 | 36 |
| 25 | 15 | 9.824280 | 10.175720 | 9.952214 | 10.047786 | 10.127934 | 9.872066 | 45 | 35 |
| 26 | 30 | 9.824315 | 10.175685 | 9.952277 | 10.047723 | 10.127962 | 9.872038 | 30 | 34 |
| 27 | 45 | 9.824351 | 10.175649 | 9.952341 | 10.047659 | 10.127990 | 9.872010 | 15 | 33 |
| 28 | 52 | 9.824386 | 10.175614 | 9.952404 | 10.047596 | 10.128019 | 9.871981 | 8 | 32 |
| 29 | 15 | 9.824421 | 10.175579 | 9.952468 | 10.047532 | 10.128047 | 9.871953 | 45 | 31 |
| 30 | 30 | 9.824456 | 10.175544 | 9.952532 | 10.047468 | 10.128075 | 9.871925 | 30 | 30 |
| 31 | 45 | 9.824491 | 10.175509 | 9.952595 | 10.047405 | 10.128104 | 9.871896 | 15 | 29 |
| 32 | 53 | 9.824527 | 10.175473 | 9.952659 | 10.047341 | 10.128132 | 9.871868 | 7 | 28 |
| 33 | 15 | 9.824562 | 10.175438 | 9.952722 | 10.047278 | 10.128160 | 9.871840 | 45 | 27 |
| 34 | 30 | 9.824597 | 10.175403 | 9.952786 | 10.047214 | 10.128189 | 9.871811 | 30 | 26 |
| 35 | 45 | 9.824632 | 10.175368 | 9.952849 | 10.047151 | 10.128217 | 9.871783 | 15 | 25 |
| 36 | 54 | 9.824668 | 10.175332 | 9.952913 | 10.047087 | 10.128245 | 9.871755 | 6 | 24 |
| 37 | 15 | 9.824703 | 10.175297 | 9.952976 | 10.047024 | 10.128274 | 9.871726 | 45 | 23 |
| 38 | 30 | 9.824738 | 10.175262 | 9.953040 | 10.046960 | 10.128302 | 9.871698 | 30 | 22 |
| 39 | 45 | 9.824773 | 10.175227 | 9.953103 | 10.046897 | 10.128330 | 9.871670 | 15 | 21 |
| 40 | 55 | 9.824808 | 10.175192 | 9.953167 | 10.046833 | 10.128359 | 9.871641 | 5 | 20 |
| 41 | 15 | 9.824843 | 10.175157 | 9.953230 | 10.046770 | 10.128387 | 9.871613 | 45 | 19 |
| 42 | 30 | 9.824879 | 10.175121 | 9.953294 | 10.046706 | 10.128415 | 9.871585 | 30 | 18 |
| 43 | 45 | 9.824914 | 10.175086 | 9.953358 | 10.046642 | 10.128444 | 9.871556 | 15 | 17 |
| 44 | 56 | 9.824949 | 10.175051 | 9.953421 | 10.046579 | 10.128472 | 9.871528 | 4 | 16 |
| 45 | 15 | 9.824984 | 10.175016 | 9.953485 | 10.046515 | 10.128501 | 9.871499 | 45 | 15 |
| 46 | 30 | 9.825019 | 10.174981 | 9.953548 | 10.046452 | 10.128529 | 9.871471 | 30 | 14 |
| 47 | 45 | 9.825054 | 10.174946 | 9.953612 | 10.046388 | 10.128557 | 9.871443 | 15 | 13 |
| 48 | 57 | 9.825090 | 10.174910 | 9.953675 | 10.046325 | 10.128586 | 9.871414 | 3 | 12 |
| 49 | 15 | 9.825125 | 10.174875 | 9.953739 | 10.046261 | 10.128614 | 9.871386 | 45 | 11 |
| 50 | 30 | 9.825160 | 10.174840 | 9.953802 | 10.046198 | 10.128642 | 9.871358 | 30 | 10 |
| 51 | 45 | 9.825195 | 10.174805 | 9.953866 | 10.046134 | 10.128671 | 9.871329 | 15 | 9 |
| 52 | 58 | 9.825230 | 10.174770 | 9.953929 | 10.046071 | 10.128699 | 9.871301 | 2 | 8 |
| 53 | 15 | 9.825265 | 10.174735 | 9.953993 | 10.046007 | 10.128728 | 9.871272 | 45 | 7 |
| 54 | 30 | 9.825300 | 10.174700 | 9.954056 | 10.045944 | 10.128756 | 9.871244 | 30 | 6 |
| 55 | 45 | 9.825335 | 10.174665 | 9.954120 | 10.045880 | 10.128784 | 9.871216 | 15 | 5 |
| 56 | 59 | 9.825370 | 10.174630 | 9.954183 | 10.045817 | 10.128813 | 9.871187 | 1 | 4 |
| 57 | 15 | 9.825406 | 10.174594 | 9.954247 | 10.045753 | 10.128841 | 9.871159 | 45 | 3 |
| 58 | 30 | 9.825441 | 10.174559 | 9.954310 | 10.045690 | 10.128870 | 9.871130 | 30 | 2 |
| 59 | 45 | 9.825476 | 10.174524 | 9.954374 | 10.045626 | 10.128898 | 9.871102 | 15 | 1 |
| 60 | 60 | 9.825511 | 10.174489 | 9.954437 | 10.045563 | 10.128927 | 9.871073 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 3h 12m. | | LOG. SINES, &c. | | | | 48 deg. | | |

| 2h 48m. | | | LOG. SINES, &c. (t.) | | | 42 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.825511 | 10.174489 | 9.954437 | 10.045563 | 10.128927 | 9.871073 | 60 | 60 |
| 1 | 15 | 9.825546 | 10.174454 | 9.954501 | 10.045499 | 10.128955 | 9.871045 | 45 | 59 |
| 2 | 30 | 9.825581 | 10.174419 | 9.954564 | 10.045436 | 10.128983 | 9.871017 | 30 | 58 |
| 3 | 45 | 9.825616 | 10.174384 | 9.954628 | 10.045372 | 10.129012 | 9.870988 | 15 | 57 |
| 4 | 1 | 9.825651 | 10.174349 | 9.954691 | 10.045309 | 10.129040 | 9.870960 | 59 | 56 |
| 5 | 15 | 9.825686 | 10.174314 | 9.954755 | 10.045245 | 10 129069 | 9.870931 | 45 | 55 |
| 6 | 30 | 9.825721 | 10.174279 | 9.954818 | 10.045182 | 10.129097 | 9.870903 | 30 | 54 |
| 7 | 45 | 9.825756 | 10.174244 | 9.954882 | 10.045118 | 10.129126 | 9.870874 | 15 | 53 |
| 8 | 2 | 9.825791 | 10.174209 | 9.954945 | 10.045055 | 10.129154 | 9.870846 | 58 | 52 |
| 9 | 15 | 9.825826 | 10.174174 | 9.955009 | 10.044991 | 10.129183 | 9.870817 | 45 | 51 |
| 10 | 30 | 9.825861 | 10.174139 | 9.955072 | 10.044928 | 10.129211 | 9.870789 | 30 | 50 |
| 11 | 45 | 9.825896 | 10.174104 | 9.955136 | 10.044864 | 10.129240 | 9.870760 | 15 | 49 |
| 12 | 3 | 9.825931 | 10.174069 | 9.955199 | 10.044801 | 10.129268 | 9.870732 | 57 | 48 |
| 13 | 15 | 9.825966 | 10.174034 | 9.955263 | 10.044737 | 10.129297 | 9.870703 | 45 | 47 |
| 14 | 30 | 9.826001 | 10.173999 | 9.955326 | 10.044674 | 10.129325 | 9.870675 | 30 | 46 |
| 15 | 45 | 9.826036 | 10.173964 | 9.955390 | 10.044610 | 10.129354 | 9.870646 | 15 | 45 |
| 16 | 4 | 9.826071 | 10.173929 | 9.955453 | 10.044547 | 10.129382 | 9.870618 | 56 | 44 |
| 17 | 15 | 9.826106 | 10.173894 | 9.955517 | 10.044483 | 10.129411 | 9.870589 | 45 | 43 |
| 18 | 30 | 9.826141 | 10.173859 | 9.955580 | 10.044420 | 10.129439 | 9.870561 | 30 | 42 |
| 19 | 45 | 9.826176 | 10.173824 | 9.955644 | 10.044356 | 10.129468 | 9.870532 | 15 | 41 |
| 20 | 5 | 9.826211 | 10.173789 | 9.955707 | 10.044293 | 10.129496 | 9.870504 | 55 | 40 |
| 21 | 15 | 9.826246 | 10.173754 | 9.955771 | 10.044229 | 10.129525 | 9.870475 | 45 | 39 |
| 22 | 30 | 9.826281 | 10.173719 | 9.955834 | 10.044166 | 10.129553 | 9.870447 | 30 | 38 |
| 23 | 45 | 9.826316 | 10.173684 | 9.955898 | 10.044102 | 10.129582 | 9.870418 | 15 | 37 |
| 24 | 6 | 9.826351 | 10.173649 | 9.955961 | 10.044039 | 10.129610 | 9.870390 | 54 | 36 |
| 25 | 15 | 9.826386 | 10.173614 | 9.956025 | 10.043975 | 10.129639 | 9.870361 | 45 | 35 |
| 26 | 30 | 9.826421 | 10.173579 | 9.956088 | 10.043912 | 10.129667 | 9.870333 | 30 | 34 |
| 27 | 45 | 9.826456 | 10.173544 | 9.956152 | 10.043848 | 10.129696 | 9.870304 | 15 | 33 |
| 28 | 7 | 9.826491 | 10.173509 | 9.956215 | 10.043785 | 10.129724 | 9.870276 | 53 | 32 |
| 29 | 15 | 9.826526 | 10.173474 | 9.956279 | 10.043721 | 10.129753 | 9.870247 | 45 | 31 |
| 30 | 30 | 9.826561 | 10.173439 | 9.956342 | 10.043658 | 10.129782 | 9.870218 | 30 | 30 |
| 31 | 45 | 9.826596 | 10.173404 | 9.956406 | 10.043594 | 10.129810 | 9.870190 | 15 | 29 |
| 32 | 8 | 9.826631 | 10.173369 | 9.956469 | 10.043531 | 10.129839 | 9.870161 | 52 | 28 |
| 33 | 15 | 9.826666 | 10.173334 | 9.956533 | 10.043467 | 10.129867 | 9.870133 | 45 | 27 |
| 34 | 30 | 9.826700 | 10.173300 | 9.956596 | 10.043404 | 10.129896 | 9.870104 | 30 | 26 |
| 35 | 45 | 9.826735 | 10.173265 | 9.956660 | 10.043340 | 10.129924 | 9.870076 | 15 | 25 |
| 36 | 9 | 9.826770 | 10.173230 | 9.956723 | 10.043277 | 10.129953 | 9.870047 | 51 | 24 |
| 37 | 15 | 9.826805 | 10.173195 | 9.956787 | 10.043213 | 10.129982 | 9.870018 | 45 | 23 |
| 38 | 30 | 9.826840 | 10.173160 | 9.956850 | 10.043150 | 10.130010 | 9.869990 | 30 | 22 |
| 39 | 45 | 9.826875 | 10.173125 | 9.956914 | 10.043086 | 10.130039 | 9.869961 | 15 | 21 |
| 40 | 10 | 9.826910 | 10.173090 | 9.956977 | 10.043023 | 10.130067 | 9.869933 | 50 | 20 |
| 41 | 15 | 9.826945 | 10.173055 | 9.957041 | 10.042959 | 10.130096 | 9.869904 | 45 | 19 |
| 42 | 30 | 9.826980 | 10.173020 | 9.957104 | 10.042896 | 10.130125 | 9.869875 | 30 | 18 |
| 43 | 45 | 9.827014 | 10.172986 | 9.957168 | 10.042832 | 10.130153 | 9.869847 | 15 | 17 |
| 44 | 11 | 9.827049 | 10.172951 | 9.957231 | 10.042769 | 10.130182 | 9.869818 | 49 | 16 |
| 45 | 15 | 9.827084 | 10.172916 | 9.957295 | 10.042705 | 10.130210 | 9.869790 | 45 | 15 |
| 46 | 30 | 9.827119 | 10.172881 | 9.957358 | 10.042642 | 10.130239 | 9.869761 | 30 | 14 |
| 47 | 45 | 9.827154 | 10.172846 | 9.957421 | 10.042579 | 10.130268 | 9.869732 | 15 | 13 |
| 48 | 12 | 9.827189 | 10.172811 | 9.957485 | 10.042515 | 10.130296 | 9.869704 | 48 | 12 |
| 49 | 15 | 9.827223 | 10.172777 | 9.957548 | 10.042452 | 10.130325 | 9.869675 | 45 | 11 |
| 50 | 30 | 9.827258 | 10.172742 | 9.957612 | 10.042388 | 10.130354 | 9.869646 | 30 | 10 |
| 51 | 45 | 9.827293 | 10.172707 | 9.957675 | 10.042325 | 10.130382 | 9.869618 | 15 | 9 |
| 52 | 13 | 9.827328 | 10.172672 | 9.957739 | 10.042261 | 10.130411 | 9.869589 | 47 | 8 |
| 53 | 15 | 9.827363 | 10.172637 | 9.957802 | 10.042198 | 10.130440 | 9.869560 | 45 | 7 |
| 54 | 30 | 9.827398 | 10.172602 | 9.957866 | 10.042134 | 10.130468 | 9.869532 | 30 | 6 |
| 55 | 45 | 9.827432 | 10.172568 | 9.957929 | 10.042071 | 10.130497 | 9.869503 | 15 | 5 |
| 56 | 14 | 9.827467 | 10.172533 | 9.957993 | 10.042007 | 10.130526 | 9.869474 | 46 | 4 |
| 57 | 15 | 9.827502 | 10.172498 | 9.958056 | 10.041944 | 10.130554 | 9.869446 | 45 | 3 |
| 58 | 30 | 9.827537 | 10.172463 | 9.958120 | 10.041880 | 10.130583 | 9.869417 | 30 | 2 |
| 59 | 45 | 9.827571 | 10.172429 | 9.958183 | 10.041817 | 10.130612 | 9.869386 | 15 | 1 |
| 60 | 15 | 9.827606 | 10.172394 | 9.958246 | 10.041754 | 10.130640 | 9.869360 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 2h 49m. | | | LOG. SINES, &c. (t.) | | | | 42 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.827606 | 10.172394 | 9.958246 | 10.041754 | 10.160640 | 9.839360 | 45 | 60 |
| 1 | 15 | 9.827641 | 10.172359 | 9.958310 | 10.041690 | 10.130669 | 9.869331 | 45 | 59 |
| 2 | 30 | 9.827676 | 10.172324 | 9.958373 | 10.041627 | 10.130698 | 9.869302 | 30 | 58 |
| 3 | 45 | 9.827711 | 10.172289 | 9.958437 | 10.041563 | 10.130726 | 9.869274 | 15 | 57 |
| 4 | 16 | 9.827745 | 10.172255 | 9.958500 | 10.041500 | 10.130755 | 9.869245 | 44 | 56 |
| 5 | 15 | 9.827780 | 10.172220 | 9.958564 | 10.041436 | 10.130784 | 9.869216 | 45 | 55 |
| 6 | 30 | 9.827815 | 10.172185 | 9.958627 | 10.041373 | 10.130813 | 9.869187 | 30 | 54 |
| 7 | 45 | 9.827849 | 10.172151 | 9.958691 | 10.041309 | 10.130841 | 9.869159 | 15 | 53 |
| 8 | 17 | 9.827884 | 10.172116 | 9.958754 | 10.041246 | 10.130870 | 9.869130 | 43 | 52 |
| 9 | 15 | 9.827919 | 10.172081 | 9.958818 | 10.041182 | 10.130899 | 9.869101 | 45 | 51 |
| 10 | 30 | 9.827954 | 10.172046 | 9.958881 | 10.041119 | 10.130927 | 9.869073 | 30 | 50 |
| 11 | 45 | 9.827988 | 10.172012 | 9.958944 | 10.041056 | 10.130956 | 9.869044 | 15 | 49 |
| 12 | 18 | 9.828023 | 10.171977 | 9.959008 | 10.040992 | 10.130985 | 9.869015 | 42 | 48 |
| 13 | 15 | 9.828058 | 10.171942 | 9.959071 | 10.040929 | 10.131014 | 9.868986 | 45 | 47 |
| 14 | 30 | 9.828092 | 10.171908 | 9.959135 | 10.040865 | 10.131042 | 9.868958 | 30 | 46 |
| 15 | 45 | 9.828127 | 10.171873 | 9.959198 | 10.040802 | 10.131071 | 9.868929 | 15 | 45 |
| 16 | 19 | 9.828162 | 10.171838 | 9.959262 | 10.040738 | 10.131100 | 9.868900 | 41 | 44 |
| 17 | 15 | 9.828197 | 10.171803 | 9.959325 | 10.040675 | 10.131129 | 9.868871 | 45 | 43 |
| 18 | 30 | 9.828231 | 10.171769 | 9.959389 | 10.040611 | 10.131157 | 9.868843 | 30 | 42 |
| 19 | 45 | 9.828266 | 10.171734 | 9.959452 | 10.040548 | 10.131186 | 9.868814 | 15 | 41 |
| 20 | 20 | 9.828301 | 10.171699 | 9.959515 | 10.040485 | 10.131215 | 9.868785 | 40 | 40 |
| 21 | 15 | 9.828335 | 10.171665 | 9.959579 | 10.040421 | 10.131244 | 9.868756 | 45 | 39 |
| 22 | 30 | 9.828370 | 10.171630 | 9.959642 | 10.040358 | 10.131272 | 9.868728 | 30 | 38 |
| 23 | 45 | 9.828405 | 10.171595 | 9.959706 | 10.040294 | 10.131301 | 9.868699 | 15 | 37 |
| 24 | 21 | 9.828439 | 10.171561 | 9.959769 | 10.040231 | 10.131330 | 9.868670 | 39 | 36 |
| 25 | 15 | 9.828474 | 10.171526 | 9.959833 | 10.040167 | 10.131359 | 9.868641 | 45 | 35 |
| 26 | 30 | 9.828509 | 10.171491 | 9.959896 | 10.040104 | 10.131388 | 9.868612 | 30 | 34 |
| 27 | 45 | 9.828543 | 10.171457 | 9.959960 | 10.040040 | 10.131416 | 9.868584 | 15 | 33 |
| 28 | 22 | 9.828578 | 10.171422 | 9.960023 | 10.039977 | 10.131445 | 9.868555 | 38 | 32 |
| 29 | 15 | 9.828612 | 10.171388 | 9.960086 | 10.039914 | 10.131474 | 9.868526 | 45 | 31 |
| 30 | 30 | 9.828647 | 10.171353 | 9.960150 | 10.039850 | 10.131503 | 9.868497 | 30 | 30 |
| 31 | 45 | 9.828682 | 10.171318 | 9.960213 | 10.039787 | 10.131532 | 9.868468 | 15 | 29 |
| 32 | 23 | 9.828716 | 10.171284 | 9.960277 | 10.039723 | 10.131560 | 9.868440 | 37 | 28 |
| 33 | 15 | 9.828751 | 10.171249 | 9.960340 | 10.039660 | 10.131589 | 9.868411 | 45 | 27 |
| 34 | 30 | 9.828785 | 10.171215 | 9.960404 | 10.039596 | 10.131618 | 9.868382 | 30 | 26 |
| 35 | 45 | 9.828820 | 10.171180 | 9.960467 | 10.039533 | 10.131647 | 9.868353 | 15 | 25 |
| 36 | 24 | 9.828855 | 10.171145 | 9.960530 | 10.039470 | 10.131676 | 9.868324 | 36 | 24 |
| 37 | 15 | 9.828889 | 10.171111 | 9.960594 | 10.039406 | 10.131705 | 9.868295 | 45 | 23 |
| 38 | 30 | 9.828924 | 10.171076 | 9.960657 | 10.039343 | 10.131734 | 9.868266 | 30 | 22 |
| 39 | 45 | 9.828958 | 10.171042 | 9.960721 | 10.039279 | 10.131762 | 9.868238 | 15 | 21 |
| 40 | 25 | 9.828993 | 10.171007 | 9.960784 | 10.039216 | 10.131791 | 9.868209 | 35 | 20 |
| 41 | 15 | 9.829028 | 10.170972 | 9.960848 | 10.039152 | 10.131820 | 9.868180 | 45 | 19 |
| 42 | 30 | 9.829062 | 10.170938 | 9.960911 | 10.039089 | 10.131849 | 9.868151 | 30 | 18 |
| 43 | 45 | 9.829097 | 10.170903 | 9.960974 | 10.039026 | 10.131878 | 9.868122 | 15 | 17 |
| 44 | 26 | 9.829131 | 10.170869 | 9.961038 | 10.038962 | 10.131907 | 9.868093 | 34 | 16 |
| 45 | 15 | 9.829166 | 10.170834 | 9.961101 | 10.038899 | 10.131936 | 9.868064 | 45 | 15 |
| 46 | 30 | 9.829200 | 10.170800 | 9.961165 | 10.038835 | 10.131964 | 9.868036 | 30 | 14 |
| 47 | 45 | 9.829235 | 10.170765 | 9.961228 | 10.038772 | 10.131993 | 9.868007 | 15 | 13 |
| 48 | 27 | 9.829269 | 10.170731 | 9.961291 | 10.038709 | 10.132022 | 9.867978 | 33 | 12 |
| 49 | 15 | 9.829304 | 10.170696 | 9.961355 | 10.038645 | 10.132051 | 9.867949 | 45 | 11 |
| 50 | 30 | 9.829338 | 10.170662 | 9.961418 | 10.038582 | 10.132080 | 9.867920 | 30 | 10 |
| 51 | 45 | 9.829373 | 10.170627 | 9.961482 | 10.038518 | 10.132109 | 9.867891 | 15 | 9 |
| 52 | 28 | 9.829407 | 10.170593 | 9.961545 | 10.038455 | 10.132138 | 9.867862 | 32 | 8 |
| 53 | 15 | 9.829442 | 10.170558 | 9.961609 | 10.038391 | 10.132167 | 9.867833 | 45 | 7 |
| 54 | 30 | 9.829476 | 10.170524 | 9.961672 | 10.038328 | 10.132196 | 9.867804 | 30 | 6 |
| 55 | 45 | 9.829511 | 10.170489 | 9.961735 | 10.038265 | 10.132225 | 9.867775 | 15 | 5 |
| 56 | 29 | 9.829545 | 10.170455 | 9.961799 | 10.038201 | 10.132253 | 9.867747 | 31 | 4 |
| 57 | 15 | 9.829580 | 10.170420 | 9.961862 | 10.038138 | 10.132282 | 9.867718 | 45 | 3 |
| 58 | 30 | 9.829614 | 10.170386 | 9.961926 | 10.038074 | 10.132311 | 9.867689 | 30 | 2 |
| 59 | 45 | 9.829649 | 10.170351 | 9.961989 | 10.038011 | 10.132340 | 9.867660 | 15 | 1 |
| 60 | 30 | 9.829683 | 10.170317 | 9.962052 | 10.037948 | 10.132369 | 9.867631 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 10m. | LOG. SINES, &c. | 47 deg. |
|---|---|---|

| 2h 50m. | | LOG. SINES, &c. (t.) | | | | | 42 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.829683 | 10.170317 | 9.962052 | 10.037948 | 10.132369 | 9.867631 | 30 | 60 |
| 1 | 15 | 9.829718 | 10.170282 | 9.962116 | 10.037884 | 10.132398 | 9.867602 | 45 | 59 |
| 2 | 30 | 9.829752 | 10.170248 | 9.962179 | 10.037821 | 10.132427 | 9.867573 | 30 | 58 |
| 3 | 45 | 9.829787 | 10.170213 | 9.962243 | 10.037757 | 10.132456 | 9.867544 | 15 | 57 |
| 4 | 31 | 9.829821 | 10.170179 | 9.962306 | 10.037694 | 10.132485 | 9.867515 | 29 | 56 |
| 5 | 15 | 9.829856 | 10.170144 | 9.962369 | 10.037631 | 10.132514 | 9.867486 | 45 | 55 |
| 6 | 30 | 9.829890 | 10.170110 | 9.962433 | 10.037567 | 10.132543 | 9.867457 | 30 | 54 |
| 7 | 45 | 9.829924 | 10.170076 | 9.962496 | 10.037504 | 10.132572 | 9.867428 | 15 | 53 |
| 8 | 32 | 9.829959 | 10.170041 | 9.962560 | 10.037440 | 10.132601 | 9.867399 | 28 | 52 |
| 9 | 15 | 9.829993 | 10.170007 | 9.962623 | 10.037377 | 10.132630 | 9.867370 | 45 | 51 |
| 10 | 30 | 9.830028 | 10.169972 | 9.962686 | 10.037314 | 10.132659 | 9.867341 | 30 | 50 |
| 11 | 45 | 9.830062 | 10.169938 | 9.962750 | 10.037250 | 10.132688 | 9.867312 | 15 | 49 |
| 12 | 33 | 9.830097 | 10.169903 | 9.962813 | 10.037187 | 10.132717 | 9.867283 | 27 | 48 |
| 13 | 15 | 9.830131 | 10.169869 | 9.962877 | 10.037123 | 10.132746 | 9.867254 | 45 | 47 |
| 14 | 30 | 9.830165 | 10.169835 | 9.962940 | 10.037060 | 10.132775 | 9.867225 | 30 | 46 |
| 15 | 45 | 9.830200 | 10.169800 | 9.963003 | 10.036997 | 10.132804 | 9.867196 | 15 | 45 |
| 16 | 34 | 9.830234 | 10.169766 | 9.963067 | 10.036933 | 10.132833 | 9.867167 | 26 | 44 |
| 17 | 15 | 9.830269 | 10.169731 | 9.963130 | 10.036870 | 10.132862 | 9.867138 | 45 | 43 |
| 18 | 30 | 9.830303 | 10.169697 | 9.963194 | 10.036806 | 10.132891 | 9.867109 | 30 | 42 |
| 19 | 45 | 9.830337 | 10.169663 | 9.963257 | 10.036743 | 10.132920 | 9.867080 | 15 | 41 |
| 20 | 35 | 9.830372 | 10.169628 | 9.963320 | 10.036680 | 10.132949 | 9.867051 | 25 | 40 |
| 21 | 15 | 9.830406 | 10.169594 | 9.963384 | 10.036616 | 10.132978 | 9.867022 | 45 | 39 |
| 22 | 30 | 9.830440 | 10.169560 | 9.963447 | 10.036553 | 10.133007 | 9.866993 | 30 | 38 |
| 23 | 45 | 9.830475 | 10.169525 | 9.963511 | 10.036489 | 10.133036 | 9.866964 | 15 | 37 |
| 24 | 36 | 9.830509 | 10.169491 | 9.963574 | 10.036426 | 10.133065 | 9.866935 | 24 | 36 |
| 25 | 15 | 9.830543 | 10.169457 | 9.963637 | 10.036363 | 10.133094 | 9.866906 | 45 | 35 |
| 26 | 30 | 9.830578 | 10.169422 | 9.963701 | 10.036299 | 10.133123 | 9.866877 | 30 | 34 |
| 27 | 45 | 9.830612 | 10.169388 | 9.963764 | 10.036236 | 10.133152 | 9.866848 | 15 | 33 |
| 28 | 37 | 9.830646 | 10.169354 | 9.963827 | 10.036173 | 10.133181 | 9.866819 | 23 | 32 |
| 29 | 15 | 9.830681 | 10.169319 | 9.963891 | 10.036109 | 10.133210 | 9.866790 | 45 | 31 |
| 30 | 30 | 9.830715 | 10.169285 | 9.963954 | 10.036046 | 10.133239 | 9.866761 | 30 | 30 |
| 31 | 45 | 9.830749 | 10.169251 | 9.964018 | 10.035982 | 10.133268 | 9.866732 | 15 | 29 |
| 32 | 38 | 9.830784 | 10.169216 | 9.964081 | 10.035919 | 10.133297 | 9.866703 | 22 | 28 |
| 33 | 15 | 9.830818 | 10.169182 | 9.964144 | 10.035856 | 10.133326 | 9.866674 | 45 | 27 |
| 34 | 30 | 9.830852 | 10.169148 | 9.964208 | 10.035792 | 10.133356 | 9.866644 | 30 | 26 |
| 35 | 45 | 9.830887 | 10.169113 | 9.964271 | 10.035729 | 10.133385 | 9.866615 | 15 | 25 |
| 36 | 39 | 9.830921 | 10.169079 | 9.964335 | 10.035665 | 10.133414 | 9.866586 | 21 | 24 |
| 37 | 15 | 9.830955 | 10.169045 | 9.964398 | 10.035602 | 10.133443 | 9.866557 | 45 | 23 |
| 38 | 30 | 9.830989 | 10.169011 | 9.964461 | 10.035539 | 10.133472 | 9.866528 | 30 | 22 |
| 39 | 45 | 9.831024 | 10.168976 | 9.964525 | 10.035475 | 10.133501 | 9.866499 | 15 | 21 |
| 40 | 40 | 9.831058 | 10.168942 | 9.964588 | 10.035412 | 10.133530 | 9.866470 | 20 | 20 |
| 41 | 15 | 9.831092 | 10.168908 | 9.964651 | 10.035349 | 10.133559 | 9.866441 | 45 | 19 |
| 42 | 30 | 9.831126 | 10.168874 | 9.964715 | 10.035285 | 10.133588 | 9.866412 | 30 | 18 |
| 43 | 45 | 9.831161 | 10.168839 | 9.964778 | 10.035222 | 10.133618 | 9.866382 | 15 | 17 |
| 44 | 41 | 9.831195 | 10.168805 | 9.964842 | 10.035158 | 10.133647 | 9.866353 | 19 | 16 |
| 45 | 15 | 9.831229 | 10.168771 | 9.964905 | 10.035095 | 10.133676 | 9.866324 | 45 | 15 |
| 46 | 30 | 9.831263 | 10.168737 | 9.964968 | 10.035032 | 10.133705 | 9.866295 | 30 | 14 |
| 47 | 45 | 9.831298 | 10.168702 | 9.965032 | 10.034968 | 10.133734 | 9.866266 | 15 | 13 |
| 48 | 42 | 9.831332 | 10.168668 | 9.965095 | 10.034905 | 10.133763 | 9.866237 | 18 | 12 |
| 49 | 15 | 9.831366 | 10.168634 | 9.965158 | 10.034842 | 10.133792 | 9.866208 | 45 | 11 |
| 50 | 30 | 9.831400 | 10.168600 | 9.965222 | 10.034778 | 10.133821 | 9.866179 | 30 | 10 |
| 51 | 45 | 9.831435 | 10.168565 | 9.965285 | 10.034715 | 10.133851 | 9.866149 | 15 | 9 |
| 52 | 43 | 9.831469 | 10.168531 | 9.965349 | 10.034651 | 10.133880 | 9.866120 | 17 | 8 |
| 53 | 15 | 9.831503 | 10.168497 | 9.965412 | 10.034588 | 10.133909 | 9.866091 | 45 | 7 |
| 54 | 30 | 9.831537 | 10.168463 | 9.965475 | 10.034525 | 10.133938 | 9.866062 | 30 | 6 |
| 55 | 45 | 9.831571 | 10.168429 | 9.965539 | 10.034461 | 10.133967 | 9.866033 | 15 | 5 |
| 56 | 44 | 9.831606 | 10.168394 | 9.965602 | 10.034398 | 10.133996 | 9.866004 | 16 | 4 |
| 57 | 15 | 9.831640 | 10.168360 | 9.965665 | 10.034335 | 10.134026 | 9.865974 | 45 | 3 |
| 58 | 30 | 9.831674 | 10.168326 | 9.965729 | 10.034271 | 10.134055 | 9.865945 | 30 | 2 |
| 59 | 45 | 9.831708 | 10.168292 | 9.965792 | 10.034208 | 10.134084 | 9.865916 | 15 | 1 |
| 60 | 45 | 9.831742 | 10.168258 | 9.965855 | 10.034145 | 10.134113 | 9.865887 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| 3h 9m. | LOG. SINES, &c. | 47 deg. |
|---|---|---|

| $2^h$ $51^m$. | | LOG. SINES, &c. (t.) | | | | | 42 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.831742 | 10.168258 | 9.965855 | 10.034145 | 10.134113 | 9.865887 | 15 | 60 |
| 1 | 15 | 9.831776 | 10 168224 | 9.965919 | 10.034081 | 10.134142 | 9.865858 | 45 | 59 |
| 2 | 30 | 9 831811 | 10.168189 | 9.965982 | 10.034018 | 10.134172 | 9.865828 | 30 | 58 |
| 3 | 45 | 9.831845 | 10.168155 | 9.966045 | 10.033955 | 10.134201 | 9.865799 | 15 | 57 |
| 4 | 46 | 9.831879 | 10.168121 | 9.966109 | 10.033891 | 10.134230 | 9.865770 | 14 | 56 |
| 5 | 15 | 9.831913 | 10.168087 | 9.966172 | 10.033828 | 10.134259 | 9.865741 | 45 | 55 |
| 6 | 30 | 9.831947 | 10.168053 | 9.966236 | 10.033764 | 10.134288 | 9.865712 | 30 | 54 |
| 7 | 45 | 9.831981 | 10.168019 | 9.966299 | 10.033701 | 10.134318 | 9.865682 | 15 | 53 |
| 8 | 47 | 9.832015 | 10.167985 | 9.966362 | 10.033638 | 10.134347 | 9.865653 | 13 | 52 |
| 9 | 15 | 9.832050 | 10.167950 | 9.966426 | 10.033574 | 10.134376 | 9.865624 | 45 | 51 |
| 10 | 30 | 9.832084 | 10.167916 | 9.966489 | 10.033511 | 10.134405 | 9.865595 | 30 | 50 |
| 11 | 45 | 9.832118 | 10.167882 | 9.966552 | 10.033448 | 10.134435 | 9.865565 | 15 | 49 |
| 12 | 48 | 9.832152 | 10.167848 | 9.966616 | 10.033384 | 10.134464 | 9.865536 | 12 | 48 |
| 13 | 15 | 9.832186 | 10.167814 | 9.966679 | 10.033321 | 10.134493 | 9.865507 | 45 | 47 |
| 14 | 30 | 9.832220 | 10.167780 | 9.966742 | 10.033258 | 10.134522 | 9.865478 | 30 | 46 |
| 15 | 45 | 9.832254 | 10.167746 | 9.966806 | 10.033194 | 10.134552 | 9.865448 | 15 | 45 |
| 16 | 49 | 9.832288 | 10.167712 | 9.966869 | 10.033131 | 10.134581 | 9.865419 | 11 | 44 |
| 17 | 15 | 9.832322 | 10.167678 | 9.966932 | 10.033068 | 10.134610 | 9.865390 | 45 | 43 |
| 18 | 30 | 9.832356 | 10.167644 | 9.966996 | 10.033004 | 10.134639 | 9.865361 | 30 | 42 |
| 19 | 45 | 9.832391 | 10.167609 | 9.967059 | 10.032941 | 10.134669 | 9.865331 | 15 | 41 |
| 20 | 50 | 9.832425 | 10.167575 | 9.967122 | 10.032878 | 10.134698 | 9.865302 | 10 | 40 |
| 21 | 15 | 9.832459 | 10.167541 | 9.967186 | 10.032814 | 10.134727 | 9.865273 | 45 | 39 |
| 22 | 30 | 9.832493 | 10.167507 | 9.967249 | 10.032751 | 10.134757 | 9.865243 | 30 | 38 |
| 23 | 45 | 9.832527 | 10.167473 | 9.967313 | 10 032687 | 10.134786 | 9 865214 | 15 | 37 |
| 24 | 51 | 9.832561 | 10.167439 | 9.967376 | 10.032624 | 10.134815 | 9.865185 | 9 | 36 |
| 25 | 15 | 9.832595 | 10.167405 | 9.967439 | 10.032561 | 10.134844 | 9.865156 | 45 | 35 |
| 26 | 30 | 9.832629 | 10.167371 | 9 967503 | 10.032497 | 10.134874 | 9.865126 | 30 | 34 |
| 27 | 45 | 9.832663 | 10.167337 | 9.967566 | 10.032434 | 10.134903 | 9.865097 | 15 | 33 |
| 28 | 52 | 9.832697 | 10.167303 | 9.967629 | 10.032371 | 10.134932 | 9.865068 | 8 | 32 |
| 29 | 15 | 9.832731 | 10.167269 | 9.967693 | 10.032307 | 10.134962 | 9.865038 | 45 | 31 |
| 30 | 30 | 9.832765 | 10.167235 | 9.967756 | 10.032244 | 10.134991 | 9.865009 | 30 | 30 |
| 31 | 45 | 9.832799 | 10.167201 | 9.967819 | 10.032181 | 10.135020 | 9.864980 | 15 | 29 |
| 32 | 53 | 9.832833 | 10.167167 | 9.967883 | 10.032117 | 10.135050 | 9.864950 | 7 | 28 |
| 33 | 15 | 9.832867 | 10.167133 | 9.967946 | 10.032054 | 10.135079 | 9.864921 | 45 | 27 |
| 34 | 30 | 9.832901 | 10.167099 | 9.968009 | 10.031991 | 10.135108 | 9.864892 | 30 | 26 |
| 35 | 45 | 9.832935 | 10.167065 | 9.968073 | 10.031927 | 10.135138 | 9.864862 | 15 | 25 |
| 36 | 54 | 9.832969 | 10.167031 | 9.968136 | 10.031864 | 10.135167 | 9.864833 | 6 | 24 |
| 37 | 15 | 9.833003 | 10.166997 | 9.968199 | 10.031801 | 10.135196 | 9.864804 | 45 | 23 |
| 38 | 30 | 9.833037 | 10.166963 | 9.968263 | 10.031737 | 10.135226 | 9.864774 | 30 | 22 |
| 39 | 45 | 9.833071 | 10.166929 | 9.968326 | 10.031674 | 10.135255 | 9.864745 | 15 | 21 |
| 40 | 55 | 9.833105 | 10.166895 | 9.968389 | 10.031611 | 10.135284 | 9.864716 | 5 | 20 |
| 41 | 15 | 9.833139 | 10.166861 | 9.968453 | 10.031547 | 10.135314 | 9.864686 | 45 | 19 |
| 42 | 30 | 9.833173 | 10.166827 | 9.968516 | 10.031484 | 10.135343 | 9.864657 | 30 | 18 |
| 43 | 45 | 9.833207 | 10.166793 | 9.968579 | 10.031421 | 10.135373 | 9.864627 | 15 | 17 |
| 44 | 56 | 9.833241 | 10.166759 | 9.968643 | 10.031357 | 10.135402 | 9.864598 | 4 | 16 |
| 45 | 15 | 9.833275 | 10.166725 | 9.968706 | 10.031294 | 10.135431 | 9.864569 | 45 | 15 |
| 46 | 30 | 9.833309 | 10.166691 | 9.968769 | 10.031231 | 10.135461 | 9.864539 | 30 | 14 |
| 47 | 45 | 9.833343 | 10.166657 | 9.968833 | 10.031167 | 10.135490 | 9.864510 | 15 | 13 |
| 48 | 57 | 9.833377 | 10.166623 | 9.968896 | 10.031104 | 10.135519 | 9.864481 | 3 | 12 |
| 49 | 15 | 9.833410 | 10.166590 | 9.968959 | 10.031041 | 10.135549 | 9.864451 | 45 | 11 |
| 50 | 30 | 9.833444 | 10.166556 | 9.969023 | 10.030977 | 10.135578 | 9.864422 | 30 | 10 |
| 51 | 45 | 9.833478 | 10.166522 | 9.969086 | 10.030914 | 10.135608 | 9.864392 | 15 | 9 |
| 52 | 58 | 9.833512 | 10.166488 | 9.969149 | 10.030851 | 10.135637 | 9.864363 | 2 | 8 |
| 53 | 15 | 9.833546 | 10.166454 | 9.969213 | 10.030787 | 10.135667 | 9.864333 | 45 | 7 |
| 54 | 30 | 9.833580 | 10.166420 | 9.969276 | 10.030724 | 10.135696 | 9.864304 | 30 | 6 |
| 55 | 45 | 9.833614 | 10.166386 | 9.969339 | 10.030661 | 10.135725 | 9.864275 | 15 | 5 |
| 56 | 59 | 9.833648 | 10.166352 | 9.969403 | 10.030597 | 10.135755 | 9.864245 | 1 | 4 |
| 57 | 15 | 9.833682 | 10.166318 | 9.969466 | 10.030534 | 10.135784 | 9.864216 | 45 | 3 |
| 58 | 30 | 9.833716 | 10.166284 | 9.969529 | 10.030471 | 10.135814 | 9.864186 | 30 | 2 |
| 59 | 45 | 9.833749 | 10.166251 | 9.969592 | 10.030408 | 10.135843 | 9.864157 | 15 | 1 |
| 60 | 60 | 9.833783 | 10.166217 | 9.969656 | 10.030344 | 10.135873 | 9.864127 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |

| $3^h$ $8^m$. | LOG. SINES, &c. | 47 deg. |
|---|---|---|

| 2h 52m. | | | LOG. SINES, &c. (t.) | | | 43 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.833783 | 10.166217 | 9 969656 | 10.030344 | 10.135873 | 9.864127 | 60 | 60 |
| 1 | 15 | 9.833817 | 10.166183 | 9.969719 | 10.030281 | 10.135902 | 9.864098 | 45 | 59 |
| 2 | 30 | 9.833851 | 10.166149 | 9.969782 | 10.030218 | 10.135931 | 9.864069 | 30 | 58 |
| 3 | 45 | 9.833885 | 10.166115 | 9.969846 | 10.030154 | 10.135961 | 9.864039 | 15 | 57 |
| 4 | 1 | 9.833919 | 10.166081 | 9.969909 | 10.030091 | 10.135990 | 9.864010 | 59 | 56 |
| 5 | 15 | 9.833953 | 10.166047 | 9.969972 | 10.030028 | 10.136020 | 9.863980 | 45 | 55 |
| 6 | 30 | 9.833986 | 10.166014 | 9.970036 | 10.029964 | 10.136049 | 9.863951 | 30 | 54 |
| 7 | 45 | 9.834020 | 10.165980 | 9.970099 | 10.029901 | 10.136079 | 9.863921 | 15 | 53 |
| 8 | 2 | 9.834054 | 10.165946 | 9.970162 | 10.029838 | 10.136108 | 9.863892 | 58 | 52 |
| 9 | 15 | 9.834088 | 10.165912 | 9.970226 | 10.029774 | 10.136138 | 9.863862 | 45 | 51 |
| 10 | 30 | 9.834122 | 10.165878 | 9.970289 | 10.029711 | 10.136167 | 9.863833 | 30 | 50 |
| 11 | 45 | 9.834156 | 10.165844 | 9.970352 | 10.029648 | 10.136197 | 9.863803 | 15 | 49 |
| 12 | 3 | 9.834189 | 10.165811 | 9.970416 | 10.029584 | 10.136226 | 9.863774 | 57 | 48 |
| 13 | 15 | 9.834223 | 10.165777 | 9.970479 | 10.029521 | 10.136256 | 9.863744 | 45 | 47 |
| 14 | 30 | 9.834257 | 10.165743 | 9.970542 | 10.029458 | 10.136285 | 9.863715 | 30 | 46 |
| 15 | 45 | 9.834291 | 10.165709 | 9.970606 | 10.029394 | 10.136315 | 9.863685 | 15 | 45 |
| 16 | 4 | 9.834325 | 10.165675 | 9.970669 | 10.029331 | 10.136344 | 9.863656 | 56 | 44 |
| 17 | 15 | 9.834358 | 10.165642 | 9.970732 | 10.029268 | 10.136374 | 9.863626 | 45 | 43 |
| 18 | 30 | 9.834392 | 10.165608 | 9.970795 | 10.029205 | 10.136403 | 9.863597 | 30 | 42 |
| 19 | 45 | 9.834426 | 10.165574 | 9.970859 | 10.029141 | 10.136433 | 9.863567 | 15 | 41 |
| 20 | 5 | 9.834460 | 10.165540 | 9.970922 | 10.029078 | 10.136462 | 9.863538 | 55 | 40 |
| 21 | 15 | 9.834493 | 10.165507 | 9.970985 | 10.029015 | 10.136492 | 9.863508 | 45 | 39 |
| 22 | 30 | 9.834527 | 10.165473 | 9.971049 | 10.028951 | 10.136522 | 9.863478 | 30 | 38 |
| 23 | 45 | 9.834561 | 10.165439 | 9.971112 | 10.028888 | 10.136551 | 9.863449 | 15 | 37 |
| 24 | 6 | 9.834595 | 10.165405 | 9.971175 | 10.028825 | 10.136581 | 9.863419 | 54 | 36 |
| 25 | 15 | 9.834628 | 10.165372 | 9.971239 | 10.028761 | 10.136610 | 9.863390 | 45 | 35 |
| 26 | 30 | 9.834662 | 10.165338 | 9.971302 | 10.028698 | 10.136640 | 9.863360 | 30 | 34 |
| 27 | 45 | 9.834696 | 10.165304 | 9.971365 | 10.028635 | 10.136669 | 9.863331 | 15 | 33 |
| 28 | 7 | 9.834730 | 10.165270 | 9.971429 | 10.028571 | 10.136699 | 9.863301 | 53 | 32 |
| 29 | 15 | 9.834763 | 10.165237 | 9.971492 | 10.028508 | 10.136728 | 9.863272 | 45 | 31 |
| 30 | 30 | 9.834797 | 10.165203 | 9.971555 | 10.028445 | 10.136758 | 9.863242 | 30 | 30 |
| 31 | 45 | 9.834831 | 10.165169 | 9.971618 | 10.028382 | 10.136788 | 9.863212 | 15 | 29 |
| 32 | 8 | 9.834865 | 10.165135 | 9.971682 | 10.028318 | 10.136817 | 9.863183 | 52 | 28 |
| 33 | 15 | 9.834898 | 10.165102 | 9.971745 | 10.028255 | 10.136847 | 9.863153 | 45 | 27 |
| 34 | 30 | 9.834932 | 10.165068 | 9.971808 | 10.028192 | 10.136876 | 9.863124 | 30 | 26 |
| 35 | 45 | 9.834966 | 10.165034 | 9.971872 | 10.028128 | 10.136906 | 9.863094 | 15 | 25 |
| 36 | 9 | 9.834999 | 10.165001 | 9.971935 | 10.028065 | 10.136936 | 9.863064 | 51 | 24 |
| 37 | 15 | 9.835033 | 10.164967 | 9.971998 | 10.028002 | 10.136965 | 9.863035 | 45 | 23 |
| 38 | 30 | 9.835067 | 10.164933 | 9.972062 | 10.027938 | 10.136995 | 9.863005 | 30 | 22 |
| 39 | 45 | 9.835100 | 10.164900 | 9.972125 | 10.027875 | 10.137024 | 9.862976 | 15 | 21 |
| 40 | 10 | 9.835134 | 10.164866 | 9.972188 | 10.027812 | 10.137054 | 9.862946 | 50 | 20 |
| 41 | 15 | 9.835168 | 10.164832 | 9.972251 | 10.027749 | 10.137084 | 9.862916 | 45 | 19 |
| 42 | 30 | 9.835201 | 10.164799 | 9.972315 | 10.027685 | 10.137113 | 9.862887 | 30 | 18 |
| 43 | 45 | 9.835235 | 10.164765 | 9.972378 | 10.027622 | 10.137143 | 9.862857 | 15 | 17 |
| 44 | 11 | 9.835269 | 10.164731 | 9.972441 | 10.027559 | 10.137173 | 9.862827 | 49 | 16 |
| 45 | 15 | 9.835302 | 10.164698 | 9.972505 | 10.027495 | 10.137202 | 9.862798 | 45 | 15 |
| 46 | 30 | 9.835336 | 10.164664 | 9.972568 | 10.027432 | 10.137232 | 9.862768 | 30 | 14 |
| 47 | 45 | 9.835370 | 10.164630 | 9.972631 | 10.027369 | 10.137262 | 9.862738 | 15 | 13 |
| 48 | 12 | 9.835403 | 10.164597 | 9.972694 | 10.027306 | 10.137291 | 9.862709 | 48 | 12 |
| 49 | 15 | 9.835437 | 10.164563 | 9.972758 | 10.027242 | 10.137321 | 9.862679 | 45 | 11 |
| 50 | 30 | 9.835471 | 10.164529 | 9.972821 | 10.027179 | 10.137351 | 9.862649 | 30 | 10 |
| 51 | 45 | 9.835504 | 10.164496 | 9.972884 | 10.027116 | 10.137380 | 9.862620 | 15 | 9 |
| 52 | 13 | 9.835538 | 10.164462 | 9.972948 | 10.027052 | 10.137410 | 9.862590 | 47 | 8 |
| 53 | 15 | 9.835571 | 10.164429 | 9.973011 | 10.026989 | 10.137440 | 9.862560 | 45 | 7 |
| 54 | 30 | 9.835605 | 10.164395 | 9.973074 | 10.026926 | 10.137469 | 9.862531 | 30 | 6 |
| 55 | 45 | 9 835639 | 10.164361 | 9.973137 | 10.026863 | 10.137499 | 9.862501 | 15 | 5 |
| 56 | 14 | 9.835672 | 10.164328 | 9.973201 | 10.026799 | 10.137529 | 9.862471 | 46 | 4 |
| 57 | 15 | 9.835706 | 10.164294 | 9.973264 | 10.026736 | 10.137558 | 9.862442 | 45 | 3 |
| 58 | 30 | 9.835739 | 10.164261 | 9.973327 | 10.026673 | 10.137588 | 9.862412 | 30 | 2 |
| 59 | 45 | 9.835773 | 10.164227 | 9.973391 | 10.026609 | 10.137618 | 9.862382 | 15 | 1 |
| 60 | 15 | 9.835807 | 10.164193 | 9.973454 | 10.026546 | 10.137647 | 9.862353 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 7m. | | | LOG. SINES, &c. | | | 46 deg. | | | |

| 2h 58m. | | LOG. SINES, &c. (t.) | | | | | 43 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.835807 | 10.164193 | 9.973454 | 10.026546 | 10.137647 | 9.862353 | 45 | 60 |
| 1 | 15 | 9.835840 | 10.164160 | 9.973517 | 10.026483 | 10.137677 | 9.862323 | 45 | 59 |
| 2 | 30 | 9.835874 | 10.164126 | 9.973580 | 10.026420 | 10.137707 | 9.862293 | 30 | 58 |
| 3 | 45 | 9.835907 | 10.164093 | 9.973644 | 10.026356 | 10.137737 | 9.862263 | 15 | 57 |
| 4 | 16 | 9.835941 | 10.164059 | 9.973707 | 10.026293 | 10.137766 | 9.862234 | 44 | 56 |
| 5 | 15 | 9.835974 | 10.164026 | 9.973770 | 10.026230 | 10.137796 | 9.862204 | 45 | 55 |
| 6 | 30 | 9.836008 | 10.163992 | 9.973834 | 10.026166 | 10.137826 | 9.862174 | 30 | 54 |
| 7 | 45 | 9.836041 | 10.163959 | 9.973897 | 10.026103 | 10.137855 | 9.862145 | 15 | 53 |
| 8 | 17 | 9.836075 | 10.163925 | 9.973960 | 10.026040 | 10.137885 | 9.862115 | 43 | 52 |
| 9 | 15 | 9.836108 | 10.163892 | 9.974023 | 10.025977 | 10.137915 | 9.862085 | 45 | 51 |
| 10 | 30 | 9.836142 | 10.163858 | 9.974087 | 10.025913 | 10.137945 | 9.862055 | 30 | 50 |
| 11 | 45 | 9.836176 | 10.163824 | 9.974150 | 10.025850 | 10.137974 | 9.862026 | 15 | 49 |
| 12 | 18 | 9.836209 | 10.163791 | 9.974213 | 10.025787 | 10.138004 | 9.861996 | 42 | 48 |
| 13 | 15 | 9.836243 | 10.163757 | 9.974277 | 10.025723 | 10.138034 | 9.861966 | 45 | 47 |
| 14 | 30 | 9.836276 | 10.163724 | 9.974340 | 10.025660 | 10.138064 | 9.861936 | 30 | 46 |
| 15 | 45 | 9.836310 | 10.163690 | 9.974403 | 10.025597 | 10.138094 | 9.861906 | 15 | 45 |
| 16 | 19 | 9.836343 | 10.163657 | 9.974466 | 10.025534 | 10.138123 | 9.861877 | 41 | 44 |
| 17 | 15 | 9.836377 | 10.163623 | 9.974530 | 10.025470 | 10.138153 | 9.861847 | 45 | 43 |
| 18 | 30 | 9.836410 | 10.163590 | 9.974593 | 10.025407 | 10.138183 | 9.861817 | 30 | 42 |
| 19 | 45 | 9.836444 | 10.163556 | 9.974656 | 10.025344 | 10.138213 | 9.861787 | 15 | 41 |
| 20 | 20 | 9.836477 | 10.163523 | 9.974719 | 10.025281 | 10.138242 | 9.861758 | 40 | 40 |
| 21 | 15 | 9.836510 | 10.163490 | 9.974783 | 10.025217 | 10.138272 | 9.861728 | 45 | 39 |
| 22 | 30 | 9.836544 | 10.163456 | 9.974846 | 10.025154 | 10.138302 | 9.861698 | 30 | 38 |
| 23 | 45 | 9.836577 | 10.163423 | 9.974909 | 10.025091 | 10.138332 | 9.861668 | 15 | 37 |
| 24 | 21 | 9.836611 | 10.163389 | 9.974973 | 10.025027 | 10.138362 | 9.861638 | 39 | 36 |
| 25 | 15 | 9.836644 | 10.163356 | 9.975036 | 10.024964 | 10.138392 | 9.861608 | 45 | 35 |
| 26 | 30 | 9.836678 | 10.163322 | 9.975099 | 10.024901 | 10.138421 | 9.861579 | 30 | 34 |
| 27 | 45 | 9.836711 | 10.163289 | 9.975162 | 10.024838 | 10.138451 | 9.861549 | 15 | 33 |
| 28 | 22 | 9.836745 | 10.163255 | 9.975226 | 10.024774 | 10.138481 | 9.861519 | 38 | 32 |
| 29 | 15 | 9.836778 | 10.163222 | 9.975289 | 10.024711 | 10.138511 | 9.861489 | 45 | 31 |
| 30 | 30 | 9.836812 | 10.163188 | 9.975352 | 10.024648 | 10.138541 | 9.861459 | 30 | 30 |
| 31 | 45 | 9.836845 | 10.163155 | 9.975415 | 10.024585 | 10.138571 | 9.861429 | 15 | 29 |
| 32 | 23 | 9.836878 | 10.163122 | 9.975479 | 10.024521 | 10.138600 | 9.861400 | 37 | 28 |
| 33 | 15 | 9.836912 | 10.163088 | 9.975542 | 10.024458 | 10.138630 | 9.861370 | 45 | 27 |
| 34 | 30 | 9.836945 | 10.163055 | 9.975605 | 10.024395 | 10.138660 | 9.861340 | 30 | 26 |
| 35 | 45 | 9.836979 | 10.163021 | 9.975668 | 10.024332 | 10.138690 | 9.861310 | 15 | 25 |
| 36 | 24 | 9.837012 | 10.162988 | 9.975732 | 10.024268 | 10.138720 | 9.861280 | 36 | 24 |
| 37 | 15 | 9.837045 | 10.162955 | 9.975795 | 10.024205 | 10.138750 | 9.861250 | 45 | 23 |
| 38 | 30 | 9.837079 | 10.162921 | 9.975858 | 10.024142 | 10.138780 | 9.861220 | 30 | 22 |
| 39 | 45 | 9.837112 | 10.162888 | 9.975922 | 10.024078 | 10.138809 | 9.861191 | 15 | 21 |
| 40 | 25 | 9.837146 | 10.162854 | 9.975985 | 10.024015 | 10.138839 | 9.861161 | 35 | 20 |
| 41 | 15 | 9.837179 | 10.162821 | 9.976048 | 10.023952 | 10.138869 | 9.861131 | 45 | 19 |
| 42 | 30 | 9.837212 | 10.162788 | 9.976111 | 10.023889 | 10.138899 | 9.861101 | 30 | 18 |
| 43 | 45 | 9.837246 | 10.162754 | 9.976175 | 10.023825 | 10.138929 | 9.861071 | 15 | 17 |
| 44 | 26 | 9.837279 | 10.162721 | 9.976238 | 10.023762 | 10.138959 | 9.861041 | 34 | 16 |
| 45 | 15 | 9.837312 | 10.162688 | 9.976301 | 10.023699 | 10.138989 | 9.861011 | 45 | 15 |
| 46 | 30 | 9.837346 | 10.162654 | 9.976364 | 10.023636 | 10.139019 | 9.860981 | 30 | 14 |
| 47 | 45 | 9.837379 | 10.162621 | 9.976428 | 10.023572 | 10.139049 | 9.860951 | 15 | 13 |
| 48 | 27 | 9.837412 | 10.162588 | 9.976491 | 10.023509 | 10.139079 | 9.860921 | 33 | 12 |
| 49 | 15 | 9.837446 | 10.162554 | 9.976554 | 10.023446 | 10.139108 | 9.860892 | 45 | 11 |
| 50 | 30 | 9.837479 | 10.162521 | 9.976617 | 10.023383 | 10.139138 | 9.860862 | 30 | 10 |
| 51 | 45 | 9.837512 | 10.162488 | 9.976681 | 10.023319 | 10.139168 | 9.860832 | 15 | 9 |
| 52 | 28 | 9.837546 | 10.162454 | 9.976744 | 10.023256 | 10.139198 | 9.860802 | 32 | 8 |
| 53 | 15 | 9.837579 | 10.162421 | 9.976807 | 10.023193 | 10.139228 | 9.860772 | 45 | 7 |
| 54 | 30 | 9.837612 | 10.162388 | 9.976870 | 10.023130 | 10.139258 | 9.860742 | 30 | 6 |
| 55 | 45 | 9.837646 | 10.162354 | 9.976934 | 10.023066 | 10.139288 | 9.860712 | 15 | 5 |
| 56 | 29 | 9.837679 | 10.162321 | 9.976997 | 10.023003 | 10.139318 | 9.860682 | 31 | 4 |
| 57 | 15 | 9.837712 | 10.162288 | 9.977060 | 10.022940 | 10.139348 | 9.860652 | 45 | 3 |
| 58 | 30 | 9.837746 | 10.162254 | 9.977123 | 10.022877 | 10.139378 | 9.860622 | 30 | 2 |
| 59 | 45 | 9.837779 | 10.162221 | 9.977187 | 10.022813 | 10.139408 | 9.860592 | 15 | 1 |
| 60 | 30 | 9.837812 | 10.162188 | 9.977250 | 10.022750 | 10.139438 | 9.860562 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent | cosecant. | sine. | ′ | sec. |

| 3h 6m. | LOG. SINES, &c. | 46 deg. |
|---|---|---|

| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
|---|---|---|---|---|---|---|---|---|---|
| | 2h 54m. | | LOG. SINES, &c. (t.) | | | | 43 deg. | | |
| 0 | 30 | 9.837812 | 10.162188 | 9.977250 | 10.022750 | 10.139438 | 9.860562 | 30 | 60 |
| 1 | 15 | 9.837845 | 10.162155 | 9.977313 | 10.022687 | 10.139468 | 9.860532 | 45 | 59 |
| 2 | 30 | 9.837879 | 10.162121 | 9.977376 | 10.022624 | 10.139498 | 9.860502 | 30 | 58 |
| 3 | 45 | 9.837912 | 10.162088 | 9.977440 | 10.022560 | 10.139528 | 9.860472 | 15 | 57 |
| 4 | 31 | 9.837945 | 10.162055 | 9.977503 | 10.022497 | 10.139558 | 9.860442 | 29 | 56 |
| 5 | 15 | 9.837978 | 10.162022 | 9.977566 | 10.022434 | 10.139588 | 9.860412 | 45 | 55 |
| 6 | 30 | 9.838012 | 10.161988 | 9.977629 | 10.022371 | 10.139618 | 9.860382 | 30 | 54 |
| 7 | 45 | 9.838045 | 10.161955 | 9.977693 | 10.022307 | 10.139648 | 9.860352 | 15 | 53 |
| 8 | 32 | 9.838078 | 10.161922 | 9.977756 | 10.022244 | 10.139678 | 9.860322 | 28 | 52 |
| 9 | 15 | 9.838111 | 10.161889 | 9.977819 | 10.022181 | 10.139708 | 9.860292 | 45 | 51 |
| 10 | 30 | 9.838145 | 10.161855 | 9.977882 | 10.022118 | 10.139738 | 9.860262 | 30 | 50 |
| 11 | 45 | 9.838178 | 10.161822 | 9.977946 | 10.022054 | 10.139768 | 9.860232 | 15 | 49 |
| 12 | 33 | 9.838211 | 10.161789 | 9.978009 | 10.021991 | 10.139798 | 9.860202 | 27 | 48 |
| 13 | 15 | 9.838244 | 10.161756 | 9.978072 | 10.021928 | 10.139828 | 9.860172 | 45 | 47 |
| 14 | 30 | 9.838278 | 10.161722 | 9.978135 | 10.021865 | 10.139858 | 9.860142 | 30 | 46 |
| 15 | 45 | 9.838311 | 10.161689 | 9.978199 | 10.021801 | 10.139888 | 9.860112 | 15 | 45 |
| 16 | 34 | 9.838344 | 10.161656 | 9.978262 | 10.021738 | 10.139918 | 9.860082 | 26 | 44 |
| 17 | 15 | 9.838377 | 10.161623 | 9.978325 | 10.021675 | 10.139948 | 9.860052 | 45 | 43 |
| 18 | 30 | 9.838410 | 10.161590 | 9.978388 | 10.021612 | 10.139978 | 9.860022 | 30 | 42 |
| 19 | 45 | 9.838444 | 10.161556 | 9.978452 | 10.021548 | 10.140008 | 9.859992 | 15 | 41 |
| 20 | 35 | 9.838477 | 10.161523 | 9.978515 | 10.021485 | 10.140038 | 9.859962 | 25 | 40 |
| 21 | 15 | 9.838510 | 10.161490 | 9.978578 | 10.021422 | 10.140068 | 9.859932 | 45 | 39 |
| 22 | 30 | 9.838543 | 10.161457 | 9.978641 | 10.021359 | 10.140098 | 9.859902 | 30 | 38 |
| 23 | 45 | 9.838576 | 10.161424 | 9.978705 | 10.021295 | 10.140128 | 9.859872 | 15 | 37 |
| 24 | 36 | 9.838610 | 10.161390 | 9.978768 | 10.021232 | 10.140158 | 9.859842 | 24 | 36 |
| 25 | 15 | 9.838643 | 10.161357 | 9.978831 | 10.021169 | 10.140188 | 9.859812 | 45 | 35 |
| 26 | 30 | 9.838676 | 10.161324 | 9.978894 | 10.021106 | 10.140219 | 9.859781 | 30 | 34 |
| 27 | 45 | 9.838709 | 10.161291 | 9.978958 | 10.021042 | 10.140249 | 9.859751 | 15 | 33 |
| 28 | 37 | 9.838742 | 10.161258 | 9.979021 | 10.020979 | 10.140279 | 9.859721 | 23 | 32 |
| 29 | 15 | 9.838775 | 10.161225 | 9.979084 | 10.020916 | 10.140309 | 9.859691 | 45 | 31 |
| 30 | 30 | 9.838808 | 10.161192 | 9.979147 | 10.020853 | 10.140339 | 9.859661 | 30 | 30 |
| 31 | 45 | 9.838842 | 10.161158 | 9.979211 | 10.020789 | 10.140369 | 9.859631 | 15 | 29 |
| 32 | 38 | 9.838875 | 10.161125 | 9.979274 | 10.020726 | 10.140399 | 9.859601 | 22 | 28 |
| 33 | 15 | 9.838908 | 10.161092 | 9 979337 | 10.020663 | 10.140429 | 9.859571 | 45 | 27 |
| 34 | 30 | 9.838941 | 10.161059 | 9.979400 | 10.020600 | 10.140459 | 9.859541 | 30 | 26 |
| 35 | 45 | 9.838974 | 10.161026 | 9.979463 | 10.020537 | 10.140490 | 9.859510 | 15 | 25 |
| 36 | 39 | 9.839007 | 10.160993 | 9.979527 | 10.020473 | 10.140520 | 9.859480 | 21 | 24 |
| 37 | 15 | 9.839040 | 10.160960 | 9.979590 | 10.020410 | 10.140550 | 9.859450 | 45 | 23 |
| 38 | 30 | 9.839073 | 10.160927 | 9.979653 | 10.020347 | 10.140580 | 9.859420 | 30 | 22 |
| 39 | 45 | 9.839106 | 10.160894 | 9.979716 | 10.020284 | 10.140610 | 9.859390 | 15 | 21 |
| 40 | 40 | 9.839140 | 10.160860 | 9.979780 | 10.020220 | 10.140640 | 9.859360 | 20 | 20 |
| 41 | 15 | 9.839173 | 10.160827 | 9.979843 | 10.020157 | 10.140670 | 9.859330 | 45 | 19 |
| 42 | 30 | 9.839206 | 10.160794 | 9.979906 | 10.020094 | 10.140700 | 9.859300 | 30 | 18 |
| 43 | 45 | 9.839239 | 10.160761 | 9.979969 | 10.020031 | 10.140731 | 9.859269 | 15 | 17 |
| 44 | 41 | 9.839272 | 10.160728 | 9.980033 | 10.019967 | 10.140761 | 9.859239 | 19 | 16 |
| 45 | 15 | 9.839305 | 10.160695 | 9.980096 | 10.019904 | 10.140791 | 9.859209 | 45 | 15 |
| 46 | 30 | 9.839338 | 10.160662 | 9.980159 | 10.019841 | 10.140821 | 9.859179 | 30 | 14 |
| 47 | 45 | 9.839371 | 10.160629 | 9.980222 | 10.019778 | 10.140851 | 9.859149 | 15 | 13 |
| 48 | 42 | 9.839404 | 10.160596 | 9.980286 | 10.019714 | 10.140881 | 9.859119 | 18 | 12 |
| 49 | 15 | 9.839437 | 10.160563 | 9.980349 | 10.019651 | 10.140912 | 9.859088 | 45 | 11 |
| 50 | 30 | 9.839470 | 10.160530 | 9.980412 | 10.019588 | 10.140942 | 9.859058 | 30 | 10 |
| 51 | 45 | 9.839503 | 10.160497 | 9.980475 | 10.019525 | 10.140972 | 9.859028 | 15 | 9 |
| 52 | 43 | 9.839536 | 10.160464 | 9.980538 | 10.019462 | 10.141002 | 9.858998 | 17 | 8 |
| 53 | 15 | 9.839569 | 10.160431 | 9.980602 | 10.019398 | 10.141032 | 9.858968 | 45 | 7 |
| 54 | 30 | 9.839602 | 10.160398 | 9.980665 | 10.019335 | 10.141063 | 9.858937 | 30 | 6 |
| 55 | 45 | 9.839635 | 10.160365 | 9.980728 | 10.019272 | 10.141093 | 9.858907 | 15 | 5 |
| 56 | 44 | 9.839668 | 10.160332 | 9.980791 | 10.019209 | 10.141123 | 9.858877 | 16 | 4 |
| 57 | 15 | 9.839701 | 10.160299 | 9.980855 | 10.019145 | 10.141153 | 9.858847 | 45 | 3 |
| 58 | 30 | 9.839734 | 10.160266 | 9.980918 | 10.019082 | 10.141184 | 9.858816 | 30 | 2 |
| 59 | 45 | 9.839767 | 10.160233 | 9.980981 | 10.019019 | 10.141214 | 9.858786 | 15 | 1 |
| 60 | 45 | 9.839800 | 10.160200 | 9.981044 | 10.018956 | 10.141244 | 9.858756 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| | 3h 5m. | | LOG. SINES, &c. | | | | 46 deg. | | |

| 2h 55m. | | LOG. SINES, &c. (t.) | | | | | | 43 deg. | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.839800 | 10.160200 | 9.981044 | 10.018956 | 10.141244 | 9.858756 | 15 | 60 |
| 1 | 15 | 9.839833 | 10.160167 | 9.981107 | 10.018893 | 10.141274 | 9.858726 | 45 | 59 |
| 2 | 30 | 9.839866 | 10.160134 | 9.981171 | 10.018829 | 10.141304 | 9.858696 | 30 | 58 |
| 3 | 45 | 9.839899 | 10.160101 | 9.981234 | 10.018766 | 10.141335 | 9.858665 | 15 | 57 |
| 4 | 46 | 9.839932 | 10.160068 | 9.981297 | 10.018703 | 10.141365 | 9.858635 | 14 | 56 |
| 5 | 15 | 9.839965 | 10.160035 | 9.981360 | 10.018640 | 10.141395 | 9.858605 | 45 | 55 |
| 6 | 30 | 9.839998 | 10.160002 | 9.981424 | 10.018576 | 10.141425 | 9.858575 | 30 | 54 |
| 7 | 45 | 9.840031 | 10.159969 | 9.981487 | 10.018513 | 10.141456 | 9.858544 | 15 | 53 |
| 8 | 47 | 9.840064 | 10.159936 | 9.981550 | 10.018450 | 10.141486 | 9.858514 | 13 | 52 |
| 9 | 15 | 9.840097 | 10.159903 | 9.981613 | 10.018387 | 10.141516 | 9.858484 | 45 | 51 |
| 10 | 30 | 9.840130 | 10.159870 | 9.981677 | 10.018323 | 10.141547 | 9.858453 | 30 | 50 |
| 11 | 45 | 9.840163 | 10.159837 | 9.981740 | 10.018260 | 10.141577 | 9.858423 | 15 | 49 |
| 12 | 48 | 9.840196 | 10.159804 | 9.981803 | 10.018197 | 10.141607 | 9.858393 | 12 | 48 |
| 13 | 15 | 9.840229 | 10.159771 | 9.981866 | 10.018134 | 10.141637 | 9.858363 | 45 | 47 |
| 14 | 30 | 9.840262 | 10.159738 | 9.981929 | 10.018071 | 10.141668 | 9.858332 | 30 | 46 |
| 15 | 45 | 9.840295 | 10.159705 | 9.981993 | 10.018007 | 10.141698 | 9.858302 | 15 | 45 |
| 16 | 49 | 9.840328 | 10.159672 | 9.982056 | 10.017944 | 10.141728 | 9.858272 | 11 | 44 |
| 17 | 15 | 9.840361 | 10.159639 | 9.982119 | 10.017881 | 10.141759 | 9.858241 | 45 | 43 |
| 18 | 30 | 9.840393 | 10.159607 | 9.982182 | 10.017818 | 10.141789 | 9.858211 | 30 | 42 |
| 19 | 45 | 9.840426 | 10.159574 | 9.982245 | 10.017755 | 10.141819 | 9.858181 | 15 | 41 |
| 20 | 50 | 9.840459 | 10.159541 | 9.982309 | 10.017691 | 10.141850 | 9.858150 | 10 | 40 |
| 21 | 15 | 9.840492 | 10.159508 | 9.982372 | 10.017628 | 10.141880 | 9.858120 | 45 | 39 |
| 22 | 30 | 9.840525 | 10.159475 | 9.982435 | 10.017565 | 10.141910 | 9.858090 | 30 | 38 |
| 23 | 45 | 9.840558 | 10.159442 | 9.982498 | 10.017502 | 10.141941 | 9.858059 | 15 | 37 |
| 24 | 51 | 9.840591 | 10.159409 | 9.982562 | 10.017438 | 10.141971 | 9.858029 | 9 | 36 |
| 25 | 15 | 9.840624 | 10.159376 | 9.982625 | 10.017375 | 10.142001 | 9.857999 | 45 | 35 |
| 26 | 30 | 9.840656 | 10.159344 | 9.982688 | 10.017312 | 10.142032 | 9.857968 | 30 | 34 |
| 27 | 45 | 9.840689 | 10.159311 | 9.982751 | 10.017249 | 10.142062 | 9.857938 | 15 | 33 |
| 28 | 52 | 9.840722 | 10.159278 | 9.982814 | 10.017186 | 10.142092 | 9.857908 | 8 | 32 |
| 29 | 15 | 9.840755 | 10.159245 | 9.982878 | 10.017122 | 10.142123 | 9.857877 | 45 | 31 |
| 30 | 30 | 9.840788 | 10.159212 | 9.982941 | 10.017059 | 10.142183 | 9.857847 | 30 | 30 |
| 31 | 45 | 9.840821 | 10.159179 | 9.983004 | 10.016996 | 10.142183 | 9.857817 | 15 | 29 |
| 32 | 53 | 9.840854 | 10.159146 | 9.983067 | 10.016933 | 10.142214 | 9.857786 | 7 | 28 |
| 33 | 15 | 9.840886 | 10.159114 | 9.983131 | 10.016869 | 10.142244 | 9.857756 | 45 | 27 |
| 34 | 30 | 9.840919 | 10.159081 | 9.983194 | 10.016806 | 10.142274 | 9.857726 | 30 | 26 |
| 35 | 45 | 9.840952 | 10.159048 | 9.983257 | 10.016743 | 10.142305 | 9.857695 | 15 | 25 |
| 36 | 54 | 9.840985 | 10.159015 | 9.983320 | 10.016680 | 10.142335 | 9.857665 | 6 | 24 |
| 37 | 15 | 9.841018 | 10.158982 | 9.983383 | 10.016617 | 10.142366 | 9.857634 | 45 | 23 |
| 38 | 30 | 9.841051 | 10.158949 | 9.983447 | 10.016553 | 10.142396 | 9.857604 | 30 | 22 |
| 39 | 45 | 9.841083 | 10.158917 | 9.983510 | 10.016490 | 10.142426 | 9.857574 | 15 | 21 |
| 40 | 55 | 9.841116 | 10.158884 | 9.983573 | 10.016427 | 10.142457 | 9.857543 | 5 | 20 |
| 41 | 15 | 9.841149 | 10.158851 | 9.983636 | 10.016364 | 10.142487 | 9.857513 | 45 | 19 |
| 42 | 30 | 9.841182 | 10.158818 | 9.983699 | 10.016301 | 10.142518 | 9.857482 | 30 | 18 |
| 43 | 45 | 9.841215 | 10.158785 | 9.983763 | 10.016237 | 10.142548 | 9.857452 | 15 | 17 |
| 44 | 56 | 9.841247 | 10.158753 | 9.983826 | 10.016174 | 10.142579 | 9.857421 | 4 | 16 |
| 45 | 15 | 9.841280 | 10.158720 | 9.983889 | 10.016111 | 10.142609 | 9.857391 | 45 | 15 |
| 46 | 30 | 9.841313 | 10.158687 | 9.983952 | 10.016048 | 10.142639 | 9.857361 | 30 | 14 |
| 47 | 45 | 9.841346 | 10.158654 | 9.984015 | 10.015985 | 10.142670 | 9.857330 | 15 | 13 |
| 48 | 57 | 9.841378 | 10.158622 | 9.984079 | 10.015921 | 10.142700 | 9.857300 | 3 | 12 |
| 49 | 15 | 9.841411 | 10.158589 | 9.984142 | 10.015858 | 10.142731 | 9.857269 | 45 | 11 |
| 50 | 30 | 9.841444 | 10.158556 | 9.984205 | 10.015795 | 10.142761 | 9.857239 | 30 | 10 |
| 51 | 45 | 9.841477 | 10.158523 | 9.984268 | 10.015732 | 10.142792 | 9.857208 | 15 | 9 |
| 52 | 58 | 9.841509 | 10.158491 | 9.984331 | 10.015669 | 10.142822 | 9.857178 | 2 | 8 |
| 53 | 15 | 9.841542 | 10.158458 | 9.984395 | 10.015605 | 10.142853 | 9.857147 | 45 | 7 |
| 54 | 30 | 9.841575 | 10.158425 | 9.984458 | 10.015542 | 10.142883 | 9.857117 | 30 | 6 |
| 55 | 45 | 9.841608 | 10.158392 | 9.984521 | 10.015479 | 10.142914 | 9.857086 | 15 | 5 |
| 56 | 59 | 9.841640 | 10.158360 | 9.984584 | 10.015416 | 10.142944 | 9.857056 | 1 | 4 |
| 57 | 15 | 9.841673 | 10.158327 | 9.984648 | 10.015352 | 10.142974 | 9.857026 | 45 | 3 |
| 58 | 30 | 9.841706 | 10.158294 | 9.984711 | 10.015289 | 10.143005 | 9.856995 | 30 | 2 |
| 59 | 45 | 9.841739 | 10.158261 | 9.984774 | 10.015226 | 10.143035 | 9.856965 | 15 | 1 |
| 60 | 60 | 9.841771 | 10.158229 | 9.984837 | 10.015163 | 10.143066 | 9.856934 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 4m. | | | | LOG. SINES, &c. | | | | 46 deg. | |

| 2h 56m. | | | LOG. SINES, &c. (t.) | | | | 44 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 0 | 9.841771 | 10.158229 | 9.984837 | 10.015163 | 10.143066 | 9.856934 | 60 | 60 |
| 1 | 15 | 9.841804 | 10.158196 | 9.984900 | 10.015100 | 10.143096 | 9.856904 | 45 | 59 |
| 2 | 30 | 9.841837 | 10.158163 | 9.984964 | 10.015036 | 10.143127 | 9.856873 | 30 | 58 |
| 3 | 45 | 9.841869 | 10.158131 | 9.985027 | 10.014973 | 10.143157 | 9.856843 | 15 | 57 |
| 4 | 1 | 9.841902 | 10.158098 | 9.985090 | 10.014910 | 10.143188 | 9.856812 | 59 | 56 |
| 5 | 15 | 9.841935 | 10.158065 | 9.985153 | 10.014847 | 10.143219 | 9.856781 | 45 | 55 |
| 6 | 30 | 9.841967 | 10.158033 | 9.985216 | 10.014784 | 10.143249 | 9.856751 | 30 | 54 |
| 7 | 45 | 9.842000 | 10.158000 | 9.985280 | 10.014720 | 10.143280 | 9.856720 | 15 | 53 |
| 8 | 2 | 9.842033 | 10.157967 | 9.985343 | 10.014657 | 10.143310 | 9.856690 | 58 | 52 |
| 9 | 15 | 9.842065 | 10.157935 | 9.985406 | 10.014594 | 10.143341 | 9.856659 | 45 | 51 |
| 10 | 30 | 9.842098 | 10.157902 | 9.985469 | 10.014531 | 10.143370 | 9.856630 | 30 | 50 |
| 11 | 45 | 9.842131 | 10.157869 | 9.985532 | 10.014468 | 10.143402 | 9.856598 | 15 | 49 |
| 12 | 3 | 9.842163 | 10.157837 | 9.985596 | 10.014404 | 10.143432 | 9.856568 | 57 | 48 |
| 13 | 15 | 9.842196 | 10.157804 | 9.985659 | 10.014341 | 10.143463 | 9.856537 | 45 | 47 |
| 14 | 30 | 9.842229 | 10.157771 | 9.985722 | 10.014278 | 10.143493 | 9.856507 | 30 | 46 |
| 15 | 45 | 9.842261 | 10.157739 | 9.985785 | 10.014215 | 10.143524 | 9.856476 | 15 | 45 |
| 16 | 4 | 9.842294 | 10.157706 | 9.985848 | 10.014152 | 10.143555 | 9.856445 | 56 | 44 |
| 17 | 15 | 9.842327 | 10.157673 | 9.985912 | 10.014088 | 10.143585 | 9.856415 | 45 | 43 |
| 18 | 30 | 9.842359 | 10.157641 | 9.985975 | 10.014025 | 10.143616 | 9.856384 | 30 | 42 |
| 19 | 45 | 9.842392 | 10.157608 | 9.986038 | 10.013962 | 10.143646 | 9.856354 | 15 | 41 |
| 20 | 5 | 9.842424 | 10.157576 | 9.986101 | 10.013899 | 10.143677 | 9.856323 | 55 | 40 |
| 21 | 15 | 9.842457 | 10.157543 | 9.986164 | 10.013836 | 10.143707 | 9.856293 | 45 | 39 |
| 22 | 30 | 9.842490 | 10.157510 | 9.986228 | 10.013772 | 10.143738 | 9 856262 | 30 | 38 |
| 23 | 45 | 9.842522 | 10.157478 | 9.986291 | 10.013709 | 10.143769 | 9.856231 | 15 | 37 |
| 24 | 6 | 9.842555 | 10.157445 | 9.986354 | 10.013646 | 10.143799 | 9.856201 | 54 | 36 |
| 25 | 15 | 9.842587 | 10.157413 | 9.986417 | 10.013583 | 10.143830 | 9.856170 | 45 | 35 |
| 26 | 30 | 9.842620 | 10.157380 | 9.986480 | 10.013520 | 10.143860 | 9.856140 | 30 | 34 |
| 27 | 45 | 9.842653 | 10.157347 | 9.986544 | 10.013456 | 10.143891 | 9.856109 | 15 | 33 |
| 28 | 7 | 9.842685 | 10.157315 | 9.986607 | 10.013393 | 10.143922 | 9.856078 | 53 | 32 |
| 29 | 15 | 9.842718 | 10.157282 | 9.986670 | 10.013330 | 10.143952 | 9.856048 | 45 | 31 |
| 30 | 30 | 9.842750 | 10.157250 | 9.986733 | 10.013267 | 10.143983 | 9.856017 | 30 | 30 |
| 31 | 45 | 9.842783 | 10.157217 | 9.986796 | 10.013204 | 10.144014 | 9.855986 | 15 | 29 |
| 32 | 8 | 9.842815 | 10.157185 | 9.986860 | 10.013140 | 10.144044 | 9.855956 | 52 | 28 |
| 33 | 15 | 9.842848 | 10.157152 | 9.986923 | 10.013077 | 10.144075 | 9.855925 | 45 | 27 |
| 34 | 30 | 9.842880 | 10.157120 | 9.986986 | 10.013014 | 10.144106 | 9.855894 | 30 | 26 |
| 35 | 45 | 9.842913 | 10.157087 | 9.987049 | 10.012951 | 10.144136 | 9.855864 | 15 | 25 |
| 36 | 9 | 9.842946 | 10.157054 | 9.987112 | 10.012888 | 10.144167 | 9.855833 | 51 | 24 |
| 37 | 15 | 9.842978 | 10.157022 | 9.987175 | 10.012825 | 10.144197 | 9.855803 | 45 | 23 |
| 38 | 30 | 9.843011 | 10.156989 | 9.987239 | 10.012761 | 10.144228 | 9.855772 | 30 | 22 |
| 39 | 45 | 9.843043 | 10.156957 | 9.987302 | 10.012698 | 10.144259 | 9.855741 | 15 | 21 |
| 40 | 10 | 9.843076 | 10.156924 | 9.987365 | 10.012635 | 10.144289 | 9.855711 | 50 | 20 |
| 41 | 15 | 9.843108 | 10.156892 | 9.987428 | 10.012572 | 10.144320 | 9.855680 | 45 | 19 |
| 42 | 30 | 9.843141 | 10.156859 | 9.987491 | 10.012509 | 10.144351 | 9.855649 | 30 | 18 |
| 43 | 45 | 9.843173 | 10.156827 | 9.987555 | 10.012445 | 10.144382 | 9.855618 | 15 | 17 |
| 44 | 11 | 9.843206 | 10.156794 | 9.987618 | 10.012382 | 10.144412 | 9.855588 | 49 | 16 |
| 45 | 15 | 9.843238 | 10.156762 | 9.987681 | 10.012319 | 10.144443 | 9.855557 | 45 | 15 |
| 46 | 30 | 9.843271 | 10.156729 | 9.987744 | 10.012256 | 10.144474 | 9.855526 | 30 | 14 |
| 47 | 45 | 9.843303 | 10.156697 | 9.987807 | 10.012193 | 10.144504 | 9.855496 | 15 | 13 |
| 48 | 12 | 9.843336 | 10.156664 | 9.987871 | 10.012129 | 10.144535 | 9.855465 | 48 | 12 |
| 49 | 15 | 9.843368 | 10.156632 | 9.987934 | 10.012066 | 10.144566 | 9.855434 | 45 | 11 |
| 50 | 30 | 9.843401 | 10.156599 | 9.987997 | 10.012003 | 10.144596 | 9.855404 | 30 | 10 |
| 51 | 45 | 9.843433 | 10.156567 | 9.988060 | 10.011940 | 10.144627 | 9.855373 | 15 | 9 |
| 52 | 13 | 9.843465 | 10.156535 | 9.988123 | 10.011877 | 10.144658 | 9.855342 | 47 | 8 |
| 53 | 15 | 9.843498 | 10.156502 | 9.988187 | 10.011813 | 10.144689 | 9.855311 | 45 | 7 |
| 54 | 30 | 9.843530 | 10.156470 | 9.988250 | 10.011750 | 10.144719 | 9.855281 | 30 | 6 |
| 55 | 45 | 9.843563 | 10.156437 | 9.988313 | 10.011687 | 10.144750 | 9.855250 | 15 | 5 |
| 56 | 14 | 9.843595 | 10.156405 | 9.988376 | 10.011624 | 10.144781 | 9.855219 | 46 | 4 |
| 57 | 15 | 9.843628 | 10.156372 | 9.988439 | 10.011561 | 10.144812 | 9.855188 | 45 | 3 |
| 58 | 30 | 9.843660 | 10.156340 | 9.988502 | 10.011498 | 10.144842 | 9.855158 | 30 | 2 |
| 59 | 45 | 9.843693 | 10.156307 | 9.988566 | 10.011434 | 10.144873 | 9.855127 | 15 | 1 |
| 60 | 15 | 9.843725 | 10.156275 | 9.988629 | 10.011371 | 10.144904 | 9.855096 | 45 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 3m. | | | LOG. SINES, &c. | | | | 45 deg. | | |

| 2h 57m. | | | LOG. SINES, &c. (t.) | | | | 44 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 15 | 9.843725 | 10.156275 | 9.988629 | 10.011371 | 10.144904 | 9.855096 | 45 | 60 |
| 1 | 15 | 9.843757 | 10.156243 | 9.988692 | 10.011308 | 10.144935 | 9.855065 | 45 | 59 |
| 2 | 30 | 9.843790 | 10.156210 | 9.988755 | 10.011245 | 10.144965 | 9.855035 | 30 | 58 |
| 3 | 45 | 9.843822 | 10.156178 | 9.988818 | 10.011182 | 10.144996 | 9.855004 | 15 | 57 |
| 4 | 16 | 9.843855 | 10.156145 | 9.988882 | 10.011118 | 10.145027 | 9.854973 | 44 | 56 |
| 5 | 15 | 9.843887 | 10.156113 | 9.988945 | 10.011055 | 10.145058 | 9.854942 | 45 | 55 |
| 6 | 30 | 9.843919 | 10.156081 | 9.989008 | 10.010992 | 10.145089 | 9.854911 | 30 | 54 |
| 7 | 45 | 9.843952 | 10.156048 | 9.989071 | 10.010929 | 10.145119 | 9.854881 | 15 | 53 |
| 8 | 17 | 9.843984 | 10.156016 | 9.989134 | 10.010866 | 10.145150 | 9.854850 | 43 | 52 |
| 9 | 15 | 9.844017 | 10.155983 | 9.989198 | 10.010802 | 10.145181 | 9.854819 | 45 | 51 |
| 10 | 30 | 9.844049 | 10.155951 | 9.989261 | 10.010739 | 10.145212 | 9.854788 | 30 | 50 |
| 11 | 45 | 9.844081 | 10.155919 | 9.989324 | 10.010676 | 10.145243 | 9.854757 | 15 | 49 |
| 12 | 18 | 9.844114 | 10.155886 | 9.989387 | 10.010613 | 10.145273 | 9.854727 | 42 | 48 |
| 13 | 15 | 9.844146 | 10.155854 | 9.989450 | 10.010550 | 10.145304 | 9.854696 | 45 | 47 |
| 14 | 30 | 9.844178 | 10.155822 | 9.989513 | 10.010487 | 10.145335 | 9.854665 | 30 | 46 |
| 15 | 45 | 9.844211 | 10.155789 | 9.989577 | 10.010423 | 10.145366 | 9.854634 | 15 | 45 |
| 16 | 19 | 9.844243 | 10.155757 | 9.989640 | 10.010360 | 10.145397 | 9.854603 | 41 | 44 |
| 17 | 15 | 9.844275 | 10.155725 | 9.989703 | 10.010297 | 10.145428 | 9.854572 | 45 | 43 |
| 18 | 30 | 9.844308 | 10.155692 | 9.989766 | 10.010234 | 10.145458 | 9.854542 | 30 | 42 |
| 19 | 45 | 9.844340 | 10.155660 | 9.989829 | 10.010171 | 10.145489 | 9.854511 | 15 | 41 |
| 20 | 20 | 9.844372 | 10.155628 | 9.989893 | 10.010107 | 10.145520 | 9.854480 | 40 | 40 |
| 21 | 15 | 9.844405 | 10.155595 | 9.989956 | 10.010044 | 10.145551 | 9.854449 | 45 | 39 |
| 22 | 30 | 9.844437 | 10.155563 | 9.990019 | 10.009981 | 10.145582 | 9.854418 | 30 | 38 |
| 23 | 45 | 9.844469 | 10.155531 | 9.990082 | 10.009918 | 10.145613 | 9.854387 | 15 | 37 |
| 24 | 21 | 9.844502 | 10.155498 | 9.990145 | 10.009855 | 10.145644 | 9.854356 | 39 | 36 |
| 25 | 15 | 9.844534 | 10.155466 | 9.990208 | 10.009792 | 10.145674 | 9.854326 | 45 | 35 |
| 26 | 30 | 9.844566 | 10.155434 | 9.990272 | 10.009728 | 10.145705 | 9.854295 | 30 | 34 |
| 27 | 45 | 9.844599 | 10.155401 | 9.990335 | 10.009665 | 10.145736 | 9.854264 | 15 | 33 |
| 28 | 22 | 9.844631 | 10.155369 | 9.990398 | 10.009602 | 10.145767 | 9.854233 | 38 | 32 |
| 29 | 15 | 9.844663 | 10.155337 | 9.990461 | 10.009539 | 10.145798 | 9.854202 | 45 | 31 |
| 30 | 30 | 9.844695 | 10.155305 | 9.990524 | 10.009476 | 10.145829 | 9.854171 | 30 | 30 |
| 31 | 45 | 9.844728 | 10.155272 | 9.990588 | 10.009412 | 10.145860 | 9.854140 | 15 | 29 |
| 32 | 23 | 9.844760 | 10.155240 | 9.990651 | 10.009349 | 10.145891 | 9.854109 | 37 | 28 |
| 33 | 15 | 9.844792 | 10.155208 | 9.990714 | 10.009286 | 10.145922 | 9.854078 | 45 | 27 |
| 34 | 30 | 9.844825 | 10.155175 | 9.990777 | 10.009223 | 10.145953 | 9.854047 | 30 | 26 |
| 35 | 45 | 9.844857 | 10.155143 | 9.990840 | 10.009160 | 10.145983 | 9.854017 | 15 | 25 |
| 36 | 24 | 9.844889 | 10.155111 | 9.990903 | 10.009097 | 10.146014 | 9.853986 | 36 | 24 |
| 37 | 15 | 9.844921 | 10.155079 | 9.990967 | 10.009033 | 10.146045 | 9.853955 | 45 | 23 |
| 38 | 30 | 9.844954 | 10.155046 | 9.991030 | 10.008970 | 10.146076 | 9.853924 | 30 | 22 |
| 39 | 45 | 9.844986 | 10.155014 | 9.991093 | 10.008907 | 10.146107 | 9.853893 | 15 | 21 |
| 40 | 25 | 9.845018 | 10.154982 | 9.991156 | 10.008844 | 10.146138 | 9.853862 | 35 | 20 |
| 41 | 15 | 9.845050 | 10.154950 | 9.991219 | 10.008781 | 10.146169 | 9.853831 | 45 | 19 |
| 42 | 30 | 9.845082 | 10.154918 | 9.991283 | 10.008717 | 10.146200 | 9.853800 | 30 | 18 |
| 43 | 45 | 9.845115 | 10.154885 | 9.991346 | 10.008654 | 10.146231 | 9.853769 | 15 | 17 |
| 44 | 26 | 9.845147 | 10.154853 | 9.991409 | 10.008591 | 10.146262 | 9.853738 | 34 | 16 |
| 45 | 15 | 9.845179 | 10.154821 | 9.991472 | 10.008528 | 10.146293 | 9.853707 | 45 | 15 |
| 46 | 30 | 9.845211 | 10.154789 | 9.991535 | 10.008465 | 10.146324 | 9.853676 | 30 | 14 |
| 47 | 45 | 9.845244 | 10.154756 | 9.991598 | 10.008402 | 10.146355 | 9.853645 | 15 | 13 |
| 48 | 27 | 9.845276 | 10.154724 | 9.991662 | 10.008338 | 10.146386 | 9.853614 | 33 | 12 |
| 49 | 15 | 9.845308 | 10.154692 | 9.991725 | 10.008275 | 10.146417 | 9.853583 | 45 | 11 |
| 50 | 30 | 9.845340 | 10.154660 | 9.991788 | 10.008212 | 10.146448 | 9.853552 | 30 | 10 |
| 51 | 45 | 9.845372 | 10.154628 | 9.991851 | 10.008149 | 10.146479 | 9.853521 | 15 | 9 |
| 52 | 28 | 9.845404 | 10.154596 | 9.991914 | 10.008086 | 10.146510 | 9.853490 | 32 | 8 |
| 53 | 15 | 9.845437 | 10.154563 | 9.991977 | 10.008023 | 10.146541 | 9.853459 | 45 | 7 |
| 54 | 30 | 9.845469 | 10.154531 | 9.992041 | 10.007959 | 10.146572 | 9.853428 | 30 | 6 |
| 55 | 45 | 9.845501 | 10.154499 | 9.992104 | 10.007896 | 10.146603 | 9.853397 | 15 | 5 |
| 56 | 29 | 9.845533 | 10.154467 | 9.992167 | 10.007833 | 10.146634 | 9.853366 | 31 | 4 |
| 57 | 15 | 9.845565 | 10.154435 | 9.992230 | 10.007770 | 10.146665 | 9.853335 | 45 | 3 |
| 58 | 30 | 9.845597 | 10.154403 | 9.992293 | 10.007707 | 10.146696 | 9.853304 | 30 | 2 |
| 59 | 45 | 9.845630 | 10.154370 | 9.992357 | 10.007643 | 10.146727 | 9.853273 | 15 | 1 |
| 60 | 30 | 9.845662 | 10.154338 | 9.992420 | 10.007580 | 10.146758 | 9.853242 | 30 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 2m. | | | LOG. SINES, &c. | | | | 45 deg. | | |

| 2h 5m. | | | LOG. SINES, &c. (t.) | | | | 44 deg. | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 30 | 9.845662 | 10.154338 | 9.992420 | 10.007580 | 10.146758 | 9.853242 | 30 | 60 |
| 1 | 15 | 9.845694 | 10.154306 | 9.992483 | 10.007517 | 10.146789 | 9.853211 | 45 | 59 |
| 2 | 30 | 9.845726 | 10.154274 | 9.992546 | 10.007454 | 10.146820 | 9.853180 | 30 | 58 |
| 3 | 45 | 9.845758 | 10.154242 | 9.992609 | 10.007391 | 10.146851 | 9.853149 | 15 | 57 |
| 4 | 31 | 9.845790 | 10.154210 | 9.992672 | 10.007328 | 10.146882 | 9.853118 | 29 | 56 |
| 5 | 15 | 9.845822 | 10.154178 | 9.992736 | 10.007264 | 10.146913 | 9.853087 | 45 | 55 |
| 6 | 30 | 9.845854 | 10.154146 | 9.992799 | 10.007201 | 10.146944 | 9.853056 | 30 | 54 |
| 7 | 45 | 9.845887 | 10.154113 | 9.992862 | 10.007138 | 10.146975 | 9.853025 | 15 | 53 |
| 8 | 32 | 9.845919 | 10.154081 | 9.992925 | 10.007075 | 10.147006 | 9.852994 | 28 | 52 |
| 9 | 15 | 9.845951 | 10.154049 | 9.992988 | 10.007012 | 10.147038 | 9.852962 | 45 | 51 |
| 10 | 30 | 9.845983 | 10.154017 | 9.993051 | 10.006949 | 10.147069 | 9.852931 | 30 | 50 |
| 11 | 45 | 9.846015 | 10.153985 | 9.993115 | 10.006885 | 10.147100 | 9.852900 | 15 | 49 |
| 12 | 33 | 9.846047 | 10.153953 | 9.993178 | 10.006822 | 10.147131 | 9.852869 | 27 | 48 |
| 13 | 15 | 9.846079 | 10.153921 | 9.993241 | 10.006759 | 10.147162 | 9.852838 | 45 | 47 |
| 14 | 30 | 9.846111 | 10.153889 | 9.993304 | 10.006696 | 10.147193 | 9.852807 | 30 | 46 |
| 15 | 45 | 9.846143 | 10.153857 | 9.993367 | 10.006633 | 10.147224 | 9.852776 | 15 | 45 |
| 16 | 34 | 9.846175 | 10.153825 | 9.993430 | 10.006570 | 10.147255 | 9.852745 | 26 | 44 |
| 17 | 15 | 9.846207 | 10.153793 | 9.993494 | 10.006506 | 10.147286 | 9.852714 | 45 | 43 |
| 18 | 30 | 9.846239 | 10.153761 | 9.993557 | 10.006443 | 10.147317 | 9.852683 | 30 | 42 |
| 19 | 45 | 9.846272 | 10.153728 | 9.993620 | 10.006380 | 10.147349 | 9.852651 | 15 | 41 |
| 20 | 35 | 9.846304 | 10.153696 | 9.993683 | 10.006317 | 10.147380 | 9.852620 | 25 | 40 |
| 21 | 15 | 9.846336 | 10.153664 | 9.993746 | 10.006254 | 10.147411 | 9.852589 | 45 | 39 |
| 22 | 30 | 9.846368 | 10.153632 | 9.993810 | 10.006190 | 10.147442 | 9.852558 | 30 | 38 |
| 23 | 45 | 9.846400 | 10.153600 | 9.993873 | 10.006127 | 10.147473 | 9.852527 | 15 | 37 |
| 24 | 36 | 9.846432 | 10.153568 | 9.993936 | 10.006064 | 10.147504 | 9.852496 | 24 | 36 |
| 25 | 15 | 9.846464 | 10.153536 | 9.993999 | 10 006001 | 10.147535 | 9.852465 | 45 | 35 |
| 26 | 30 | 9.846496 | 10.153504 | 9.994062 | 10.005938 | 10.147566 | 9.852434 | 30 | 34 |
| 27 | 45 | 9.846528 | 10.153472 | 9.994125 | 10.005875 | 10.147598 | 9.852402 | 15 | 33 |
| 28 | 37 | 9.846560 | 10.153440 | 9.994189 | 10.005811 | 10.147629 | 9.852371 | 23 | 32 |
| 29 | 15 | 9.846592 | 10.153408 | 9.994252 | 10.005748 | 10.147660 | 9.852340 | 45 | 31 |
| 30 | 30 | 9.846624 | 10.153376 | 9.994315 | 10.005685 | 10.147691 | 9.852309 | 30 | 30 |
| 31 | 45 | 9.846656 | 10.153344 | 9.994378 | 10.005622 | 10.147722 | 9.852278 | 15 | 29 |
| 32 | 38 | 9.846688 | 10.153312 | 9.994441 | 10.005559 | 10.147753 | 9.852247 | 22 | 28 |
| 33 | 15 | 9.846720 | 10.153280 | 9.994504 | 10.005496 | 10.147785 | 9.852215 | 45 | 27 |
| 34 | 30 | 9.846752 | 10.153248 | 9.994568 | 10.005432 | 10.147816 | 9.852184 | 30 | 26 |
| 35 | 45 | 9.846784 | 10.153216 | 9.994631 | 10.005369 | 10.147847 | 9.852153 | 15 | 25 |
| 36 | 39 | 9.846816 | 10.153184 | 9.994694 | 10.005306 | 10.147878 | 9.852122 | 21 | 24 |
| 37 | 15 | 9.846848 | 10.153152 | 9.994757 | 10.005243 | 10.147909 | 9.852091 | 45 | 23 |
| 38 | 30 | 9.846880 | 10.153120 | 9.994820 | 10.005180 | 10.147941 | 9.852059 | 30 | 22 |
| 39 | 45 | 9.846912 | 10.153088 | 9.994883 | 10.005117 | 10.147972 | 9.852028 | 15 | 21 |
| 40 | 40 | 9.846944 | 10.153056 | 9.994947 | 10.005053 | 10.148003 | 9.851997 | 20 | 20 |
| 41 | 15 | 9.846976 | 10.153024 | 9.995010 | 10.004990 | 10.148034 | 9.851966 | 45 | 19 |
| 42 | 30 | 9.847007 | 10.152993 | 9.995073 | 10.004927 | 10.148066 | 9.851934 | 30 | 18 |
| 43 | 45 | 9.847039 | 10.152961 | 9.995136 | 10.004864 | 10.148097 | 9.851903 | 15 | 17 |
| 44 | 41 | 9.847071 | 10.152929 | 9.995199 | 10.004801 | 10.148128 | 9.851872 | 19 | 16 |
| 45 | 15 | 9.847103 | 10.152897 | 9.995262 | 10.004738 | 10.148159 | 9.851841 | 45 | 15 |
| 46 | 30 | 9.847135 | 10.152865 | 9.995326 | 10.004674 | 10.148190 | 9.851810 | 30 | 14 |
| 47 | 45 | 9.847167 | 10.152833 | 9.995389 | 10.004611 | 10.148222 | 9.851778 | 15 | 13 |
| 48 | 42 | 9.847199 | 10.152801 | 9.995452 | 10.004548 | 10.148253 | 9.851747 | 18 | 12 |
| 49 | 15 | 9.847231 | 10.152769 | 9.995515 | 10.004485 | 10.148284 | 9.851716 | 45 | 11 |
| 50 | 30 | 9.847263 | 10.152737 | 9.995578 | 10.004422 | 10.148315 | 9.851685 | 30 | 10 |
| 51 | 45 | 9.847295 | 10.152705 | 9.995641 | 10.004359 | 10.148347 | 9 851653 | 15 | 9 |
| 52 | 43 | 9.847327 | 10.152673 | 9.995705 | 10.004295 | 10.148378 | 9.851622 | 17 | 8 |
| 53 | 15 | 9.847359 | 10.152641 | 9.995768 | 10.004232 | 10.148409 | 9.851591 | 45 | 7 |
| 54 | 30 | 9.847390 | 10.152610 | 9.995831 | 10.004169 | 10.148441 | 9.851559 | 30 | 6 |
| 55 | 45 | 9.847422 | 10.152578 | 9.995894 | 10.004106 | 10.148472 | 9.851528 | 15 | 5 |
| 56 | 44 | 9.847454 | 10.152546 | 9.995957 | 10.004043 | 10.148503 | 9.851497 | 16 | 4 |
| 57 | 15 | 9.847486 | 10.152514 | 9.996020 | 10.003980 | 10.148534 | 9.851466 | 45 | 3 |
| 58 | 30 | 9.847518 | 10.152482 | 9.996084 | 10.003916 | 10.148566 | 9.851434 | 30 | 2 |
| 59 | 45 | 9.847550 | 10.152450 | 9.996147 | 10.003853 | 10.148597 | 9.851403 | 15 | 1 |
| 60 | 45 | 9.847582 | 10.152418 | 9.996210 | 10.003790 | 10.148628 | 9.851372 | 15 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 1m. | | | LOG. SINES, &c. | | | | 45 deg. | | |

| 2h 59m | | LOG. SINES, &c. (t.) | | | | 44 deg. | | | |
|---|---|---|---|---|---|---|---|---|---|
| sec. | ′ ″ | sine. | cosecant. | tangent. | cotangent. | secant. | cosine. | ″ ′ | sec. |
| 0 | 45 | 9.847582 | 10.152418 | 9.996210 | 10.003790 | 10.148628 | 9.851372 | 15 | 60 |
| 1 | 15 | 9.847614 | 10.152386 | 9.996273 | 10.003727 | 10.148660 | 9.851340 | 45 | 59 |
| 2 | 30 | 9.847645 | 10.152355 | 9.996336 | 10.003664 | 10.148691 | 9.851309 | 30 | 58 |
| 3 | 45 | 9.847677 | 10.152323 | 9.996399 | 10.003601 | 10.148722 | 9.851278 | 15 | 57 |
| 4 | 46 | 9.847709 | 10.152291 | 9.996463 | 10.003537 | 10.148754 | 9.851246 | 14 | 56 |
| 5 | 15 | 9.847741 | 10.152259 | 9.996526 | 10.003474 | 10.148785 | 9.851215 | 45 | 55 |
| 6 | 30 | 9.847773 | 10.152227 | 9.996589 | 10.003411 | 10.148816 | 9.851184 | 30 | 54 |
| 7 | 45 | 9.847805 | 10.152195 | 9.996652 | 10.003348 | 10.148848 | 9.851152 | 15 | 53 |
| 8 | 47 | 9.847836 | 10.152164 | 9.996715 | 10.003285 | 10.148879 | 9.851121 | 13 | 52 |
| 9 | 15 | 9.847868 | 10.152132 | 9.996778 | 10.003222 | 10.148910 | 9.851090 | 45 | 51 |
| 10 | 30 | 9.847900 | 10.152100 | 9.996842 | 10.003158 | 10.148942 | 9.851058 | 30 | 50 |
| 11 | 45 | 9.847932 | 10.152068 | 9.996905 | 10.003095 | 10.148973 | 9.851027 | 15 | 49 |
| 12 | 48 | 9.847964 | 10.152036 | 9.996968 | 10.003032 | 10.149004 | 9.850996 | 12 | 48 |
| 13 | 15 | 9.847995 | 10.152005 | 9.997031 | 10.002969 | 10.149036 | 9.850964 | 45 | 47 |
| 14 | 30 | 9.848027 | 10.151973 | 9.997094 | 10.002906 | 10.149067 | 9.850933 | 30 | 46 |
| 15 | 45 | 9.848059 | 10.151941 | 9.997157 | 10.002843 | 10.149098 | 9.850902 | 15 | 45 |
| 16 | 49 | 9.848091 | 10.151909 | 9.997221 | 10.002779 | 10.149130 | 9.850870 | 11 | 44 |
| 17 | 15 | 9.848123 | 10.151877 | 9.997284 | 10.002716 | 10.149161 | 9.850839 | 45 | 43 |
| 18 | 30 | 9.848154 | 10.151846 | 9.997347 | 10.002653 | 10.149193 | 9.850807 | 30 | 42 |
| 19 | 45 | 9.848186 | 10.151814 | 9.997410 | 10.002590 | 10.149224 | 9.850776 | 15 | 41 |
| 20 | 50 | 9.848218 | 10.151782 | 9.997473 | 10.002527 | 10.149255 | 9.850745 | 10 | 40 |
| 21 | 15 | 9.848250 | 10.151750 | 9.997536 | 10.002464 | 10.149287 | 9.850713 | 45 | 39 |
| 22 | 30 | 9.848281 | 10.151719 | 9.997600 | 10.002400 | 10.149318 | 9.850682 | 30 | 38 |
| 23 | 45 | 9.848313 | 10.151687 | 9.997663 | 10.002337 | 10.149350 | 9.850650 | 15 | 37 |
| 24 | 51 | 9.848345 | 10.151655 | 9.997726 | 10.002274 | 10.149381 | 9.850619 | 9 | 36 |
| 25 | 15 | 9.848377 | 10.151623 | 9.997789 | 10.002211 | 10.149412 | 9.850588 | 45 | 35 |
| 26 | 30 | 9.848408 | 10.151592 | 9.997852 | 10.002148 | 10.149444 | 9.850556 | 30 | 34 |
| 27 | 45 | 9.848440 | 10.151560 | 9.997915 | 10.002085 | 10.149475 | 9.850525 | 15 | 33 |
| 28 | 52 | 9.848472 | 10.151528 | 9.997979 | 10.002021 | 10.149507 | 9.850493 | 8 | 32 |
| 29 | 15 | 9.848504 | 10.151496 | 9.998042 | 10.001958 | 10.149538 | 9.850462 | 45 | 31 |
| 30 | 30 | 9.848535 | 10.151465 | 9.998105 | 10.001895 | 10.149570 | 9.850430 | 30 | 30 |
| 31 | 45 | 9.848567 | 10.151433 | 9.998168 | 10.001832 | 10.149601 | 9.850399 | 15 | 29 |
| 32 | 53 | 9.848599 | 10.151401 | 9.998231 | 10.001769 | 10.149633 | 9.850367 | 7 | 28 |
| 33 | 15 | 9.848631 | 10.151369 | 9.998294 | 10.001706 | 10.149664 | 9.850336 | 45 | 27 |
| 34 | 30 | 9.848662 | 10.151338 | 9.998358 | 10.001642 | 10.149695 | 9.850305 | 30 | 26 |
| 35 | 45 | 9.848694 | 10.151306 | 9.998421 | 10.001579 | 10.149727 | 9.850273 | 15 | 25 |
| 36 | 54 | 9.848726 | 10.151274 | 9.998484 | 10.001516 | 10.149758 | 9.850242 | 6 | 24 |
| 37 | 15 | 9.848757 | 10.151243 | 9.998547 | 10.001453 | 10.149790 | 9.850210 | 45 | 23 |
| 38 | 30 | 9.848789 | 10.151211 | 9.998610 | 10.001390 | 10.149821 | 9.850179 | 30 | 22 |
| 39 | 45 | 9.848821 | 10.151179 | 9.998673 | 10.001327 | 10.149853 | 9.850147 | 15 | 21 |
| 40 | 55 | 9.848852 | 10.151148 | 9.998737 | 10.001263 | 10.149884 | 9.850116 | 5 | 20 |
| 41 | 15 | 9.848884 | 10.151116 | 9.998800 | 10.001200 | 10.149916 | 9.850084 | 45 | 19 |
| 42 | 30 | 9.848916 | 10.151084 | 9.998863 | 10.001137 | 10 149947 | 9.850053 | 30 | 18 |
| 43 | 45 | 9.848947 | 10.151053 | 9.998926 | 10.001074 | 10.149979 | 9.850021 | 15 | 17 |
| 44 | 56 | 9.848979 | 10.151021 | 9.998989 | 10.001011 | 10.150010 | 9.849990 | 4 | 16 |
| 45 | 15 | 9.849011 | 10.150989 | 9.999052 | 10.000948 | 10.150042 | 9.849958 | 45 | 15 |
| 46 | 30 | 9.849042 | 10.150958 | 9.999116 | 10.000884 | 10.150073 | 9.849927 | 30 | 14 |
| 47 | 45 | 9.849074 | 10.150926 | 9.999179 | 10.000821 | 10.150105 | 9.849895 | 15 | 13 |
| 48 | 57 | 9.849106 | 10.150894 | 9.999242 | 10.000758 | 10.150136 | 9.849864 | 3 | 12 |
| 49 | 15 | 9.849137 | 10.150863 | 9.999305 | 10.000695 | 10.150168 | 9.849832 | 45 | 11 |
| 50 | 30 | 9.849169 | 10.150831 | 9.999368 | 10.000632 | 10.150199 | 9.849801 | 30 | 10 |
| 51 | 45 | 9.849201 | 10.150799 | 9.999431 | 10.000569 | 10.150231 | 9.849769 | 15 | 9 |
| 52 | 58 | 9.849232 | 10.150768 | 9.999495 | 10.000505 | 10.150263 | 9.849737 | 2 | 8 |
| 53 | 15 | 9.849264 | 10.150736 | 9.999558 | 10.000442 | 10.150294 | 9.849706 | 45 | 7 |
| 54 | 30 | 9.849295 | 10.150705 | 9.999621 | 10.000379 | 10.150326 | 9.849674 | 30 | 6 |
| 55 | 45 | 9.849327 | 10.150673 | 9.999684 | 10.000316 | 10.150357 | 9.849643 | 15 | 5 |
| 56 | 59 | 9.849359 | 10.150641 | 9.999747 | 10.000253 | 10.150389 | 9.849611 | 1 | 4 |
| 57 | 15 | 9.849390 | 10.150610 | 9.999810 | 10.000190 | 10.150420 | 9.849580 | 45 | 3 |
| 58 | 30 | 9.849422 | 10.150578 | 9.999874 | 10.000126 | 10.150452 | 9.849548 | 30 | 2 |
| 59 | 45 | 9.849453 | 10.150547 | 9.999937 | 10.000063 | 10.150483 | 9.849517 | 15 | 1 |
| 60 | 60 | 9.849485 | 10.150515 | 10.000000 | 10.000000 | 10.150515 | 9.849485 | 0 | 0 |
| sec. | ′ ″ | cosine. | secant. | cotangent. | tangent. | cosecant. | sine. | ″ ′ | sec. |
| 3h 0m. | | | LOG. SINES, &c. | | | | 45 deg. | | |

## PROPORTIONAL PARTS.

☞ Consider as many right hand figures decimal fractions as case requires, and the same number of decimal fractions in N°. taken out as in N°. entered with.

| 15 | 14 | 13 | *12* | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | ½ | * 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60 | 56 | 52 | 48 | 44 | 40 | 36 | 32 | 28 | 24 | 20 | 16 | 12 | 8 | 4 | 1 | for min. |
| 1250 | 1167 | 1083 | 1000 | 917 | 833 | 750 | 667 | 583 | 500 | 417 | 333 | 250 | 167 | 83 | 21 | 15000 |
| 1300 | 1213 | 1127 | 1040 | 953 | 867 | 780 | 693 | 607 | 520 | 433 | 347 | 260 | 173 | 87 | 22 | 15600 |
| 1350 | 1260 | 1170 | 1080 | 990 | 900 | 810 | 720 | 630 | 540 | 450 | 360 | 270 | 180 | 90 | 23 | 16200 |
| 1400 | 1307 | 1213 | 1120 | 1027 | 933 | 840 | 747 | 653 | 560 | 467 | 373 | 280 | 187 | 93 | 23 | 16800 |
| 1450 | 1358 | 1257 | 1160 | 1063 | 967 | 870 | 773 | 677 | 580 | 483 | 387 | 290 | 193 | 97 | 24 | 17400 |
| 1500 | 1400 | 1300 | 1200 | 1100 | 1000 | 900 | 800 | 700 | 600 | 500 | 400 | 300 | 200 | 100 | 25 | 18000 |
| 1550 | 1447 | 1343 | 1240 | 1137 | 1033 | 930 | 827 | 723 | 620 | 517 | 413 | 310 | 207 | 103 | 26 | 18600 |
| 1600 | 1493 | 1387 | 1280 | 1173 | 1067 | 960 | 853 | 747 | 640 | 533 | 427 | 320 | 213 | 107 | 27 | 19200 |
| 1650 | 1540 | 1430 | 1320 | 1210 | 1100 | 990 | 880 | 770 | 660 | 550 | 440 | 330 | 220 | 110 | 27 | 19800 |
| 1700 | 1587 | 1473 | 1360 | 1247 | 1133 | 1020 | 907 | 793 | 680 | 567 | 453 | 340 | 227 | 113 | 28 | 20400 |
| 1750 | 1633 | 1517 | 1400 | 1283 | 1167 | 1050 | 933 | 817 | 700 | 583 | 467 | 350 | 233 | 117 | 29 | 21000 |
| 1800 | 1680 | 1560 | 1440 | 1320 | 1200 | 1080 | 960 | 840 | 720 | 600 | 480 | 360 | 240 | 120 | 30 | 21600 |
| 1850 | 1727 | 1603 | 1480 | 1357 | 1233 | 1110 | 987 | 863 | 740 | 617 | 493 | 370 | 247 | 123 | 31 | 22200 |
| 1900 | 1773 | 1647 | 1520 | 1393 | 1267 | 1140 | 1013 | 887 | 760 | 633 | 507 | 380 | 253 | 127 | 32 | 22800 |
| 1950 | 1820 | 1690 | 1560 | 1430 | 1300 | 1170 | 1040 | 910 | 780 | 650 | 520 | 390 | 260 | 130 | 32 | 23400 |
| 2000 | 1867 | 1733 | 1600 | 1467 | 1333 | 1200 | 1067 | 933 | 800 | 667 | 533 | 400 | 267 | 133 | 33 | 24000 |
| 2050 | 1913 | 1777 | 1640 | 1503 | 1367 | 1230 | 1093 | 957 | 820 | 683 | 547 | 410 | 273 | 137 | 34 | 24600 |
| 2100 | 1960 | 1820 | 1680 | 1540 | 1400 | 1260 | 1120 | 980 | 840 | 700 | 560 | 420 | 280 | 140 | 35 | 25200 |
| 2150 | 2007 | 1863 | 1720 | 1577 | 1433 | 1290 | 1147 | 1003 | 860 | 717 | 573 | 430 | 287 | 143 | 36 | 25800 |
| 2200 | 2053 | 1907 | 1760 | 1613 | 1467 | 1320 | 1173 | 1027 | 880 | 733 | 587 | 440 | 293 | 147 | 37 | 26400 |
| 2250 | 2100 | 1950 | 1800 | 1650 | 1500 | 1350 | 1200 | 1050 | 900 | 750 | 600 | 450 | 300 | 150 | 37 | 27000 |
| 2300 | 2147 | 1993 | 1840 | 1687 | 1533 | 1380 | 1227 | 1073 | 920 | 767 | 613 | 460 | 307 | 153 | 38 | 27600 |
| 2350 | 2193 | 2037 | 1880 | 1723 | 1567 | 1410 | 1253 | 1097 | 940 | 783 | 627 | 470 | 313 | 157 | 39 | 28200 |
| 2400 | 2240 | 2080 | 1920 | 1760 | 1600 | 1440 | 1280 | 1120 | 960 | 800 | 640 | 480 | 320 | 160 | 40 | 28800 |
| 2450 | 2287 | 2123 | 1960 | 1797 | 1633 | 1470 | 1307 | 1143 | 980 | 817 | 653 | 490 | 327 | 163 | 41 | 29400 |
| 2500 | 2333 | 2167 | 2000 | 1833 | 1667 | 1500 | 1333 | 1167 | 1000 | 833 | 667 | 500 | 333 | 167 | 42 | 30000 |
| 2550 | 2380 | 2210 | 2040 | 1870 | 1700 | 1530 | 1360 | 1190 | 1020 | 850 | 680 | 510 | 340 | 170 | 42 | 30600 |
| 2600 | 2427 | 2253 | 2080 | 1907 | 1733 | 1560 | 1387 | 1213 | 1040 | 867 | 693 | 520 | 347 | 173 | 43 | 31200 |
| 2650 | 2473 | 2297 | 2120 | 1943 | 1767 | 1590 | 1413 | 1237 | 1060 | 883 | 707 | 530 | 353 | 177 | 44 | 31800 |
| 2700 | 2520 | 2340 | 2160 | 1980 | 1800 | 1620 | 1440 | 1260 | 1080 | 900 | 720 | 540 | 360 | 180 | 45 | 32400 |
| 2750 | 2567 | 2383 | 2200 | 2017 | 1833 | 1650 | 1467 | 1283 | 1100 | 917 | 733 | 550 | 367 | 183 | 46 | 33000 |
| 2800 | 2613 | 2427 | 2240 | 2053 | 1867 | 1680 | 1493 | 1307 | 1120 | 933 | 747 | 560 | 373 | 187 | 47 | 33600 |
| 2850 | 2660 | 2470 | 2280 | 2090 | 1900 | 1710 | 1520 | 1330 | 1140 | 950 | 760 | 570 | 380 | 190 | 47 | 34200 |
| 2900 | 2707 | 2513 | 2320 | 2127 | 1933 | 1740 | 1547 | 1353 | 1160 | 967 | 773 | 580 | 387 | 193 | 48 | 34800 |
| 2950 | 2753 | 2557 | 2360 | 2163 | 1967 | 1770 | 1573 | 1377 | 1180 | 983 | 787 | 590 | 393 | 197 | 49 | 35400 |
| 3000 | 2800 | 2600 | 2400 | 2200 | 2000 | 1800 | 1600 | 1400 | 1200 | 1000 | 800 | 600 | 400 | 200 | 50 | 36000 |
| 3050 | 2847 | 2643 | 2440 | 2237 | 2033 | 1830 | 1627 | 1423 | 1220 | 1017 | 813 | 610 | 407 | 203 | 51 | 36600 |
| 3100 | 2893 | 2687 | 2480 | 2273 | 2067 | 1860 | 1653 | 1447 | 1240 | 1033 | 827 | 620 | 413 | 207 | 52 | 37200 |
| 3150 | 2940 | 2730 | 2520 | 2310 | 2100 | 1890 | 1680 | 1470 | 1260 | 1050 | 840 | 630 | 420 | 210 | 52 | 37800 |
| 3200 | 2987 | 2773 | 2560 | 2347 | 2133 | 1920 | 1707 | 1493 | 1280 | 1067 | 853 | 640 | 427 | 213 | 53 | 38400 |
| 3250 | 3033 | 2817 | 2600 | 2383 | 2167 | 1950 | 1733 | 1517 | 1300 | 1083 | 867 | 650 | 433 | 217 | 54 | 39000 |
| 3300 | 3080 | 2860 | 2640 | 2420 | 2200 | 1980 | 1760 | 1540 | 1320 | 1100 | 880 | 660 | 440 | 220 | 55 | 39600 |
| 3350 | 3127 | 2903 | 2680 | 2457 | 2233 | 2010 | 1787 | 1563 | 1340 | 1117 | 893 | 670 | 447 | 223 | 56 | 40200 |
| 3400 | 3173 | 2947 | 2720 | 2493 | 2267 | 2040 | 1813 | 1587 | 1360 | 1133 | 907 | 680 | 453 | 227 | 57 | 40800 |
| 3450 | 3220 | 2990 | 2760 | 2530 | 2300 | 2070 | 1840 | 1610 | 1380 | 1150 | 920 | 690 | 460 | 230 | 57 | 41400 |
| 3500 | 3267 | 3033 | 2800 | 2567 | 2333 | 2100 | 1867 | 1633 | 1400 | 1167 | 933 | 700 | 467 | 233 | 58 | 42000 |
| 3750 | 3500 | 3250 | 3000 | 2750 | 2500 | 2250 | 2000 | 1750 | 1500 | 1250 | 1000 | 750 | 500 | 250 | 62 | 45000 |
| 4000 | 3733 | 3467 | 3200 | 2933 | 2667 | 2400 | 2133 | 1867 | 1600 | 1333 | 1067 | 800 | 533 | 267 | 67 | 48000 |
| 4250 | 3967 | 3683 | 3400 | 3117 | 2833 | 2550 | 2267 | 1983 | 1700 | 1417 | 1133 | 850 | 567 | 283 | 71 | 51000 |
| 4500 | 4200 | 3900 | 3600 | 3300 | 3000 | 2700 | 2400 | 2100 | 1800 | 1500 | 1200 | 900 | 600 | 300 | 75 | 54000 |
| 4750 | 4433 | 4117 | 3800 | 3483 | 3167 | 2850 | 2533 | 2217 | 1900 | 1583 | 1267 | 950 | 633 | 317 | 79 | 57000 |
| 5000 | 4667 | 4333 | 4000 | 3667 | 3333 | 3000 | 2667 | 2333 | 2000 | 1667 | 1333 | 1000 | 667 | 333 | 83 | 60000 |
| 5250 | 4900 | 4550 | 4200 | 3850 | 3500 | 3150 | 2800 | 2450 | 2100 | 1750 | 1400 | 1050 | 700 | 350 | 87 | 63000 |
| 5500 | 5133 | 4767 | 4400 | 4033 | 3667 | 3300 | 2933 | 2567 | 2200 | 1833 | 1467 | 1100 | 733 | 367 | 92 | 66000 |
| 5750 | 5367 | 4983 | 4600 | 4217 | 3833 | 3450 | 3067 | 2683 | 2300 | 1917 | 1533 | 1150 | 767 | 383 | 96 | 69000 |
| 6000 | 5600 | 5200 | 4800 | 4400 | 4000 | 3600 | 3200 | 2800 | 2400 | 2000 | 1600 | 1200 | 800 | 400 | 100 | 72000 |
| 6250 | 5833 | 5417 | 5000 | 4583 | 4167 | 3750 | 3333 | 2917 | 2500 | 2083 | 1667 | 1250 | 833 | 417 | 104 | 75000 |
| 6500 | 6067 | 5633 | 5200 | 4767 | 4333 | 3900 | 3467 | 3033 | 2600 | 2167 | 1733 | 1300 | 867 | 433 | 108 | 78000 |
| 6750 | 6300 | 5850 | 5400 | 4950 | 4500 | 4050 | 3600 | 3150 | 2700 | 2250 | 1800 | 1350 | 900 | 450 | 112 | 81000 |
| 7000 | 6533 | 6067 | 5600 | 5133 | 4667 | 4200 | 3733 | 3267 | 2800 | 2333 | 1867 | 1400 | 933 | 467 | 117 | 84000 |
| 7250 | 6767 | 6283 | 5800 | 5317 | 4833 | 4350 | 3867 | 3333 | 2900 | 2417 | 1933 | 1450 | 967 | 483 | 121 | 87000 |
| 7500 | 7000 | 6500 | 6000 | 5500 | 5000 | 4500 | 4000 | 3500 | 3000 | 2500 | 2000 | 1500 | 1000 | 500 | 125 | 90000 |
| 7750 | 7233 | 6717 | 6200 | 5683 | 5167 | 4650 | 4133 | 3617 | 3100 | 2583 | 2067 | 1550 | 1033 | 517 | 129 | 93000 |
| 8000 | 7467 | 6933 | 6400 | 5867 | 5333 | 4800 | 4267 | 3733 | 3200 | 2667 | 2133 | 1600 | 1067 | 533 | 133 | 96000 |
| 8250 | 7700 | 7150 | 6600 | 6050 | 5500 | 4950 | 4400 | 3850 | 3300 | 2750 | 2200 | 1650 | 1100 | 550 | 137 | 99000 |
| 8500 | 7933 | 7367 | 6800 | 6233 | 5667 | 5100 | 4533 | 3967 | 3400 | 2833 | 2267 | 1700 | 1133 | 567 | 142 | 102000 |
| 8750 | 8167 | 7583 | 7000 | 6417 | 5833 | 5250 | 4667 | 4083 | 3500 | 2917 | 2333 | 1750 | 1167 | 583 | 146 | 105000 |
| 9000 | 8400 | 7800 | 7200 | 6600 | 6000 | 5400 | 4800 | 4200 | 3600 | 3000 | 2400 | 1800 | 1200 | 600 | 150 | 108000 |
| 9250 | 8633 | 8017 | 7400 | 6783 | 6167 | 5550 | 4933 | 4317 | 3700 | 3083 | 2467 | 1850 | 1233 | 617 | 154 | 111000 |
| 9500 | 8867 | 8233 | 7600 | 6967 | 6333 | 5700 | 5067 | 4433 | 3800 | 3167 | 2533 | 1900 | 1267 | 633 | 158 | 114000 |
| 9750 | 9100 | 8450 | 7800 | 7150 | 6500 | 5850 | 5200 | 4550 | 3900 | 3250 | 2600 | 1950 | 1300 | 650 | 162 | 117000 |
| 10000 | 9333 | 8667 | 8000 | 7333 | 6667 | 6000 | 5333 | 4667 | 4000 | 3333 | 2667 | 2000 | 1333 | 667 | 167 | 120000 |
| 10250 | 9567 | 8883 | 8200 | 7517 | 6833 | 6150 | 5467 | 4783 | 4100 | 3417 | 2733 | 2050 | 1367 | 683 | 171 | 123000 |
| 10500 | 9800 | 9100 | 8400 | 7700 | 7000 | 6300 | 5600 | 4900 | 4200 | 3500 | 2800 | 2100 | 1400 | 700 | 175 | 126000 |
| 10750 | 10033 | 9317 | 8600 | 7883 | 7167 | 6450 | 5733 | 5017 | 4300 | 3583 | 2867 | 2150 | 1433 | 717 | 179 | 129000 |
| 11000 | 10267 | 9533 | 8800 | 8067 | 7333 | 6600 | 5867 | 5133 | 4400 | 3667 | 2933 | 2200 | 1467 | 733 | 183 | 132000 |
| 11250 | 10500 | 9750 | 9000 | 8250 | 7500 | 6750 | 6000 | 5250 | 4500 | 3750 | 3000 | 2250 | 1500 | 750 | 187 | 135000 |
| 11500 | 10733 | 9967 | 9200 | 8433 | 7667 | 6900 | 6133 | 5367 | 4600 | 3833 | 3067 | 2300 | 1533 | 767 | 192 | 138000 |
| 11750 | 10967 | 10183 | 9400 | 8617 | 7833 | 7050 | 6267 | 5483 | 4700 | 3917 | 3133 | 2350 | 1567 | 783 | 196 | 141000 |
| 12000 | 11200 | 10400 | 9600 | 8800 | 8000 | 7200 | 6400 | 5600 | 4800 | 4000 | 3200 | 2400 | 1600 | 800 | 200 | 144000 |
| 12250 | 11433 | 10617 | 9800 | 8983 | 8167 | 7350 | 6533 | 5717 | 4900 | 4083 | 3267 | 2450 | 1633 | 817 | 204 | 147000 |
| 12500 | 11667 | 10833 | 10000 | 9167 | 8333 | 7500 | 6667 | 5833 | 5000 | 4167 | 3333 | 2500 | 1667 | 833 | 208 | 150000 |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 deg. | | | | 1 deg. | | | | 2 deg. | | |
| | ′ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 0.000000 | 2.338787 | 2.639816 | 2.815905 | 2.940842 | 3.037749 | 3.116926 | 3.183868 | 3.241855 | 3.293002 | 60 |
| 1 | 15 0.560637 | 345965 | 643420 | 818311 | 942647 | 039194 | 118131 | 184901 | 242759 | 293805 | 59 |
| 2 | 30 0.861666 | 353027 | 646994 | 820704 | 944446 | 040634 | 119332 | 185931 | 243661 | 294607 | 58 |
| 3 | 45 1.037758 | 359976 | 650539 | 823084 | 946236 | 042070 | 120530 | 186959 | 244561 | 295407 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31 | 46′ | 1 | 16′ | |
| 4 | 0 1.162696 | 2.366815 | 2.654056 | 2.825450 | 2.948020 | 3.043501 | 3.121725 | 3.187985 | 3.245459 | 3.296206 | 56 |
| 5 | 15 259606 | 373549 | 657544 | 827804 | 949796 | 044927 | 122916 | 189008 | 246355 | 297004 | 55 |
| 6 | 30 338787 | 380179 | 661005 | 830146 | 951565 | 046348 | 124104 | 190028 | 247250 | 297800 | 54 |
| 7 | 45 405735 | 386710 | 664438 | 832474 | 953327 | 047765 | 125289 | 191046 | 248142 | 298595 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2 | 17′ | |
| 8 | 0 1.463726 | 2.393144 | 2.667844 | 2.834790 | 2.955082 | 3.049178 | 3.126471 | 3.192062 | 3.249033 | 3.299388 | 52 |
| 9 | 15 514879 | 399484 | 671224 | 837094 | 956829 | 050585 | 127649 | 193076 | 249922 | 300179 | 51 |
| 10 | 30 560636 | 405733 | 674578 | 839386 | 958570 | 051988 | 128825 | 194087 | 250809 | 300970 | 50 |
| 11 | 45 602028 | 411894 | 677905 | 841666 | 960304 | 053387 | 129997 | 195095 | 251694 | 301758 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 1.639817 | 2.417968 | 2.681208 | 2.843934 | 2.962030 | 3.054781 | 3.131166 | 3.196102 | 3.252578 | 3.302546 | 48 |
| 13 | 15 674579 | 423958 | 684486 | 846190 | 963750 | 056171 | 132331 | 197106 | 253460 | 303333 | 47 |
| 14 | 30 706764 | 429867 | 687739 | 848434 | 965463 | 057556 | 133494 | 198108 | 254339 | 304116 | 46 |
| 15 | 45 736727 | 435696 | 690968 | 850667 | 967170 | 058937 | 134654 | 199107 | 255218 | 304899 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34 | 49′ | 4′ | 19′ | |
| 16 | 0 1.764756 | 2.441449 | 2.694173 | 2.852888 | 2.968870 | 3.060313 | 3.135810 | 3.200104 | 3.256094 | 3.305681 | 44 |
| 17 | 15 791085 | 447126 | 697355 | 855098 | 970563 | 061685 | 136964 | 201099 | 256969 | 306461 | 43 |
| 18 | 30 815908 | 452730 | 700513 | 857297 | 972249 | 063053 | 138114 | 202092 | 257841 | 307242 | 42 |
| 19 | 45 839390 | 458262 | 703649 | 859485 | 973929 | 064417 | 139261 | 203082 | 258713 | 308018 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 1.861666 | 2.463725 | 2.706762 | 2.861662 | 2.975603 | 3.065776 | 3.140406 | 3.204070 | 3.259582 | 3.308794 | 40 |
| 21 | 15 882855 | 469120 | 709853 | 863828 | 977270 | 067131 | 141547 | 205056 | 260450 | 309569 | 39 |
| 22 | 30 903059 | 474449 | 712922 | 865983 | 978931 | 068482 | 142685 | 206039 | 261315 | 310342 | 38 |
| 23 | 45 922364 | 479713 | 715970 | 868128 | 980585 | 069828 | 143821 | 207021 | 262180 | 311114 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 1.940847 | 2.484914 | 2.718996 | 2.870262 | 2.982233 | 3.071171 | 3.144953 | 3.208000 | 3.263042 | 3.311885 | 36 |
| 25 | 15 958576 | 490054 | 722002 | 872386 | 983875 | 072509 | 146082 | 208977 | 263903 | 312654 | 35 |
| 26 | 30 975609 | 495134 | 724987 | 874499 | 985511 | 073843 | 147209 | 209952 | 264762 | 313421 | 34 |
| 27 | 45 992000 | 500154 | 727951 | 876602 | 987140 | 075173 | 148332 | 210924 | 265619 | 314185 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22 | |
| 28 | 0 2.007794 | 2.505118 | 2.730895 | 2.878695 | 2.988764 | 3.076499 | 3.149453 | 3.211895 | 3.266475 | 3.314945 | 32 |
| 29 | 15 023034 | 510025 | 733820 | 880778 | 990381 | 077821 | 150571 | 212863 | 267329 | 315717 | 31 |
| 30 | 30 037757 | 514878 | 736725 | 882851 | 991993 | 079139 | 151686 | 213829 | 268181 | 316489 | 30 |
| 31 | 45 051998 | 519676 | 739611 | 884914 | 993598 | 080453 | 152798 | 214793 | 269032 | 317241 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 2.065786 | 2.524423 | 2.742477 | 2.886967 | 2.995198 | 3.081763 | 3.153907 | 3.215755 | 3.269881 | 3.318001 | 28 |
| 33 | 15 079150 | 529118 | 745325 | 889011 | 996791 | 083069 | 155014 | 216714 | 270728 | 318759 | 27 |
| 34 | 30 092115 | 533763 | 748154 | 891045 | 998379 | 084372 | 156117 | 217672 | 271574 | 319516 | 26 |
| 35 | 45 104704 | 538358 | 750965 | 893070 | 999962 | 085670 | 157218 | 218627 | 272468 | 320272 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 2.116938 | 2.542906 | 2.753758 | 2.895085 | 3.001538 | 3.086964 | 3.158316 | 3.219581 | 3.273261 | 3.321027 | 24 |
| 37 | 15 128837 | 547407 | 756533 | 897091 | 003108 | 088255 | 159411 | 220532 | 274101 | 321780 | 23 |
| 38 | 30 140419 | 551861 | 759291 | 899088 | 004673 | 089542 | 160504 | 221481 | 274940 | 322532 | 22 |
| 39 | 45 151700 | 556270 | 762031 | 901075 | 006233 | 090825 | 161593 | 222428 | 275777 | 323282 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 2.162696 | 2.560635 | 2.764753 | 2.903054 | 3.007786 | 3.092104 | 3.162681 | 3.223373 | 3.276613 | 3.324032 | 20 |
| 41 | 15 173420 | 564956 | 767459 | 905023 | 009335 | 093379 | 163765 | 224316 | 277448 | 324780 | 19 |
| 42 | 30 183885 | 569235 | 770148 | 906984 | 010877 | 094651 | 164846 | 225257 | 278280 | 325526 | 18 |
| 43 | 45 194104 | 573472 | 772821 | 908936 | 012415 | 095919 | 165925 | 226196 | 279111 | 326272 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 2.204088 | 2.577668 | 2.775477 | 2.910879 | 3.013947 | 3.097183 | 3.167002 | 3.227133 | 3.279941 | 3.327016 | 16 |
| 45 | 15 213848 | 581824 | 778117 | 912814 | 015473 | 098444 | 168075 | 228068 | 280769 | 327759 | 15 |
| 46 | 30 223394 | 585941 | 780741 | 914789 | 016994 | 099701 | 169146 | 229001 | 281595 | 328501 | 14 |
| 47 | 45 232733 | 590018 | 783350 | 916657 | 018510 | 100954 | 170214 | 229932 | 282420 | 329241 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 2.241877 | 2.594059 | 2.785942 | 2.918566 | 3.020020 | 3.102204 | 3.171280 | 3.230861 | 3.283243 | 3.329980 | 12 |
| 49 | 15 250832 | 598061 | 788520 | 920466 | 021526 | 103450 | 172343 | 231788 | 284065 | 330718 | 11 |
| 50 | 30 259606 | 602027 | 791082 | 922359 | 023026 | 104692 | 173404 | 232713 | 284885 | 331455 | 10 |
| 51 | 45 268206 | 605958 | 793629 | 924243 | 024521 | 105931 | 174461 | 233636 | 285703 | 332191 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 2.276639 | 2.609853 | 2.796161 | 2.926119 | 3.026011 | 3.107167 | 3.175517 | 3.234557 | 3.286520 | 3.332924 | 8 |
| 53 | 15 284911 | 613713 | 798679 | 927987 | 027495 | 108399 | 176570 | 235476 | 287336 | 333657 | 7 |
| 54 | 30 293029 | 617539 | 801182 | 929846 | 028975 | 109627 | 177620 | 236393 | 288150 | 334389 | 6 |
| 55 | 45 300998 | 621332 | 803671 | 931698 | 030450 | 110852 | 178667 | 237308 | 288962 | 335119 | 5 |
| | 14′ | 29 | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 2.308824 | 2.625093 | 2.806146 | 2.933543 | 3.031919 | 3.112074 | 3.179713 | 3.238221 | 3.289773 | 3.335848 | 4 |
| 57 | 15 316510 | 628820 | 808606 | 935379 | 033384 | 113292 | 180755 | 239132 | 290583 | 336577 | 3 |
| 58 | 30 324064 | 632517 | 811053 | 937207 | 034844 | 114507 | 181795 | 240042 | 291390 | 337305 | 2 |
| 59 | 45 331487 | 636181 | 813486 | 939028 | 036298 | 115718 | 182833 | 240949 | 292197 | 338032 | 1 |
| 60 | 60 2.338787 | 2.639816 | 2.815905 | 2.940842 | 3.037749 | 3.116926 | 3.183868 | 3.241855 | 3.293002 | 3.338753 | 0 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50 | sec. |

| sec. | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 deg. | | 3 deg. | | | | 4 deg. | | | | |
| | ′ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 3.338753 | 3.380138 | 3.417919 | 3.452672 | 3.484848 | 3.514801 | 3.542819 | 3.569137 | 3.593948 | 3.617417 | 60 |
| 1 | 15 339476 | 380796 | 418521 | 453229 | 485364 | 515283 | 543271 | 569562 | 594350 | 617797 | 59 |
| 2 | 30 340198 | 381452 | 419123 | 453784 | 485880 | 515765 | 543723 | 569987 | 594751 | 618177 | 58 |
| 3 | 45 340918 | 382107 | 419724 | 454339 | 486395 | 516246 | 544173 | 570411 | 595152 | 618557 | 57 |
| | 31 | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 3.341638 | 3.382762 | 3.420324 | 3.454893 | 3.486910 | 3.516726 | 3.544624 | 3.570836 | 3.595553 | 3.618937 | 56 |
| 5 | 15 342356 | 383415 | 420924 | 455447 | 487424 | 517206 | 545074 | 571259 | 595953 | 619316 | 55 |
| 6 | 30 343074 | 384068 | 421522 | 456000 | 487938 | 517686 | 545524 | 571883 | 596353 | 619695 | 54 |
| 7 | 45 343789 | 384719 | 422120 | 456551 | 488451 | 518164 | 545973 | 572105 | 596752 | 620073 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 3.344504 | 3.385370 | 3.422717 | 3.457103 | 3.488963 | 3.518643 | 3.546422 | 3.572528 | 3.597152 | 3.620452 | 52 |
| 9 | 15 345218 | 386019 | 423313 | 457653 | 489475 | 519121 | 546870 | 572950 | 597550 | 620830 | 51 |
| 10 | 30 345930 | 386668 | 423908 | 458203 | 489986 | 519598 | 547318 | 573372 | 597949 | 621207 | 50 |
| 11 | 45 346640 | 387315 | 424502 | 458752 | 490496 | 520075 | 547760 | 573793 | 598347 | 621584 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 3.347352 | 3.387962 | 3.425096 | 3.459301 | 3.491006 | 3.520551 | 3.548212 | 3.574214 | 3.598745 | 3.621962 | 48 |
| 13 | 15 348060 | 388608 | 425688 | 459849 | 491515 | 521027 | 548658 | 574634 | 599142 | 622338 | 47 |
| 14 | 30 348768 | 389253 | 426281 | 460396 | 492024 | 521502 | 549104 | 575054 | 599539 | 622714 | 46 |
| 15 | 45 349475 | 389896 | 426871 | 460943 | 492532 | 521977 | 549550 | 575474 | 599935 | 623090 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 3.350180 | 3.390539 | 3.427462 | 3.461489 | 3.493040 | 3.522451 | 3.549995 | 3.575893 | 3.600332 | 3.623466 | 44 |
| 17 | 15 350885 | 391181 | 428051 | 462033 | 493546 | 522925 | 550439 | 576312 | 600727 | 623841 | 43 |
| 18 | 30 351588 | 391822 | 428640 | 462578 | 494053 | 523398 | 550883 | 576730 | 601123 | 624216 | 42 |
| 19 | 45 352290 | 392462 | 429228 | 463122 | 494558 | 523871 | 551327 | 577148 | 601518 | 624591 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 3.352991 | 3.393101 | 3.429815 | 3.463665 | 3.495064 | 3.524343 | 3.551770 | 3.577566 | 3.601913 | 3.624965 | 40 |
| 21 | 15 353691 | 393739 | 430402 | 464207 | 495568 | 524814 | 552213 | 577983 | 602307 | 625339 | 39 |
| 22 | 30 354389 | 394376 | 430987 | 464749 | 496072 | 525286 | 552655 | 578400 | 602701 | 625713 | 38 |
| 23 | 45 355087 | 395012 | 431572 | 465290 | 496575 | 525756 | 553097 | 578816 | 603095 | 626086 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 3.355783 | 3.395647 | 3.432156 | 3.465830 | 3.497078 | 3.526226 | 3.553539 | 3.579232 | 3.603489 | 3.626459 | 36 |
| 25 | 15 356478 | 396282 | 432739 | 466370 | 497580 | 526696 | 553979 | 579648 | 603881 | 626832 | 35 |
| 26 | 30 357173 | 396915 | 433322 | 466909 | 498082 | 527165 | 554420 | 580063 | 604274 | 627205 | 34 |
| 27 | 45 357866 | 397547 | 433903 | 467447 | 498583 | 527633 | 554860 | 580478 | 604666 | 627576 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 3.358558 | 3.398179 | 3.434484 | 3.467985 | 3.499084 | 3.528102 | 3.555300 | 3.580892 | 3.605058 | 3.627948 | 32 |
| 29 | 15 359249 | 398810 | 435064 | 468522 | 499583 | 528569 | 555739 | 581306 | 605450 | 628320 | 31 |
| 30 | 30 359939 | 399440 | 435644 | 469058 | 500083 | 529036 | 556177 | 581720 | 605841 | 628691 | 30 |
| 31 | 45 360627 | 400068 | 436222 | 469594 | 500581 | 529503 | 556616 | 582133 | 606232 | 629062 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38 | 53′ | |
| 32 | 0 3.361315 | 3.400696 | 3.436800 | 3.470129 | 3.501080 | 3.529969 | 3.557054 | 3.582546 | 3.606623 | 3.629432 | 28 |
| 33 | 15 362001 | 401323 | 437377 | 470663 | 501577 | 530434 | 557491 | 582958 | 607012 | 629802 | 27 |
| 34 | 30 362687 | 401949 | 437953 | 471197 | 502074 | 530899 | 557928 | 583370 | 607403 | 630172 | 26 |
| 35 | 45 363371 | 402574 | 438528 | 471730 | 502571 | 531364 | 558364 | 583782 | 607792 | 630542 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 3.364054 | 3.403199 | 3.439103 | 3.472263 | 3.503067 | 3.531828 | 3.558800 | 3.584193 | 3.608181 | 3.630911 | 24 |
| 37 | 15 364736 | 403822 | 439677 | 472794 | 503562 | 532291 | 559236 | 584604 | 608570 | 631280 | 23 |
| 38 | 30 365418 | 404445 | 440250 | 473325 | 504057 | 532755 | 559671 | 585015 | 608958 | 631649 | 22 |
| 39 | 45 366098 | 405066 | 440822 | 473856 | 504551 | 533217 | 560106 | 585424 | 609346 | 632017 | 21 |
| | 40 | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 3.366777 | 3.405687 | 3.441394 | 3.474386 | 3.505045 | 3.533679 | 3.560540 | 3.585834 | 3.609734 | 3.632385 | 20 |
| 41 | 15 367455 | 406307 | 441965 | 474914 | 505537 | 534141 | 560974 | 586244 | 610121 | 632752 | 19 |
| 42 | 30 368132 | 406926 | 442535 | 475443 | 506030 | 534602 | 561408 | 586653 | 610508 | 633120 | 18 |
| 43 | 45 368807 | 407544 | 443105 | 475971 | 506522 | 535062 | 561840 | 587061 | 610895 | 633487 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 3.369482 | 3.408161 | 3.443674 | 3.476498 | 3.507014 | 3.535523 | 3.562273 | 3.587469 | 3.611281 | 3.633854 | 16 |
| 45 | 15 370156 | 408777 | 444241 | 477025 | 507504 | 535982 | 562705 | 587877 | 611667 | 634220 | 15 |
| 46 | 30 370829 | 409393 | 444809 | 477551 | 507995 | 536442 | 563137 | 588285 | 612053 | 634586 | 14 |
| 47 | 45 371500 | 410007 | 445375 | 478076 | 508484 | 536900 | 563568 | 588691 | 612438 | 634952 | 13 |
| | 42′ | 57 | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 3.372171 | 3.410621 | 3.445941 | 3.478601 | 3.508974 | 3.537358 | 3.563999 | 3.589098 | 3.612823 | 3.635317 | 12 |
| 49 | 15 372840 | 411234 | 446506 | 479125 | 509462 | 537816 | 564430 | 589504 | 613208 | 635682 | 11 |
| 50 | 30 373509 | 411846 | 447070 | 479648 | 509950 | 538273 | 564860 | 589910 | 613592 | 636048 | 10 |
| 51 | 45 374176 | 412457 | 447633 | 480171 | 510438 | 538730 | 565289 | 590316 | 613976 | 636412 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 3.374843 | 3.413068 | 3.448196 | 3.480693 | 3.510925 | 3.539186 | 3.565719 | 3.590721 | 3.614360 | 3.636776 | 8 |
| 53 | 15 375508 | 413677 | 448758 | 481214 | 511411 | 539642 | 566147 | 591125 | 614743 | 637140 | 7 |
| 54 | 30 376173 | 414286 | 449320 | 481736 | 511897 | 540097 | 566576 | 591530 | 615126 | 637504 | 6 |
| 55 | 45 376836 | 414893 | 449880 | 482256 | 512382 | 540552 | 567003 | 591934 | 615508 | 637867 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 3.377499 | 3.415500 | 3.450440 | 3.482775 | 3.512867 | 3.541007 | 3.567431 | 3.592338 | 3.615891 | 3.638230 | 4 |
| 57 | 15 378160 | 416106 | 450999 | 483294 | 513351 | 541460 | 567858 | 592741 | 616273 | 638593 | 3 |
| 58 | 30 378821 | 416711 | 451558 | 483813 | 513835 | 541914 | 568285 | 593144 | 616654 | 638956 | 2 |
| 59 | 45 379480 | 417315 | 452115 | 484330 | 514318 | 542366 | 568711 | 593546 | 617035 | 639317 | 1 |
| 60 | 3.380138 | 3.417919 | 3.452672 | 3.484848 | 3.514801 | 3.542819 | 3.569137 | 3.593948 | 3.617417 | 3.639680 | 0 |
| sec. | 49m | 48m | 47m | 46m | 45m | 44m | 43m | 42m | 41m | 40m | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 deg. | | | | 6 deg. | | | | 7 deg. | | |
| | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 3.639680 | 3.660855 | 3.681043 | 3.700333 | 3.718800 | 3.736512 | 3.753528 | 3.769900 | 3.785675 | 3.800896 | 60 |
| 1 | 15 640041 | 661199 | 681372 | 700647 | 719102 | 736801 | 753806 | 770167 | 785933 | 801145 | 59 |
| 2 | 30 640402 | 661543 | 681700 | 700961 | 719402 | 737090 | 754084 | 770435 | 786191 | 801394 | 58 |
| 3 | 45 640763 | 661887 | 682028 | 701275 | 719703 | 737379 | 754361 | 770702 | 786449 | 801642 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 3.641124 | 3.662230 | 3.682356 | 3.701589 | 3.720004 | 3.737667 | 3.754639 | 3.770970 | 3.786707 | 3.801891 | 56 |
| 5 | 15 641484 | 662573 | 682684 | 701902 | 720304 | 737956 | 754916 | 771237 | 786964 | 802140 | 55 |
| 6 | 30 641844 | 662916 | 683011 | 702215 | 720604 | 738244 | 755193 | 771504 | 787222 | 802389 | 54 |
| 7 | 45 642204 | 663259 | 683338 | 702528 | 720904 | 738532 | 755470 | 771770 | 787479 | 802637 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 3.642563 | 3.663601 | 3.683665 | 3.702841 | 3.721204 | 3.738820 | 3.755747 | 3.772037 | 3.787736 | 3.802885 | 52 |
| 9 | 15 642922 | 663943 | 683992 | 703153 | 721503 | 739107 | 756023 | 772303 | 787992 | 803133 | 51 |
| 10 | 30 643281 | 664285 | 684318 | 703466 | 721803 | 739395 | 756300 | 772569 | 788249 | 803381 | 50 |
| 11 | 45 643640 | 664627 | 684644 | 703778 | 722102 | 739682 | 756576 | 772835 | 788506 | 803629 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 3.643998 | 3.664968 | 3.684971 | 3.704090 | 3.722401 | 3.739969 | 3.756852 | 3.773101 | 3.788762 | 3.803876 | 48 |
| 13 | 15 644356 | 665309 | 685296 | 704401 | 722700 | 740256 | 757123 | 773367 | 789018 | 804124 | 47 |
| 14 | 30 644714 | 665650 | 685622 | 704713 | 722998 | 740543 | 757404 | 773633 | 789275 | 804371 | 46 |
| 15 | 45 645071 | 665990 | 685947 | 705024 | 723297 | 740829 | 757679 | 773898 | 789531 | 804618 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 3.645428 | 3.666331 | 3.686272 | 3.705335 | 3.723595 | 3.741115 | 3.757955 | 3.774163 | 3.789787 | 3.804865 | 44 |
| 17 | 15 645785 | 666671 | 686596 | 705645 | 723893 | 741401 | 758230 | 774428 | 790042 | 805112 | 43 |
| 18 | 30 646141 | 667011 | 686921 | 705956 | 724190 | 741687 | 758505 | 774693 | 790298 | 805359 | 42 |
| 19 | 45 646497 | 667350 | 687245 | 706266 | 724488 | 741973 | 758779 | 774958 | 790553 | 805606 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 3.646853 | 3.667689 | 3.687569 | 3.706577 | 3.724785 | 3.742259 | 3.759054 | 3.775223 | 3.790808 | 3.805852 | 40 |
| 21 | 15 647209 | 668028 | 687893 | 706886 | 725082 | 742544 | 759329 | 775487 | 791063 | 806097 | 39 |
| 22 | 30 647564 | 668367 | 688216 | 707196 | 725379 | 742829 | 759603 | 775751 | 791318 | 806345 | 38 |
| 23 | 45 647919 | 668705 | 688539 | 707505 | 725676 | 743114 | 759877 | 776015 | 791573 | 806591 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 3.648274 | 3.669043 | 3.688862 | 3.707815 | 3.725972 | 3.743399 | 3.760151 | 3.776279 | 3.791828 | 3.806837 | 36 |
| 25 | 15 648628 | 669381 | 689185 | 708123 | 726268 | 743683 | 760425 | 776543 | 792082 | 807083 | 35 |
| 26 | 30 648983 | 669719 | 689508 | 708432 | 726564 | 743968 | 760699 | 776807 | 792337 | 807330 | 34 |
| 27 | 45 649336 | 670056 | 689830 | 708740 | 726861 | 744252 | 760972 | 777070 | 792590 | 807574 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 3.649690 | 3.670393 | 3.690152 | 3.709049 | 3.727156 | 3.744536 | 3.761245 | 3.777333 | 3.792845 | 3.807819 | 32 |
| 29 | 15 650043 | 670730 | 690474 | 709357 | 727452 | 744820 | 761518 | 777596 | 793098 | 808064 | 31 |
| 30 | 30 650396 | 671067 | 690795 | 709665 | 727747 | 745103 | 761791 | 777859 | 793352 | 808309 | 30 |
| 31 | 45 650749 | 671403 | 691117 | 709972 | 728042 | 745387 | 762064 | 778122 | 793606 | 808554 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 3.651102 | 3.671739 | 3.691438 | 3.710280 | 3.728337 | 3.745670 | 3.762337 | 3.778385 | 3.793859 | 3.808799 | 28 |
| 33 | 15 651453 | 672074 | 691758 | 710587 | 728632 | 745953 | 762609 | 778647 | 794112 | 809044 | 27 |
| 34 | 30 651806 | 672410 | 692079 | 710894 | 728926 | 746236 | 762881 | 778910 | 794366 | 809286 | 26 |
| 35 | 45 652157 | 672745 | 692399 | 711201 | 729220 | 746519 | 763153 | 779172 | 794618 | 809533 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 3.652508 | 3.673080 | 3.692720 | 3.711507 | 3.729514 | 3.746801 | 3.763425 | 3.779434 | 3.794872 | 3.809777 | 24 |
| 37 | 15 652859 | 673415 | 693039 | 711814 | 729808 | 747084 | 763697 | 779696 | 795124 | 810021 | 23 |
| 38 | 30 653210 | 673750 | 693359 | 712120 | 730101 | 747366 | 763968 | 779958 | 795377 | 810265 | 22 |
| 39 | 45 653560 | 674084 | 693679 | 712426 | 730395 | 747648 | 764240 | 780219 | 795629 | 810509 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 3.653911 | 3.674418 | 3.693998 | 3.712731 | 3.730688 | 3.747930 | 3.764511 | 3.780480 | 3.795881 | 3.810753 | 20 |
| 41 | 15 654260 | 674751 | 694317 | 713037 | 730981 | 748211 | 764782 | 780741 | 796133 | 810996 | 19 |
| 42 | 30 654610 | 675085 | 694636 | 713342 | 731274 | 748493 | 765053 | 781003 | 796385 | 811240 | 18 |
| 43 | 45 654959 | 675418 | 694954 | 713647 | 731567 | 748774 | 765323 | 781263 | 796637 | 811483 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 3.655308 | 3.675751 | 3.695272 | 3.713952 | 3.731859 | 3.749055 | 3.765594 | 3.781524 | 3.796889 | 3.811726 | 16 |
| 45 | 15 655657 | 676083 | 695590 | 714256 | 732152 | 749336 | 765864 | 781785 | 797140 | 811969 | 15 |
| 46 | 30 656006 | 676416 | 695908 | 714561 | 732444 | 749617 | 766135 | 782045 | 797392 | 812211 | 14 |
| 47 | 45 656354 | 676748 | 696226 | 714865 | 732736 | 749897 | 766405 | 782305 | 797643 | 812455 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 3.656702 | 3.677080 | 3.696543 | 3.715169 | 3.733027 | 3.750178 | 3.766675 | 3.782566 | 3.797894 | 3.812698 | 12 |
| 49 | 15 657049 | 677412 | 696860 | 715473 | 733318 | 750458 | 766944 | 782826 | 798145 | 812942 | 11 |
| 50 | 30 657397 | 677743 | 697177 | 715766 | 733610 | 750738 | 767214 | 783086 | 798396 | 813182 | 10 |
| 51 | 45 657743 | 678074 | 697493 | 716080 | 733901 | 751017 | 767483 | 783345 | 798646 | 813424 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 3.658090 | 3.678405 | 3.697810 | 3.716383 | 3.734192 | 3.751297 | 3.767752 | 3.783605 | 3.798897 | 3.813665 | 8 |
| 53 | 15 658437 | 678736 | 698126 | 716686 | 734482 | 751576 | 768021 | 783864 | 799147 | 813905 | 7 |
| 54 | 30 658783 | 679066 | 698442 | 716988 | 734773 | 751856 | 768290 | 784123 | 799397 | 814145 | 6 |
| 55 | 45 659129 | 679396 | 698758 | 717291 | 735063 | 752135 | 768559 | 784382 | 799647 | 814392 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 1.659476 | 3.679726 | 3.699073 | 3.717593 | 3.735353 | 3.752414 | 3.768827 | 3.784641 | 3.799897 | 3.814634 | 4 |
| 57 | 15 659820 | 680056 | 699388 | 717895 | 735643 | 752692 | 769096 | 784900 | 800147 | 814875 | 3 |
| 58 | 30 660165 | 680386 | 699704 | 718197 | 735933 | 752971 | 769364 | 785159 | 800397 | 815116 | 2 |
| 59 | 45 660510 | 680714 | 700018 | 718498 | 736223 | 753249 | 769632 | 785417 | 800647 | 815357 | 1 |
| 60 | 0 3.660855 | 3.681043 | 3.700333 | 3.718800 | 3.736512 | 3.753528 | 3.769900 | 3.785675 | 3.800896 | 3.815598 | 0 |
| ″ | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 deg. | | 8 deg. | | | | 9 deg. | | | | |
| | ″ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 3.815598 | 3.829818 | 3.843584 | 3.856926 | 3.869868 | 3.882433 | 3.894643 | 3.906517 | 3.918073 | 3.929328 | 60 |
| 1 | 15 815839 | 830051 | 843810 | 857145 | 870080 | 882639 | 894844 | 906712 | 918263 | 929513 | 59 |
| 2 | 30 816080 | 830284 | 844036 | 857364 | 870293 | 882846 | 895044 | 906908 | 918453 | 929698 | 58 |
| 3 | 45 816320 | 830517 | 844261 | 857582 | 870505 | 883052 | 895245 | 907102 | 918643 | 929883 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 3.816561 | 3.830749 | 3.844487 | 3.857801 | 3.870717 | 3.883258 | 3.895445 | 3.907297 | 3.918833 | 3.930068 | 56 |
| 5 | 15 816801 | 830982 | 844712 | 858019 | 870929 | 883464 | 895645 | 907492 | 919022 | 930252 | 55 |
| 6 | 30 817042 | 831214 | 844937 | 858238 | 871141 | 883670 | 895845 | 907687 | 919212 | 930437 | 54 |
| 7 | 45 817282 | 831447 | 845162 | 858456 | 871353 | 883875 | 896045 | 907881 | 919401 | 930622 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 3.817522 | 3.831679 | 3.845387 | 3.858674 | 3.871565 | 3.884081 | 3.896245 | 3.908076 | 3.919591 | 3.930806 | 52 |
| 9 | 15 817761 | 831911 | 845612 | 858892 | 871776 | 884287 | 896445 | 908271 | 919780 | 930991 | 51 |
| 10 | 30 818001 | 832143 | 845837 | 859110 | 871988 | 884492 | 896645 | 908465 | 919970 | 931175 | 50 |
| 11 | 45 818240 | 832375 | 846061 | 859328 | 872199 | 884698 | 896845 | 908659 | 920159 | 931359 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 3.818480 | 3.832607 | 3.846286 | 3.859546 | 3.872410 | 3.884903 | 3.897044 | 3.908853 | 3.920348 | 3.931544 | 48 |
| 13 | 15 818719 | 832838 | 846510 | 859763 | 872621 | 885108 | 897244 | 909047 | 920537 | 931728 | 47 |
| 14 | 30 818958 | 833070 | 846735 | 859981 | 872833 | 885313 | 897443 | 909242 | 920726 | 931912 | 46 |
| 15 | 45 819197 | 833301 | 846958 | 860198 | 873043 | 885518 | 897642 | 909435 | 920914 | 932096 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 3.819436 | 3.833532 | 3.847183 | 3.860415 | 3.873255 | 3.885723 | 3.897842 | 3.909629 | 3.921103 | 3.932280 | 44 |
| 17 | 15 819675 | 833763 | 847406 | 860632 | 873465 | 885928 | 898041 | 909823 | 921292 | 932464 | 43 |
| 18 | 30 819914 | 833994 | 847630 | 860849 | 873676 | 886133 | 898240 | 910017 | 921481 | 932648 | 42 |
| 19 | 45 820152 | 834225 | 847854 | 861066 | 873886 | 886337 | 898439 | 910210 | 921669 | 932831 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 3.820390 | 3.834456 | 3.848078 | 3.861283 | 3.874097 | 3.886542 | 3.898638 | 3.910404 | 3.921858 | 3.933015 | 40 |
| 21 | 15 820628 | 834686 | 848301 | 861500 | 874307 | 886746 | 898836 | 910597 | 922046 | 933198 | 39 |
| 22 | 30 820867 | 834917 | 848524 | 861717 | 874518 | 886950 | 899035 | 910791 | 922234 | 933382 | 38 |
| 23 | 45 821104 | 835147 | 848747 | 861933 | 874728 | 887154 | 899233 | 910984 | 922422 | 933565 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 3.821342 | 3.835377 | 3.848971 | 3.862149 | 3.874938 | 3.887359 | 3.899432 | 3.911177 | 3.922610 | 3.933749 | 36 |
| 25 | 15 821580 | 835607 | 849193 | 862365 | 875148 | 887563 | 899630 | 911370 | 922798 | 933932 | 35 |
| 26 | 30 821818 | 835837 | 849416 | 862582 | 875358 | 887767 | 899829 | 911563 | 922986 | 934115 | 34 |
| 27 | 45 822055 | 836067 | 849639 | 862798 | 875567 | 887970 | 900027 | 911756 | 923174 | 934298 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 3.822292 | 3.836297 | 3.849862 | 3.863014 | 3.875777 | 3.888174 | 3.900225 | 3.911949 | 3.923362 | 3.934481 | 32 |
| 29 | 15 822529 | 836526 | 850084 | 863229 | 875987 | 888378 | 900423 | 912141 | 923549 | 934664 | 31 |
| 30 | 30 822767 | 836756 | 850307 | 863445 | 876196 | 888581 | 900621 | 912334 | 923737 | 934847 | 30 |
| 31 | 45 823003 | 836985 | 850529 | 863661 | 876405 | 888785 | 900819 | 912526 | 923925 | 935029 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 3.823240 | 3.837215 | 3.850751 | 3.863877 | 3.876615 | 3.888988 | 3.901017 | 3.912719 | 3.924112 | 3.935212 | 28 |
| 33 | 15 823477 | 837443 | 850973 | 864092 | 876824 | 889191 | 901214 | 912912 | 924299 | 935395 | 27 |
| 34 | 30 823713 | 837673 | 851195 | 864307 | 877033 | 889395 | 901412 | 913104 | 924487 | 935577 | 26 |
| 35 | 45 823950 | 837901 | 851417 | 864522 | 877242 | 889597 | 901609 | 913296 | 924674 | 935760 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 3.824186 | 3.838130 | 3.851639 | 3.864738 | 3.877451 | 3.889801 | 3.901807 | 3.913488 | 3.924861 | 3.935942 | 24 |
| 37 | 15 824422 | 838359 | 851860 | 864952 | 877659 | 890003 | 902004 | 913680 | 925048 | 936124 | 23 |
| 38 | 30 824658 | 838587 | 852082 | 865167 | 877868 | 890206 | 902201 | 913872 | 925235 | 936307 | 22 |
| 39 | 45 824894 | 838816 | 852303 | 865382 | 878077 | 890409 | 902398 | 914064 | 925422 | 936489 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 3.825130 | 3.839044 | 3.852524 | 3.865597 | 3.878285 | 3.890612 | 3.902595 | 3.914256 | 3.925609 | 3.936671 | 20 |
| 41 | 15 825365 | 839272 | 852745 | 865811 | 878493 | 890814 | 902792 | 914447 | 925795 | 936853 | 19 |
| 42 | 30 825601 | 839500 | 852967 | 866026 | 878702 | 891016 | 902989 | 914639 | 925982 | 937035 | 18 |
| 43 | 45 825836 | 839728 | 853187 | 866240 | 878910 | 891218 | 903186 | 914830 | 926169 | 937216 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 3.826072 | 3.839956 | 3.853408 | 3.866454 | 3.879118 | 3.891421 | 3.903383 | 3.915022 | 3.926355 | 3.937398 | 16 |
| 45 | 15 826306 | 840183 | 853629 | 866668 | 879326 | 891623 | 903579 | 915213 | 926541 | 937580 | 15 |
| 46 | 30 826542 | 840411 | 853850 | 866883 | 879534 | 891825 | 903776 | 915404 | 926728 | 937762 | 14 |
| 47 | 45 826776 | 840638 | 854070 | 867096 | 879741 | 892027 | 903972 | 915595 | 926914 | 937943 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 3.827011 | 3.840866 | 3.854290 | 3.867310 | 3.879949 | 3.892229 | 3.904168 | 3.915787 | 3.927100 | 3.938125 | 12 |
| 49 | 15 827246 | 841093 | 854510 | 867524 | 880157 | 892430 | 904364 | 915978 | 927286 | 938306 | 11 |
| 50 | 30 827480 | 841320 | 854731 | 867738 | 880364 | 892632 | 904561 | 916169 | 927472 | 938487 | 10 |
| 51 | 45 827714 | 841547 | 854951 | 867951 | 880571 | 892833 | 904757 | 916359 | 927658 | 938668 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58 | |
| 52 | 0 3.827949 | 3.841774 | 3.855171 | 3.868165 | 3.880779 | 3.893035 | 3.904953 | 3.916550 | 3.927844 | 3.938850 | 8 |
| 53 | 15 828183 | 842001 | 855390 | 868378 | 880986 | 893236 | 905148 | 916741 | 928030 | 939030 | 7 |
| 54 | 30 828417 | 842227 | 855610 | 868591 | 881193 | 893438 | 905345 | 916932 | 928215 | 939212 | 6 |
| 55 | 45 828650 | 842454 | 855830 | 868804 | 881400 | 893639 | 905540 | 917122 | 928401 | 939392 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59 | |
| 56 | 0 3.828884 | 3.842680 | 3.856049 | 3.869017 | 3.881607 | 3.893840 | 3.905736 | 3.917312 | 3.928587 | 3.939573 | 4 |
| 57 | 15 829118 | 842906 | 856268 | 869230 | 881813 | 894041 | 905931 | 917503 | 928772 | 939754 | 3 |
| 58 | 30 829351 | 843133 | 856488 | 869443 | 882020 | 894242 | 906127 | 917693 | 928957 | 939935 | 2 |
| 59 | 45 829584 | 843358 | 856707 | 869655 | 882227 | 894442 | 906322 | 917883 | 929142 | 940115 | 1 |
| 60 | 60 3.829818 | 3.843584 | 3.856926 | 3.869868 | 3.882433 | 3.894643 | 3.906517 | 3.918073 | 3.929328 | 3.940296 | 0 |
| | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| sec. | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 deg: | | | | 11 deg. | | | | 12 deg. | | |
| | ′ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 3.940296 | 3.950992 | 3.961429 | 3.971619 | 3.981573 | 3.991302 | 4.000816 | 4.010124 | 4.019235 | 4.028156 | 60 |
| 1 | 15 940476 | 951168 | 961600 | 971786 | 981737 | 991462 | 000972 | 010277 | 019385 | 028303 | 59 |
| 2 | 30 940657 | 951344 | 961772 | 971954 | 981901 | 991623 | 001129 | 010431 | 019535 | 028450 | 58 |
| 3 | 45 940837 | 951520 | 961944 | 972122 | 982064 | 991782 | 001286 | 010584 | 019685 | 028597 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 3.941017 | 3.951696 | 3.962116 | 3.972289 | 3.982228 | 3.991943 | 4.001443 | 4.010737 | 4.019835 | 4.028744 | 56 |
| 5 | 15 941197 | 951871 | 962287 | 972457 | 982392 | 992103 | 001599 | 010890 | 019985 | 028891 | 55 |
| 6 | 30 941378 | 952047 | 962459 | 972624 | 982556 | 992263 | 001756 | 011044 | 020135 | 029038 | 54 |
| 7 | 45 941557 | 952222 | 962630 | 972792 | 982719 | 992423 | 001912 | 011197 | 020285 | 029185 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 3.941738 | 3.952398 | 3.962801 | 3.972959 | 3.982883 | 3.992583 | 4.002069 | 4.011350 | 4.020435 | 4.029332 | 52 |
| 9 | 15 941917 | 952573 | 962972 | 973126 | 983046 | 992742 | 002225 | 011503 | 020584 | 029478 | 51 |
| 10 | 30 942097 | 952749 | 963144 | 973294 | 983210 | 992902 | 002381 | 011656 | 020734 | 029625 | 50 |
| 11 | 45 942277 | 952924 | 963315 | 973461 | 983373 | 993062 | 002537 | 011808 | 020884 | 029771 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 3.942456 | 3.953100 | 3.963486 | 3.973628 | 3.983536 | 3.993222 | 4.002694 | 4.011962 | 4.021034 | 4.029918 | 48 |
| 13 | 15 942636 | 953275 | 963657 | 973795 | 983699 | 993381 | 002850 | 012114 | 021183 | 030064 | 47 |
| 14 | 30 942816 | 953450 | 963828 | 973962 | 983863 | 993541 | 003006 | 012267 | 021333 | 030211 | 46 |
| 15 | 45 942995 | 953625 | 963999 | 974129 | 984026 | 993700 | 003162 | 012419 | 021482 | 030357 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 3.943174 | 3.953800 | 3.964170 | 3.974296 | 3.984189 | 3.993860 | 4.003318 | 4.012572 | 4.021632 | 4.030504 | 44 |
| 17 | 15 943353 | 953975 | 964340 | 974462 | 984352 | 994019 | 003473 | 012725 | 021781 | 030650 | 43 |
| 18 | 30 943533 | 954150 | 964511 | 974629 | 984515 | 994178 | 003630 | 012877 | 021930 | 030797 | 42 |
| 19 | 45 943712 | 954324 | 964681 | 974796 | 984677 | 994337 | 003785 | 013030 | 022080 | 030943 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 3.943891 | 3.954499 | 3.964852 | 3.974962 | 3.984840 | 3.994497 | 4.003941 | 4.013182 | 4.022229 | 4.031089 | 40 |
| 21 | 15 944070 | 954673 | 965022 | 975129 | 985003 | 994656 | 004096 | 013334 | 022378 | 031235 | 39 |
| 22 | 30 944249 | 954848 | 965193 | 975295 | 985166 | 994815 | 004252 | 013487 | 022527 | 031381 | 38 |
| 23 | 45 944427 | 955022 | 965363 | 975461 | 985328 | 994974 | 004408 | 013639 | 022676 | 031527 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 3.944606 | 3.955197 | 3.965534 | 3.975628 | 3.985491 | 3.995133 | 4.004563 | 4.013791 | 4.022825 | 4.031673 | 36 |
| 25 | 15 944785 | 955371 | 965704 | 975794 | 985653 | 995292 | 004719 | 013943 | 022974 | 031819 | 35 |
| 26 | 30 944963 | 955546 | 965874 | 975960 | 985816 | 995451 | 004874 | 014096 | 023123 | 031965 | 34 |
| 27 | 45 945142 | 955720 | 966044 | 976126 | 985978 | 995609 | 005029 | 014247 | 023272 | 032111 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 3.945320 | 3.955894 | 3.966214 | 3.976293 | 3.986140 | 3.995768 | 4.005185 | 4.014400 | 4.023421 | 4.032257 | 32 |
| 29 | 15 945499 | 956068 | 966384 | 976458 | 986303 | 995926 | 005340 | 014551 | 023569 | 032402 | 31 |
| 30 | 30 945677 | 956242 | 966554 | 976624 | 986465 | 996085 | 005495 | 014703 | 023718 | 032548 | 30 |
| 31 | 45 945855 | 956416 | 966723 | 976790 | 986627 | 996244 | 005650 | 014855 | 023867 | 032693 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 3.946033 | 3.956590 | 3.966893 | 3.976956 | 3.986789 | 3.996402 | 4.005805 | 4.015007 | 4.024016 | 4.032839 | 28 |
| 33 | 15 946211 | 956763 | 967063 | 977122 | 986951 | 996561 | 005960 | 015158 | 024164 | 032985 | 27 |
| 34 | 30 946390 | 956932 | 967233 | 977288 | 987113 | 996719 | 006115 | 015310 | 024313 | 033131 | 26 |
| 35 | 45 946567 | 957111 | 967402 | 977453 | 987275 | 996877 | 006270 | 015462 | 024461 | 033276 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 3.946745 | 3.957284 | 3.967572 | 3.977619 | 3.987437 | 3.997036 | 4.006425 | 4.015613 | 4.024610 | 4.033421 | 24 |
| 37 | 15 946923 | 957458 | 967741 | 977784 | 987598 | 997194 | 006579 | 015765 | 024758 | 033566 | 23 |
| 38 | 30 947101 | 957631 | 967910 | 977950 | 987760 | 997352 | 006734 | 015916 | 024906 | 033712 | 22 |
| 39 | 45 947278 | 957804 | 968079 | 978115 | 987922 | 997510 | 006889 | 016068 | 025054 | 033857 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 3.947456 | 3.957978 | 3.968249 | 3.978280 | 3.988083 | 3.997668 | 4.007044 | 4.016219 | 4.025203 | 4.034002 | 20 |
| 41 | 15 947633 | 958151 | 968418 | 978445 | 988245 | 997826 | 007198 | 016370 | 025351 | 034147 | 19 |
| 42 | 30 947811 | 958324 | 968587 | 978611 | 988406 | 997984 | 007353 | 016522 | 025499 | 034292 | 18 |
| 43 | 45 947988 | 958497 | 968756 | 978776 | 988567 | 998141 | 007507 | 016673 | 025647 | 034437 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 3.948166 | 3.958670 | 3.968925 | 3.978941 | 3.988729 | 3.998299 | 4.007661 | 4.016824 | 4.025795 | 4.034582 | 16 |
| 45 | 15 948342 | 958843 | 969093 | 979106 | 988890 | 998457 | 007816 | 016975 | 025943 | 034727 | 15 |
| 46 | 30 948520 | 959016 | 969262 | 979271 | 989051 | 998615 | 007970 | 017126 | 026091 | 034872 | 14 |
| 47 | 45 948697 | 959189 | 969431 | 979435 | 989212 | 998772 | 008124 | 017277 | 026238 | 035017 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 3.948874 | 3.959361 | 3.969600 | 3.979600 | 3.989374 | 3.998930 | 4.008278 | 4.017428 | 4.026386 | 4.035162 | 12 |
| 49 | 15 949051 | 959534 | 969768 | 979765 | 989534 | 999087 | 008432 | 017578 | 026534 | 035306 | 11 |
| 50 | 30 949228 | 959707 | 969937 | 979930 | 989696 | 999245 | 008586 | 017729 | 026682 | 035451 | 10 |
| 51 | 45 949404 | 959879 | 970105 | 980094 | 989856 | 999402 | 008740 | 017880 | 026829 | 035596 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 3.949581 | 3.960052 | 3.970224 | 3.980259 | 3.990017 | 3.999559 | 4.008894 | 4.018031 | 4.026977 | 4.035741 | 8 |
| 53 | 15 949757 | 960224 | 970441 | 980423 | 990178 | 999717 | 009048 | 018181 | 027124 | 035885 | 7 |
| 54 | 30 949934 | 960396 | 970610 | 980588 | 990339 | 999874 | 009202 | 018332 | 027272 | 036030 | 6 |
| 55 | 45 950110 | 960568 | 970778 | 980752 | 990499 | 4.000031 | 009356 | 018482 | 027419 | 036174 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 3.950287 | 3.960741 | 3.970947 | 3.980916 | 3.990660 | 4.000188 | 4.009510 | 4.018633 | 4.027567 | 4.036319 | 4 |
| 57 | 15 950463 | 960913 | 971115 | 981080 | 990821 | 000345 | 009663 | 018783 | 027714 | 036463 | 3 |
| 58 | 30 950640 | 961085 | 971283 | 981245 | 990981 | 000502 | 009817 | 018934 | 027862 | 036607 | 2 |
| 59 | 45 950816 | 961257 | 971451 | 981409 | 991141 | 000659 | 009970 | 019084 | 028009 | 036751 | 1 |
| 60 | 60 3.950992 | 3.961429 | 3.971619 | 3.981573 | 3.991302 | 4.000816 | 4.010124 | 4.019235 | 4.028156 | 4.036896 | 0 |
| sec. | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m | sec. |

| | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 deg. | | 13 deg. | | | | 14 deg. | | | | |
| ″ | ′ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | sec. |
| 0 | 4.036896 | 4.045461 | 4.053859 | 4.062095 | 4.070176 | 4.078107 | 4.085894 | 4.093542 | 4.101056 | 4.108439 | 60 |
| 15 | 037040 | 045602 | 053997 | 062231 | 070309 | 078238 | 086023 | 093668 | 101180 | 108561 | 59 |
| 30 | 037184 | 045744 | 054136 | 062367 | 070443 | 078369 | 086152 | 093795 | 101304 | 108683 | 58 |
| 45 | 037328 | 045885 | 054274 | 062502 | 070576 | 078500 | 086280 | 093921 | 101428 | 108805 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 0 | 4.037472 | 4.046026 | 4.054413 | 4.062639 | 4.070709 | 4.078631 | 4.086409 | 4.094047 | 4.101552 | 4.108927 | 56 |
| 15 | 037616 | 046167 | 054551 | 062774 | 070842 | 078762 | 086537 | 094173 | 101676 | 109049 | 55 |
| 30 | 037760 | 046308 | 054689 | 062910 | 070976 | 078892 | 086665 | 094300 | 101800 | 109171 | 54 |
| 45 | 037904 | 046449 | 054828 | 063045 | 071109 | 079023 | 086794 | 094425 | 101924 | 109292 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 0 | 4.038048 | 4.046590 | 4.054966 | 4.063181 | 4.071242 | 4.079154 | 4.086922 | 4.094552 | 4.102048 | 4.109414 | 52 |
| 15 | 038191 | 046731 | 055104 | 063317 | 071375 | 079284 | 087050 | 094678 | 102171 | 109536 | 51 |
| 30 | 038335 | 046872 | 055242 | 063452 | 071508 | 079415 | 087179 | 094804 | 102295 | 109658 | 50 |
| 45 | 038479 | 047013 | 055380 | 063588 | 071641 | 079545 | 087307 | 094929 | 102419 | 109779 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 0 | 4.038623 | 4.047154 | 4.055519 | 4.063723 | 4.071774 | 4.079676 | 4.087435 | 4.095056 | 4.102543 | 4.109901 | 48 |
| 15 | 038766 | 047294 | 055657 | 063859 | 071907 | 079806 | 087563 | 095181 | 102666 | 110022 | 47 |
| 30 | 038910 | 047435 | 055795 | 063994 | 072040 | 079937 | 087691 | 095307 | 102790 | 110144 | 46 |
| 45 | 039053 | 047576 | 055932 | 064129 | 072172 | 080067 | 087819 | 095433 | 102913 | 110265 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 0 | 4.039197 | 4.047717 | 4.056071 | 4.064265 | 4.072305 | 4.080198 | 4.087947 | 4.095559 | 4.103037 | 4.110387 | 44 |
| 15 | 039340 | 047857 | 056208 | 064400 | 072438 | 080328 | 088075 | 095684 | 103161 | 110508 | 43 |
| 30 | 039483 | 047998 | 056346 | 064535 | 072571 | 080458 | 088203 | 095810 | 103284 | 110630 | 42 |
| 45 | 039626 | 048138 | 056484 | 064670 | 072703 | 080588 | 088331 | 095936 | 103408 | 110751 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 0 | 4.039770 | 4.048279 | 4.056622 | 4.064806 | 4.072836 | 4.080719 | 4.088459 | 4.096061 | 4.103531 | 4.110873 | 40 |
| 15 | 039913 | 048419 | 056759 | 064941 | 072968 | 080849 | 088587 | 096187 | 103654 | 110994 | 39 |
| 30 | 040056 | 048559 | 056897 | 065076 | 073101 | 080979 | 088715 | 096313 | 103778 | 111115 | 38 |
| 45 | 040199 | 048699 | 057034 | 065211 | 073234 | 081109 | 088842 | 096438 | 103901 | 111236 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 0 | 4.040342 | 4.048840 | 4.057172 | 4.065346 | 4.073366 | 4.081239 | 4.088970 | 4.096564 | 4.104025 | 4.111358 | 36 |
| 15 | 040485 | 048980 | 057310 | 065480 | 073498 | 081369 | 089097 | 096689 | 104148 | 111478 | 35 |
| 30 | 040628 | 049120 | 057447 | 065616 | 073631 | 081499 | 089225 | 096814 | 104271 | 111600 | 34 |
| 45 | 040771 | 049260 | 057584 | 065750 | 073763 | 081629 | 089353 | 096939 | 104394 | 111721 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 0 | 4.040914 | 4.049400 | 4.057722 | 4.065885 | 4.073896 | 4.081759 | 4.089480 | 4.097065 | 4.104517 | 4.111842 | 32 |
| 15 | 041057 | 049540 | 057859 | 066020 | 074028 | 081889 | 089608 | 097190 | 104640 | 111963 | 31 |
| 30 | 041200 | 049680 | 057997 | 066155 | 074160 | 082019 | 089735 | 097316 | 104764 | 112084 | 30 |
| 45 | 041342 | 049820 | 058134 | 066289 | 074292 | 082148 | 089863 | 097440 | 104886 | 112205 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 0 | 4.041845 | 4.049960 | 4.058271 | 4.066424 | 4.074424 | 4.082278 | 4.089990 | 4.097566 | 4.105010 | 4.112326 | 28 |
| 15 | 041628 | 050100 | 058408 | 066558 | 074556 | 082408 | 090117 | 097691 | 105132 | 112446 | 27 |
| 30 | 041770 | 050240 | 058545 | 066693 | 074688 | 082537 | 090245 | 097816 | 105255 | 112568 | 26 |
| 45 | 041913 | 050379 | 058682 | 066827 | 074820 | 082667 | 090372 | 097941 | 105378 | 112688 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 0 | 4.042055 | 4.050519 | 4.058819 | 4.066962 | 4.074952 | 4.082797 | 4.090500 | 4.098066 | 4.105501 | 4.112809 | 24 |
| 15 | 042198 | 050659 | 058956 | 067096 | 075084 | 082926 | 090627 | 098191 | 105624 | 112930 | 23 |
| 30 | 042340 | 050799 | 059093 | 067231 | 075216 | 083056 | 090754 | 098316 | 105747 | 113051 | 22 |
| 45 | 042482 | 050938 | 059230 | 067365 | 075348 | 083185 | 090881 | 098441 | 105869 | 113171 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 0 | 4.042625 | 4.051078 | 4.059367 | 4.067499 | 4.075480 | 4.083314 | 4.091008 | 4.098566 | 4.105922 | 4.113292 | 20 |
| 15 | 042767 | 051217 | 059504 | 067633 | 075611 | 083444 | 091135 | 098691 | 106115 | 113412 | 19 |
| 30 | 042909 | 051357 | 059641 | 067768 | 075743 | 083573 | 091262 | 098816 | 106238 | 113533 | 18 |
| 45 | 043051 | 051496 | 059777 | 067902 | 075875 | 083702 | 091389 | 098940 | 106360 | 113653 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 0 | 4.043194 | 4.051635 | 4.059914 | 4.068036 | 4.076007 | 4.083832 | 4.091516 | 4.099065 | 4.106483 | 4.113774 | 16 |
| 15 | 043335 | 051774 | 060051 | 068170 | 076138 | 083961 | 091643 | 099190 | 106605 | 113894 | 15 |
| 30 | 043478 | 051914 | 060187 | 068304 | 076270 | 084090 | 091770 | 099314 | 106728 | 114015 | 14 |
| 45 | 043619 | 052053 | 060324 | 068438 | 076401 | 084219 | 091897 | 099439 | 106850 | 114135 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 0 | 4.043762 | 4.052192 | 4.060460 | 4.068572 | 4.076533 | 4.084348 | 4.092024 | 4.099564 | 4.106973 | 4.114256 | 12 |
| 15 | 043903 | 052331 | 060597 | 068706 | 076664 | 084477 | 092150 | 099688 | 107095 | 114371 | 11 |
| 30 | 044045 | 052470 | 060733 | 068840 | 076796 | 084606 | 092277 | 099813 | 107218 | 114496 | 10 |
| 45 | 044187 | 052609 | 060869 | 068973 | 076927 | 084735 | 092404 | 099937 | 107340 | 114617 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 0 | 4.044329 | 4.052748 | 4.061006 | 4.069107 | 4.077058 | 4.084864 | 4.092530 | 4.100062 | 4.107462 | 4.114737 | 8 |
| 15 | 044470 | 052887 | 061142 | 069241 | 077189 | 084993 | 092657 | 100186 | 107584 | 114857 | 7 |
| 30 | 044612 | 053026 | 061278 | 069375 | 077321 | 085122 | 092784 | 100310 | 107707 | 114977 | 6 |
| 45 | 044754 | 053165 | 061414 | 069508 | 077452 | 085251 | 092910 | 100434 | 107829 | 115096 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 0 | 4.044895 | 4.053304 | 4.061551 | 4.069642 | 4.077583 | 4.085380 | 4.093037 | 4.100559 | 4.107951 | 4.115218 | 4 |
| 15 | 045037 | 053442 | 061687 | 069775 | 077714 | 085508 | 093163 | 100683 | 108073 | 115337 | 3 |
| 30 | 045178 | 053581 | 061823 | 069909 | 077845 | 085637 | 093290 | 100807 | 108195 | 115456 | 2 |
| 45 | 045319 | 053720 | 061959 | 070042 | 077976 | 085766 | 093416 | 100931 | 108317 | 115577 | 1 |
| 60 | 4.045461 | 4.053859 | 4.062095 | 4.070176 | 4.078107 | 4.085894 | 4.093542 | 4.101056 | 4.108439 | 4.115696 | 0 |
| | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| Time | Arc | 0m | 4m | 8m | 12m | 16m | 20m | 24m | 28m | 32m | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| m s | ′ ″ | 15° | 16° | 17° | 18° | 19° | 20° | 21° | 22° | 23° | s m |
| 0 0 | 0 0 | 4.115698 | 4.143555 | 4.169702 | 4.194332 | 4.217609 | 4.239670 | 4.260633 | 4.280599 | 4.299655 | 0 1 |
| 0 2 | 0 30 | 115937 | 143780 | 169913 | 194532 | 217798 | 239849 | 260803 | 280761 | 299810 | 58 1 |
| 0 4 | 1 0 | 116177 | 144004 | 170124 | 194731 | 217986 | 240028 | 260974 | 280924 | 299966 | 56 1 |
| 0 6 | 1 30 | 116417 | 144229 | 170336 | 194930 | 218175 | 240207 | 261144 | 281086 | 300121 | 54 1 |
| 0 8 | 2 0 | 4.116656 | 4.144453 | 4.170546 | 4.195129 | 4.218363 | 4.240386 | 4.261314 | 4.281248 | 4.300276 | 52 1 |
| 0 10 | 2 30 | 116895 | 144677 | 170757 | 195328 | 218552 | 240565 | 261484 | 281410 | 300431 | 50 1 |
| 0 12 | 3 0 | 117135 | 144901 | 170968 | 195527 | 218740 | 240744 | 261654 | 281573 | 300586 | 48 1 |
| 0 14 | 3 30 | 117374 | 145125 | 171179 | 195726 | 218928 | 240922 | 261824 | 281735 | 300740 | 46 1 |
| 0 16 | 4 0 | 4.117612 | 4.145349 | 4.171389 | 4.195925 | 4.219116 | 4.241101 | 4.261994 | 4.281897 | 4.300895 | 44 1 |
| 0 18 | 4 30 | 117851 | 145573 | 171600 | 196123 | 219304 | 241279 | 262164 | 282059 | 301050 | 42 1 |
| 0 20 | 5 0 | 118090 | 145797 | 171810 | 196322 | 219492 | 241458 | 262334 | 282220 | 301205 | 40 1 |
| 0 22 | 5 30 | 118328 | 146020 | 172020 | 196520 | 219680 | 241636 | 262503 | 282382 | 301359 | 38 1 |
| 0 24 | 6 0 | 4.118567 | 4.146243 | 4.172230 | 4.196719 | 4.219868 | 4.241814 | 4.262673 | 4.282544 | 4.301514 | 36 1 |
| 0 26 | 6 30 | 118805 | 146467 | 172440 | 196917 | 220056 | 241992 | 262842 | 282706 | 301668 | 34 1 |
| 0 28 | 7 0 | 119043 | 146690 | 172650 | 197115 | 220243 | 242170 | 263012 | 282867 | 301823 | 32 1 |
| 0 30 | 7 30 | 119281 | 146913 | 172860 | 197313 | 220431 | 242348 | 263181 | 283029 | 301977 | 30 1 |
| 0 32 | 8 0 | 4.119519 | 4.147136 | 4.173070 | 4.197511 | 4.220618 | 4.242526 | 4.263351 | 4.283190 | 4.302132 | 28 1 |
| 0 34 | 8 30 | 119756 | 147359 | 173279 | 197709 | 220805 | 242704 | 263520 | 283352 | 302286 | 26 1 |
| 0 36 | 9 0 | 119994 | 147581 | 173489 | 197907 | 220993 | 242882 | 263689 | 283513 | 302440 | 24 1 |
| 0 38 | 9 30 | 120231 | 147804 | 173698 | 198104 | 221180 | 243060 | 263858 | 283675 | 302594 | 22 1 |
| 0 40 | 10 0 | 4.120469 | 4.148026 | 4.173908 | 4.198302 | 4.221367 | 4.243237 | 4.264027 | 4.283836 | 4.302748 | 20 1 |
| 0 42 | 10 30 | 120706 | 148248 | 174117 | 198499 | 221554 | 243415 | 264196 | 283997 | 302903 | 18 1 |
| 0 44 | 11 0 | 120943 | 148471 | 174326 | 198697 | 221741 | 243592 | 264365 | 284158 | 303057 | 16 1 |
| 0 46 | 11 30 | 121180 | 148693 | 174535 | 198894 | 221928 | 243770 | 264534 | 284319 | 303210 | 14 1 |
| 0 48 | 12 0 | 4.121417 | 4.148915 | 4.174744 | 4.199091 | 4.222115 | 4.243947 | 4.264703 | 4.284480 | 4.303364 | 12 1 |
| 0 50 | 12 30 | 121653 | 149137 | 174953 | 199288 | 222301 | 244124 | 264872 | 284641 | 303518 | 10 1 |
| 0 52 | 13 0 | 121890 | 149358 | 175161 | 199485 | 222488 | 244302 | 265040 | 284802 | 303672 | 8 1 |
| 0 54 | 13 30 | 122126 | 149580 | 175370 | 199682 | 222674 | 244479 | 265209 | 284963 | 303826 | 6 1 |
| 0 56 | 14 0 | 4.122362 | 4.149801 | 4.175578 | 4.199879 | 4.222861 | 4.244656 | 4.265377 | 4.285124 | 4.303979 | 4 1 |
| 0 58 | 14 30 | 122598 | 150023 | 175787 | 200076 | 223047 | 244833 | 265546 | 285284 | 304133 | 2 1 |
| 1 0 | 15 0 | 122834 | 150244 | 175995 | 200273 | 223234 | 245010 | 265714 | 285445 | 304286 | 0 1 |
| 1 2 | 15 30 | 123070 | 150465 | 176203 | 200469 | 223420 | 245186 | 265883 | 285606 | 304440 | 58 1 |
| 1 4 | 16 0 | 4.123306 | 4.150686 | 4.176411 | 4.200666 | 4.223606 | 4.245363 | 4.266051 | 4.285766 | 4.304593 | 56 1 |
| 1 6 | 16 30 | 123542 | 150907 | 176619 | 200862 | 223792 | 245540 | 266219 | 285927 | 304747 | 54 1 |
| 8 | 17 0 | 123777 | 151128 | 176827 | 201059 | 223978 | 245716 | 266387 | 286087 | 304900 | 52 1 |
| 10 | 17 30 | 124012 | 151349 | 177035 | 201255 | 224164 | 245893 | 266555 | 286247 | 305053 | 50 1 |
| 1 12 | 18 0 | 4.124248 | 4.151569 | 4.177242 | 4.201451 | 4.224349 | 4.246069 | 4.266723 | 4.286408 | 4.305207 | 48 0 |
| 1 14 | 18 30 | 124483 | 151790 | 177450 | 201647 | 224535 | 246246 | 266891 | 286568 | 305360 | 46 0 |
| 1 16 | 19 0 | 124718 | 152010 | 177657 | 201843 | 224721 | 246422 | 267059 | 286728 | 305513 | 44 0 |
| 1 18 | 19 30 | 124952 | 152230 | 177865 | 202039 | 224906 | 246598 | 267227 | 286888 | 305666 | 42 0 |
| 1 20 | 20 0 | 4.125187 | 4.152451 | 4.178072 | 4.202234 | 4.225092 | 4.246775 | 4.267394 | 4.287048 | 4.305819 | 40 0 |
| 1 22 | 20 30 | 125422 | 152671 | 178279 | 202430 | 225277 | 246951 | 267562 | 287208 | 305972 | 38 0 |
| 1 24 | 21 0 | 125656 | 152891 | 178486 | 202626 | 225462 | 247127 | 267730 | 287368 | 306125 | 36 0 |
| 1 26 | 21 30 | 125890 | 153110 | 178693 | 202821 | 225648 | 247303 | 267897 | 287528 | 306277 | 34 0 |
| 1 28 | 22 0 | 4.126125 | 4.153330 | 4.178900 | 4.203017 | 4.225833 | 4.247478 | 4.268065 | 4.287687 | 4.306430 | 32 0 |
| 1 30 | 22 30 | 126359 | 153550 | 179107 | 203212 | 226018 | 247654 | 268232 | 287847 | 306583 | 30 0 |
| 1 32 | 23 0 | 126593 | 153769 | 179313 | 203407 | 226203 | 247830 | 268399 | 288007 | 306736 | 28 0 |
| 1 34 | 23 30 | 126826 | 153988 | 179520 | 203602 | 226388 | 248006 | 268567 | 288166 | 306888 | 26 0 |
| 1 36 | 24 0 | 4.127060 | 4.154208 | 4.179726 | 4.203797 | 4.226572 | 4.248181 | 4.268734 | 4.288326 | 4.307041 | 24 0 |
| 1 38 | 24 30 | 127294 | 154427 | 179933 | 203992 | 226757 | 248357 | 268901 | 288485 | 307193 | 22 0 |
| 1 40 | 25 0 | 127527 | 154646 | 180139 | 204187 | 226942 | 248532 | 269068 | 288645 | 307346 | 20 0 |
| 1 42 | 25 30 | 127760 | 154865 | 180345 | 204382 | 227126 | 248707 | 269235 | 288804 | 307498 | 18 0 |
| 1 44 | 26 0 | 4.127993 | 4.155083 | 4.180551 | 4.204577 | 4.227311 | 4.248883 | 4.269402 | 4.288964 | 4.307650 | 16 0 |
| 1 46 | 26 30 | 128226 | 155302 | 180757 | 204771 | 227495 | 249058 | 269569 | 289123 | 307803 | 14 0 |
| 1 48 | 27 0 | 128459 | 155521 | 180963 | 204966 | 227680 | 249233 | 269735 | 289282 | 307955 | 12 0 |
| 1 50 | 27 30 | 128692 | 155739 | 181169 | 205160 | 227864 | 249408 | 269902 | 289441 | 308107 | 10 0 |
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| 1 56 | 29 0 | 129390 | 156394 | 181785 | 205743 | 228416 | 249933 | 270402 | 289918 | 308563 | 4 0 |
| 1 58 | 29 30 | 129622 | 156612 | 181991 | 205937 | 228600 | 250107 | 270568 | 290077 | 308715 | 2 0 |
| 2 0 | 30 0 | 4.129854 | 4.156830 | 4.182196 | 4.206131 | 4.228784 | 4.250282 | 4.270735 | 4.290236 | 4.308867 | 0 0 |
| m s Time | | 58m | 54m | 50m | 46m | 42m | 38m | 34m | 30m | 26m | s m Time |

| Time m | s | Arc. ′ | ″ | 2m | 6m | 10m | 14m | 18m | 22m | 26m | 30m | 34m | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 15° 30′ | 16° 30′ | 17° 30′ | 18° 30′ | 19° 30′ | 20° 30′ | 21° 30′ | 22° 30′ | 23° 30′ | | |
| 0 | 0 | 30 | 0 | 4.129854 | 4.156830 | 4.182196 | 4.206131 | 4.228784 | 4.250282 | 4.270735 | 4.290236 | 4.308867 | 0 | 2 |
| 0 | 2 | 30 | 30 | 130086 | 157047 | 182401 | 206325 | 228968 | 250457 | 270901 | 290394 | 309019 | 58 | 1 |
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| 0 | 16 | 34 | 0 | 4.131706 | 4.158569 | 4.183834 | 4.207679 | 4.230252 | 4.251677 | 4.272063 | 4.291504 | 4.310080 | 44 | 1 |
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| 0 | 20 | 35 | 0 | 132168 | 159002 | 184243 | 208066 | 230618 | 252025 | 272395 | 291820 | 310382 | 40 | 1 |
| 0 | 22 | 35 | 30 | 132399 | 159219 | 184447 | 208259 | 230801 | 252199 | 272561 | 291979 | 310534 | 38 | 1 |
| 0 | 24 | 36 | 0 | 4.132630 | 4.159435 | 4.184651 | 4.208452 | 4.230984 | 4.252373 | 4.272726 | 4.292137 | 4.310685 | 36 | 1 |
| 0 | 26 | 36 | 30 | 132860 | 159652 | 184855 | 208644 | 231167 | 252547 | 272892 | 292295 | 310836 | 34 | 1 |
| 0 | 28 | 37 | 0 | 133091 | 159868 | 185059 | 208837 | 231349 | 252720 | 273057 | 292455 | 310987 | 32 | 1 |
| 0 | 30 | 37 | 30 | 133321 | 160084 | 185263 | 209030 | 231532 | 252894 | 273223 | 292611 | 311138 | 30 | 1 |
| 0 | 32 | 38 | 0 | 4.133551 | 4.160300 | 4.185466 | 4.209222 | 4.231714 | 4.253067 | 4.273388 | 4.292768 | 4.311289 | 28 | 1 |
| 0 | 34 | 38 | 30 | 133781 | 160516 | 185670 | 209415 | 231897 | 253241 | 273553 | 292926 | 311440 | 26 | 1 |
| 0 | 36 | 39 | 0 | 134011 | 160732 | 185873 | 209607 | 232079 | 253414 | 223718 | 293084 | 311591 | 24 | 1 |
| 0 | 38 | 39 | 30 | 134241 | 160948 | 186077 | 209799 | 232262 | 253588 | 273884 | 293242 | 311742 | 22 | 1 |
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| 0 | 44 | 41 | 0 | 134929 | 161595 | 186686 | 210376 | 232808 | 254107 | 274379 | 293714 | 312194 | 16 | 1 |
| 0 | 46 | 41 | 30 | 135158 | 161810 | 186889 | 210568 | 232990 | 254280 | 274543 | 293872 | 312345 | 14 | 1 |
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| 0 | 50 | 42 | 30 | 135616 | 162241 | 187295 | 210951 | 233354 | 254626 | 274873 | 294186 | 312646 | 10 | 1 |
| 0 | 52 | 43 | 0 | 135845 | 162456 | 187498 | 211143 | 233536 | 254799 | 275038 | 294344 | 312796 | 8 | 1 |
| 0 | 54 | 43 | 30 | 136074 | 162670 | 187700 | 211335 | 233718 | 254972 | 275202 | 294501 | 312946 | 6 | 1 |
| 0 | 56 | 44 | 0 | 4.136303 | 4.162885 | 4.187903 | 4.211526 | 4.233899 | 4.255144 | 4.275367 | 4.294658 | 4.313097 | 4 | 1 |
| 0 | 58 | 44 | 30 | 136531 | 163100 | 188105 | 211718 | 234081 | 255317 | 275531 | 294815 | 313247 | 2 | 1 |
| 1 | 0 | 45 | 0 | 136760 | 163315 | 188308 | 211909 | 234262 | 255489 | 275696 | 294972 | 313397 | 0 | 1 |
| 1 | 2 | 45 | 30 | 136988 | 163529 | 188510 | 212100 | 234444 | 255662 | 275860 | 295129 | 313547 | 58 | 0 |
| 1 | 4 | 46 | 0 | 4.137216 | 4.163743 | 4.188712 | 4.212291 | 4.234625 | 4.255834 | 4.276024 | 4.295286 | 4.313698 | 56 | 0 |
| 1 | 6 | 46 | 30 | 137444 | 163958 | 188914 | 212482 | 234806 | 256007 | 276189 | 295443 | 313848 | 54 | 0 |
| 1 | 8 | 47 | 0 | 137672 | 164172 | 189116 | 212673 | 234987 | 256179 | 276353 | 295600 | 313998 | 52 | 0 |
| 1 | 10 | 47 | 30 | 137900 | 164386 | 189318 | 212864 | 235168 | 256351 | 276517 | 295756 | 314148 | 50 | 0 |
| 1 | 12 | 48 | 0 | 4.138127 | 4.164600 | 4.189519 | 4.213055 | 4.235349 | 4.256523 | 4.276681 | 4.295913 | 4.314297 | 48 | 0 |
| 1 | 14 | 48 | 30 | 138355 | 164814 | 189721 | 213246 | 235530 | 256695 | 276845 | 296070 | 314447 | 46 | 0 |
| 1 | 16 | 49 | 0 | 138582 | 165027 | 189923 | 213437 | 235711 | 256867 | 277009 | 296226 | 314597 | 44 | 0 |
| 1 | 18 | 49 | 30 | 138810 | 165241 | 190124 | 213627 | 235892 | 257039 | 277173 | 296383 | 314747 | 42 | 0 |
| 1 | 20 | 50 | 0 | 4.139037 | 4.165454 | 4.190325 | 4.213818 | 4.236073 | 4.257211 | 4.277337 | 4.296539 | 4.314896 | 40 | 0 |
| 1 | 22 | 50 | 30 | 139264 | 165668 | 190527 | 214008 | 236253 | 257383 | 277500 | 296695 | 315046 | 38 | 0 |
| 1 | 24 | 51 | 0 | 139491 | 165881 | 190728 | 214198 | 236434 | 257554 | 277664 | 296852 | 315196 | 36 | 0 |
| 1 | 26 | 51 | 30 | 139718 | 166094 | 190929 | 214389 | 236614 | 257726 | 277827 | 297008 | 315345 | 34 | 0 |
| 1 | 28 | 52 | 0 | 4.139944 | 4.166307 | 4.191130 | 4.214579 | 4.236795 | 4.257898 | 4.277991 | 4.297164 | 4.315495 | 32 | 0 |
| 1 | 30 | 52 | 30 | 140171 | 166520 | 191331 | 214769 | 236975 | 258069 | 278154 | 297320 | 315644 | 30 | 0 |
| 1 | 32 | 53 | 0 | 140397 | 166733 | 191531 | 214959 | 237155 | 258241 | 278318 | 297476 | 315793 | 28 | 0 |
| 1 | 34 | 53 | 30 | 140624 | 166946 | 191732 | 215149 | 237335 | 258412 | 278481 | 297632 | 315943 | 26 | 0 |
| 1 | 36 | 54 | 0 | 4.140850 | 4.167159 | 4.191933 | 4.215338 | 4.237515 | 4.258583 | 4.278644 | 4.297788 | 4.316092 | 24 | 0 |
| 1 | 38 | 54 | 30 | 141076 | 167371 | 192133 | 215528 | 237695 | 258754 | 278808 | 297944 | 316241 | 22 | 0 |
| 1 | 40 | 55 | 0 | 141302 | 167584 | 192334 | 215718 | 237875 | 258925 | 278971 | 298100 | 316390 | 20 | 0 |
| 1 | 42 | 55 | 30 | 141528 | 167796 | 192534 | 215907 | 238055 | 259097 | 279134 | 298256 | 316539 | 18 | 0 |
| 1 | 44 | 56 | 0 | 4.141754 | 4.168008 | 4.192734 | 4.216097 | 4.238235 | 4.259268 | 4.279297 | 4.298412 | 4.316688 | 16 | 0 |
| 1 | 46 | 56 | 30 | 141979 | 168220 | 192934 | 216286 | 238415 | 259438 | 279460 | 298567 | 316837 | 14 | 0 |
| 1 | 48 | 57 | 0 | 142205 | 168432 | 193134 | 216475 | 238594 | 259609 | 279623 | 298723 | 316986 | 12 | 0 |
| 1 | 50 | 57 | 30 | 142430 | 168644 | 193334 | 216664 | 238774 | 259780 | 279786 | 298878 | 317135 | 10 | 0 |
| 1 | 52 | 58 | 0 | 4.142655 | 4.168856 | 4.193534 | 4.216854 | 4.238953 | 4.259951 | 4.279948 | 4.299034 | 4.317284 | 8 | 0 |
| 1 | 54 | 58 | 30 | 142881 | 169068 | 193734 | 217043 | 239132 | 260121 | 280111 | 299189 | 317433 | 6 | 0 |
| 1 | 56 | 59 | 0 | 143106 | 169279 | 193933 | 217232 | 239312 | 260292 | 280274 | 299345 | 317582 | 4 | 0 |
| 1 | 58 | 59 | 30 | 143330 | 169491 | 194133 | 217420 | 239491 | 260463 | 280436 | 299500 | 317730 | 2 | 0 |
| 2 | 0 | 60 | 0 | 4.143555 | 4.169702 | 4.194332 | 4.217609 | 4.239670 | 4.260633 | 4.280599 | 4.299655 | 4.317879 | 0 | 0 |
| m | s | | | 56m | 52m | 48m | 44m | 40m | 36m | 32m | 28m | 24m | s | m |
| Time | | | | | | | | | | | | | Time | |

| Time m s | Arc. ′ ″ | 36m 24° | 40m 25° | 44m 26° | 48m 27° | 52m 28° | 56m 29° | 2h 0m 30° | 4m 31° | 8m 32° | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 0 | 4.317879 | 4.335337 | 4.352088 | 4.368185 | 4.383675 | 4.398600 | 4.412996 | 4.426899 | 4.440338 | 0 : |
| 0 2 | 0 30 | 318027 | 335479 | 352228 | 368317 | 383802 | 398722 | 413114 | 427013 | 440448 | 58 1 |
| 0 4 | 1 0 | 318176 | 335622 | 352361 | 368448 | 383928 | 398844 | 413232 | 427126 | 440558 | 56 : |
| 0 6 | 1 30 | 318324 | 335764 | 352498 | 368580 | 384055 | 398966 | 413350 | 427240 | 440668 | 54 1 |
| 0 8 | 2 0 | 4.318473 | 4.335906 | 4.352635 | 4.368711 | 4.384181 | 4.399088 | 4.413467 | 4.427354 | 4.440778 | 52 1 |
| 0 10 | 2 30 | 318621 | 336048 | 352771 | 368842 | 384308 | 399210 | 413585 | 427468 | 440888 | 50 1 |
| 0 12 | 3 0 | 318769 | 336191 | 352908 | 368974 | 384434 | 399332 | 413703 | 427581 | 440998 | 48 1 |
| 0 14 | 3 30 | 318918 | 336333 | 353044 | 369105 | 384561 | 399454 | 413821 | 427695 | 441108 | 46 1 |
| 0 16 | 4 0 | 4.319066 | 4.336475 | 4.353181 | 4.369236 | 4.384687 | 4.399575 | 4.413938 | 4.427809 | 4.441218 | 44 1 |
| 0 18 | 4 30 | 319214 | 336617 | 353317 | 369367 | 384814 | 399697 | 414056 | 427922 | 441328 | 42 1 |
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| 0 22 | 5 30 | 319510 | 336901 | 353590 | 369630 | 385066 | 399941 | 414291 | 428150 | 441548 | 38 1 |
| 0 24 | 6 0 | 4.319658 | 4.337043 | 4.353726 | 4.369761 | 4.385192 | 4.400062 | 4.414408 | 4.428263 | 4.441658 | 36 : |
| 0 26 | 6 30 | 319806 | 337185 | 353863 | 369892 | 385319 | 400184 | 414526 | 428377 | 441767 | 34 1 |
| 0 28 | 7 0 | 319954 | 337326 | 353999 | 370023 | 385445 | 400306 | 414643 | 428490 | 441877 | 32 1 |
| 0 30 | 7 30 | 320102 | 337468 | 354135 | 370154 | 385571 | 400427 | 414760 | 428603 | 441987 | 30 1 |
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| 0 34 | 8 30 | 320397 | 337751 | 354407 | 370416 | 385823 | 400670 | 414995 | 428830 | 442206 | 26 1 |
| 0 36 | 9 0 | 320545 | 337893 | 354543 | 370546 | 385949 | 400792 | 415112 | 428943 | 442316 | 24 : |
| 0 38 | 9 30 | 320692 | 338035 | 354679 | 370677 | 386075 | 400913 | 415230 | 429057 | 442425 | 22 : |
| 0 40 | 10 0 | 4.320840 | 4.338176 | 4.354815 | 4.370808 | 4.386201 | 4.401035 | 4.415347 | 4.429170 | 4.442535 | 20 : |
| 0 42 | 10 30 | 320987 | 338318 | 354951 | 370939 | 386327 | 401156 | 415464 | 429283 | 442644 | 18 1 |
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| 0 46 | 11 30 | 321282 | 338600 | 355222 | 371200 | 386578 | 401399 | 415698 | 429510 | 442863 | 14 : |
| 0 48 | 12 0 | 4.321430 | 4.338742 | 4.355358 | 4.371330 | 4.386704 | 4.401520 | 4.415815 | 4.429623 | 4.442973 | 12 : |
| 0 50 | 12 30 | 321577 | 338883 | 355494 | 371461 | 386830 | 401641 | 415932 | 429736 | 443082 | 10 : |
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| 1 2 | 15 30 | 322460 | 339730 | 356307 | 372243 | 387583 | 402368 | 416634 | 430414 | 443738 | 58 : |
| 1 4 | 16 0 | 4.322607 | 4.339871 | 4.356443 | 4.372373 | 4.387709 | 4.402489 | 4.416751 | 4.430527 | 4.443847 | 56 0 |
| 1 6 | 16 30 | 322753 | 340011 | 356578 | 372504 | 387834 | 402610 | 416867 | 430640 | 443956 | 54 : |
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| 1 24 | 21 0 | 324073 | 341277 | 357794 | 373674 | 388961 | 403697 | 417917 | 431654 | 444938 | 36 : |
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| 1 30 | 22 30 | 324512 | 341698 | 358198 | 374063 | 389336 | 404058 | 418266 | 431991 | 445264 | 30 : |
| 1 32 | 23 0 | 324658 | 341839 | 358333 | 374192 | 389461 | 404179 | 418382 | 432104 | 445373 | 28 : |
| 1 34 | 23 30 | 324804 | 341979 | 358468 | 374322 | 389586 | 404299 | 418498 | 432216 | 445482 | 26 : |
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| 1 38 | 24 30 | 325096 | 342259 | 358737 | 374581 | 389835 | 404540 | 418731 | 432441 | 445699 | 22 : |
| 1 40 | 25 0 | 325242 | 342399 | 358872 | 374711 | 389960 | 404660 | 418847 | 432553 | 445808 | 20 : |
| 1 42 | 25 30 | 325388 | 342539 | 359006 | 374840 | 390085 | 404781 | 418963 | 432665 | 445916 | 18 0 |
| 1 44 | 26 0 | 4.325534 | 4.342679 | 4.359141 | 4.374970 | 4.390210 | 4.404901 | 4.419079 | 4.432778 | 4.446025 | 16 0 |
| 1 46 | 26 30 | 325680 | 342819 | 359275 | 375099 | 390334 | 405021 | 419196 | 432890 | 446133 | 14 0 |
| 1 48 | 27 0 | 325826 | 342959 | 359410 | 375228 | 390459 | 405141 | 419312 | 433002 | 446242 | 12 0 |
| 1 50 | 27 30 | 325972 | 343099 | 359544 | 375358 | 390583 | 405261 | 419428 | 433114 | 446351 | 10 0 |
| 1 52 | 28 0 | 4.326117 | 4.343239 | 4.359678 | 4.375487 | 4.390708 | 4.405382 | 4.419544 | 4.433226 | 4.446459 | 8 0 |
| 1 54 | 28 30 | 326263 | 343378 | 359813 | 375616 | 390832 | 405502 | 419660 | 433338 | 446567 | 6 0 |
| 1 56 | 29 0 | 326409 | 343518 | 359947 | 375745 | 390957 | 405622 | 419775 | 433450 | 446676 | 4 0 |
| 1 58 | 29 30 | 326554 | 343658 | 360081 | 375874 | 391081 | 405742 | 419891 | 433563 | 446784 | 2 0 |
| 2 0 | 30 0 | 4.326700 | 4.343797 | 4.360215 | 4.376003 | 4.391206 | 4.405862 | 4.420007 | 4.433675 | 4.446893 | 0 0 |
| m s Time | | 22m | 18m | 14m | 10m | 6m | 2m 22h | 58m | 54m | 50m | s m Time |

| Time m | h | Arc. ′ | ″ | 38m 24° 30′ | 42m 25° 30′ | 46m 26° 30′ | 50m 27° 30′ | 54m 28° 30′ | 58m 29° 30′ | 2h 2m 30° 30′ | 6m 31° 30′ | 10m 32° 30′ | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 30 | 0 | 4.326700 | 4.343797 | 4.360215 | 4.376003 | 4.391206 | 4.405862 | 4.420007 | 4.433675 | 4.446893 | 0 | 2 |
| 0 | 2 | 30 | 30 | 326845 | 343937 | 360349 | 376132 | 391330 | 405982 | 420123 | 433786 | 447001 | 58 | 1 |
| 0 | 4 | 31 | 0 | 326990 | 344076 | 360483 | 376261 | 391454 | 406102 | 420239 | 433898 | 447109 | 56 | 1 |
| 0 | 6 | 31 | 30 | 327136 | 344216 | 360617 | 376390 | 391579 | 406221 | 420355 | 434010 | 447218 | 54 | 1 |
| 0 | 8 | 32 | 0 | 4.327281 | 4.344355 | 4.360751 | 4.376519 | 4.391703 | 4.406341 | 4.420470 | 4.434122 | 4.447326 | 52 | 1 |
| 0 | 10 | 32 | 30 | 327426 | 344495 | 360885 | 376648 | 391827 | 406461 | 420586 | 434234 | 447434 | 50 | 1 |
| 0 | 12 | 33 | 0 | 327571 | 344634 | 361019 | 376777 | 391951 | 406581 | 420702 | 434346 | 447542 | 48 | 1 |
| 0 | 14 | 33 | 30 | 327717 | 344773 | 361153 | 376906 | 392075 | 406701 | 420817 | 434458 | 447650 | 46 | 1 |
| 0 | 16 | 34 | 0 | 4.327862 | 4.344912 | 4.361287 | 4.377035 | 4.392199 | 4.406820 | 4.420933 | 4.434569 | 4.447759 | 44 | 1 |
| 0 | 18 | 34 | 30 | 328007 | 345052 | 361421 | 377163 | 392323 | 406940 | 421048 | 434681 | 447867 | 42 | 1 |
| 0 | 20 | 35 | 0 | 328152 | 345191 | 361554 | 377292 | 392447 | 407060 | 421164 | 434793 | 447975 | 40 | 1 |
| 0 | 22 | 35 | 30 | 328297 | 345330 | 361688 | 377421 | 392571 | 407179 | 421280 | 434904 | 448083 | 38 | 1 |
| 0 | 24 | 36 | 0 | 4.328442 | 4.345469 | 4.361822 | 4.377549 | 4.392695 | 4.407299 | 4.421395 | 4.435016 | 4.448191 | 36 | 1 |
| 0 | 26 | 36 | 30 | 328586 | 345608 | 361955 | 377678 | 392819 | 407418 | 421510 | 435128 | 448299 | 34 | 1 |
| 0 | 28 | 37 | 0 | 328731 | 345747 | 362089 | 377806 | 392943 | 407538 | 421626 | 435239 | 448407 | 32 | 1 |
| 0 | 30 | 37 | 30 | 328876 | 345886 | 362222 | 377935 | 393067 | 407657 | 421741 | 435351 | 448515 | 30 | 1 |
| 0 | 32 | 38 | 0 | 4.329021 | 4.346024 | 4.362356 | 4.378063 | 4.393190 | 4.407777 | 4.421857 | 4.435462 | 4.448623 | 28 | 1 |
| 0 | 34 | 38 | 30 | 329165 | 346163 | 362489 | 378192 | 393314 | 407896 | 421972 | 435574 | 448731 | 26 | 1 |
| 0 | 36 | 39 | 0 | 329310 | 346302 | 362623 | 378320 | 393438 | 408015 | 422087 | 435685 | 448838 | 24 | 1 |
| 0 | 38 | 39 | 30 | 329454 | 346441 | 362756 | 378448 | 393562 | 408135 | 422202 | 435797 | 448946 | 22 | 1 |
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| 0 | 42 | 40 | 30 | 329743 | 346718 | 363022 | 378705 | 393809 | 408373 | 422433 | 436019 | 449162 | 18 | 1 |
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| 0 | 46 | 41 | 30 | 330032 | 346995 | 363289 | 378961 | 394056 | 408611 | 422663 | 436242 | 449377 | 14 | 1 |
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| 0 | 50 | 42 | 30 | 330320 | 347272 | 363555 | 379217 | 394303 | 408850 | 422893 | 436464 | 449592 | 10 | 1 |
| 0 | 52 | 43 | 0 | 330464 | 347410 | 363688 | 379345 | 394426 | 408969 | 423008 | 436576 | 449700 | 8 | 1 |
| 0 | 54 | 43 | 30 | 330609 | 347549 | 363821 | 379473 | 394550 | 409088 | 423123 | 436687 | 449808 | 6 | 1 |
| 0 | 56 | 44 | 0 | 4.330753 | 4.347687 | 4.363954 | 4.379601 | 4.394673 | 4.409207 | 4.423238 | 4.436798 | 4.449915 | 4 | 1 |
| 0 | 58 | 44 | 30 | 330897 | 347825 | 364087 | 379729 | 394796 | 409326 | 423353 | 436909 | 450023 | 2 | 1 |
| 1 | 0 | 45 | 0 | 331041 | 347963 | 364220 | 379857 | 394919 | 409445 | 423468 | 437020 | 450130 | 0 | 1 |
| 1 | 2 | 45 | 30 | 331185 | 348102 | 364352 | 379985 | 395043 | 409563 | 423583 | 437131 | 450238 | 58 | 0 |
| 1 | 4 | 46 | 0 | 4.331328 | 4.348240 | 4.364485 | 4.380113 | 4.395166 | 4.409682 | 4.423697 | 4.437242 | 4.450345 | 56 | 0 |
| 1 | 6 | 46 | 30 | 331472 | 348378 | 364618 | 380241 | 395289 | 409801 | 423812 | 437353 | 450453 | 54 | 0 |
| 1 | 8 | 47 | 0 | 331616 | 348516 | 364751 | 380368 | 395412 | 409920 | 423927 | 437464 | 450560 | 52 | 0 |
| 1 | 10 | 47 | 30 | 331760 | 348654 | 364883 | 380496 | 395535 | 410039 | 424042 | 437575 | 450667 | 50 | 0 |
| 1 | 12 | 48 | 0 | 4.331903 | 4.348792 | 4.365016 | 4.380624 | 4.395658 | 4.410157 | 4.424156 | 4.437686 | 4.450775 | 48 | 0 |
| 1 | 14 | 48 | 30 | 332047 | 348930 | 365148 | 380751 | 395781 | 410276 | 424271 | 437797 | 450882 | 46 | 0 |
| 1 | 16 | 49 | 0 | 332191 | 349067 | 365281 | 380879 | 395904 | 410395 | 424386 | 437908 | 450989 | 44 | 0 |
| 1 | 18 | 49 | 30 | 332334 | 349205 | 365413 | 381006 | 396027 | 410513 | 424500 | 438018 | 451096 | 42 | 0 |
| 1 | 20 | 50 | 0 | 4.332478 | 4.349343 | 4.365546 | 4.381134 | 4.396150 | 4.410632 | 4.424615 | 4.438129 | 4.451204 | 40 | 0 |
| 1 | 22 | 50 | 30 | 332621 | 349481 | 365678 | 381261 | 396273 | 410750 | 424729 | 438240 | 451311 | 38 | 0 |
| 1 | 24 | 51 | 0 | 332764 | 349618 | 365810 | 381389 | 396395 | 410869 | 424844 | 438351 | 451418 | 36 | 0 |
| 1 | 26 | 51 | 30 | 332908 | 349756 | 365943 | 381516 | 396518 | 410987 | 424958 | 438461 | 451525 | 34 | 0 |
| 1 | 28 | 52 | 0 | 4.333051 | 4.349893 | 4.366075 | 4.381643 | 4.396641 | 4.411106 | 4.425073 | 4.438572 | 4.451632 | 32 | 0 |
| 1 | 30 | 52 | 30 | 333194 | 350031 | 366207 | 381771 | 396764 | 411224 | 425187 | 438682 | 451739 | 30 | 0 |
| 1 | 32 | 53 | 0 | 333337 | 350168 | 366339 | 381898 | 396886 | 411343 | 425301 | 438793 | 451846 | 28 | 0 |
| 1 | 34 | 53 | 30 | 333481 | 350306 | 366471 | 382025 | 397009 | 411461 | 425416 | 438904 | 451953 | 26 | 0 |
| 1 | 36 | 54 | 0 | 4.333624 | 4.350443 | 4.366604 | 4.382152 | 4.397131 | 4.411579 | 4.425530 | 4.439014 | 4.452060 | 24 | 0 |
| 1 | 38 | 54 | 30 | 333767 | 350580 | 366736 | 382279 | 397254 | 411698 | 425644 | 439125 | 452167 | 22 | 0 |
| 1 | 40 | 55 | 0 | 333910 | 350718 | 366868 | 382406 | 397377 | 411816 | 425758 | 439235 | 452274 | 20 | 0 |
| 1 | 42 | 55 | 30 | 334053 | 350855 | 367000 | 382533 | 397499 | 411934 | 425873 | 439346 | 452381 | 18 | 0 |
| 1 | 44 | 56 | 0 | 4.334195 | 4.350992 | 4.367131 | 4.382660 | 4.397621 | 4.412052 | 4.425987 | 4.439456 | 4.452488 | 16 | 0 |
| 1 | 46 | 56 | 30 | 334338 | 351129 | 367263 | 382787 | 397744 | 412170 | 426101 | 439566 | 452595 | 14 | 0 |
| 1 | 48 | 57 | 0 | 334481 | 351266 | 367395 | 382914 | 397866 | 412288 | 426215 | 439677 | 452702 | 12 | 0 |
| 1 | 50 | 57 | 30 | 334624 | 351403 | 367527 | 383041 | 397989 | 412406 | 426329 | 439787 | 452808 | 10 | 0 |
| 1 | 52 | 58 | 0 | 4.334766 | 4.351540 | 4.367659 | 4.383168 | 4.398111 | 4.412524 | 4.426443 | 4.439897 | 4.452915 | 8 | 0 |
| 1 | 54 | 58 | 30 | 334909 | 351677 | 367790 | 383295 | 398233 | 412642 | 426557 | 440007 | 453022 | 6 | 0 |
| 1 | 56 | 59 | 0 | 335052 | 351814 | 367922 | 383422 | 398355 | 412760 | 426671 | 440118 | 453128 | 4 | 0 |
| 1 | 58 | 59 | 30 | 335194 | 351951 | 368054 | 383548 | 398477 | 412878 | 426785 | 440228 | 453235 | 2 | 0 |
| 2 | 0 | 60 | 0 | 4.335337 | 4.352088 | 4.368185 | 4.383675 | 4.398600 | 4.412996 | 4.426899 | 4.440338 | 4.453342 | 0 | 0 |
| m Time | s | | | 20m | 16m | 12m | 8m | 4m | 0m 22h | 56m | 52m | 48m | s Time | m |

| Time m | s | Arc. ′ | ″ | 12m | 16m | 20m | 24m | 28m | 32m | 36m | 40m | 44m | Time m | s |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 33° | 34° | 35° | 36° | 37° | 38° | 39° | 40° | 41° | | |
| 0 | 0 | 0 | 0 | 4.453342 | 4.465935 | 4.478142 | 4.489982 | 4.501476 | 4.512642 | 4.523495 | 4.534052 | 4.544325 | 0 | 2 |
| 0 | 2 | 0 | 30 | 453448 | 466039 | 478242 | 490080 | 501571 | 512734 | 523584 | 534138 | 544410 | 58 | 1 |
| 0 | 4 | 1 | 0 | 453555 | 466142 | 478342 | 490177 | 501665 | 512825 | 523674 | 534225 | 544494 | 56 | 1 |
| 0 | 6 | 1 | 30 | 453661 | 466245 | 478442 | 490274 | 501759 | 512917 | 523763 | 534312 | 544579 | 54 | 1 |
| 0 | 8 | 2 | 0 | 4.453768 | 4.466348 | 4.478542 | 4.490371 | 4.501854 | 4.513009 | 4.523852 | 4.534399 | 4.544663 | 52 | 1 |
| 0 | 10 | 2 | 30 | 453875 | 466451 | 478642 | 490468 | 501948 | 513100 | 523941 | 534485 | 544747 | 50 | 1 |
| 0 | 12 | 3 | 0 | 453981 | 466555 | 478742 | 490565 | 502042 | 513192 | 524030 | 534572 | 544832 | 48 | 1 |
| 0 | 14 | 3 | 30 | 454087 | 466658 | 478842 | 490662 | 502137 | 513283 | 524119 | 534659 | 544916 | 46 | 1 |
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| 0 | 18 | 4 | 30 | 454300 | 466864 | 479042 | 490856 | 502325 | 513466 | 524297 | 534832 | 545085 | 42 | 1 |
| 0 | 20 | 5 | 0 | 454407 | 466967 | 479142 | 490953 | 502419 | 513558 | 524386 | 534918 | 545169 | 40 | 1 |
| 0 | 22 | 5 | 30 | 454513 | 467070 | 479242 | 491050 | 502513 | 513650 | 524475 | 535005 | 545253 | 38 | 1 |
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| 0 | 26 | 6 | 30 | 454725 | 467276 | 479442 | 491244 | 502702 | 513832 | 524653 | 535178 | 545422 | 34 | 1 |
| 0 | 28 | 7 | 0 | 454832 | 467379 | 479542 | 491341 | 502796 | 513924 | 524742 | 535265 | 545505 | 32 | 1 |
| 0 | 30 | 7 | 30 | 454938 | 467482 | 479642 | 491438 | 502890 | 514015 | 524831 | 535351 | 545590 | 30 | 1 |
| 0 | 32 | 8 | 0 | 4.455044 | 4.467585 | 4.479741 | 4.491534 | 4.502984 | 4.514107 | 4.524920 | 4.535437 | 4.545674 | 28 | 1 |
| 0 | 34 | 8 | 30 | 455150 | 467688 | 479841 | 491631 | 503078 | 514198 | 525008 | 535524 | 545759 | 26 | 1 |
| 0 | 36 | 9 | 0 | 455256 | 467790 | 479941 | 491728 | 503172 | 514289 | 525097 | 535610 | 545843 | 24 | 1 |
| 0 | 38 | 9 | 30 | 455362 | 467893 | 480040 | 491825 | 503266 | 514381 | 525186 | 535697 | 545927 | 22 | 1 |
| 0 | 40 | 10 | 0 | 4.455469 | 4.467996 | 4.480140 | 4.491922 | 4.503360 | 4.514472 | 4.525275 | 4.535783 | 4.546011 | 20 | 1 |
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| 0 | 48 | 12 | 0 | 4.455893 | 4.468407 | 4.480538 | 4.492308 | 4.503735 | 4.514837 | 4.525630 | 4.536129 | 4.546347 | 12 | 1 |
| 0 | 50 | 12 | 30 | 455998 | 468509 | 480638 | 492405 | 503829 | 514928 | 525718 | 536215 | 546431 | 10 | 1 |
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| 0 | 54 | 13 | 30 | 456210 | 468715 | 480837 | 492598 | 504017 | 515111 | 525896 | 536387 | 546599 | 6 | 1 |
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| 0 | 58 | 14 | 30 | 456422 | 468920 | 481036 | 492791 | 504204 | 515293 | 526073 | 536560 | 546767 | 2 | 1 |
| 1 | 0 | 15 | 0 | 456528 | 469022 | 481135 | 492888 | 504298 | 515384 | 526162 | 536646 | 546851 | 0 | 1 |
| 1 | 2 | 15 | 30 | 456633 | 469125 | 481235 | 492984 | 504392 | 515475 | 526250 | 536732 | 546935 | 58 | 0 |
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| 1 | 6 | 16 | 30 | 456845 | 469330 | 481434 | 493177 | 504579 | 515657 | 526427 | 536904 | 547103 | 54 | 0 |
| 1 | 8 | 17 | 0 | 456951 | 469432 | 481533 | 493273 | 504673 | 515748 | 526516 | 536991 | 547187 | 52 | 0 |
| 1 | 10 | 17 | 30 | 457056 | 469535 | 481632 | 493370 | 504766 | 515839 | 526604 | 537077 | 547270 | 50 | 0 |
| 1 | 12 | 18 | 0 | 4.457162 | 4.469637 | 4.481731 | 4.493466 | 4.504860 | 4.515930 | 4.526693 | 4.537163 | 4.547354 | 48 | 0 |
| 1 | 14 | 18 | 30 | 457267 | 469739 | 481831 | 493562 | 504953 | 516021 | 526781 | 537249 | 547438 | 46 | 0 |
| 1 | 16 | 19 | 0 | 457373 | 469842 | 481930 | 493659 | 505047 | 516112 | 526870 | 537335 | 547522 | 44 | 0 |
| 1 | 18 | 19 | 30 | 457478 | 469944 | 482029 | 493755 | 505140 | 516203 | 526958 | 537421 | 547605 | 42 | 0 |
| 1 | 20 | 20 | 0 | 4.457584 | 4.470046 | 4.482128 | 4.493851 | 4.505234 | 4.516294 | 4.527046 | 4.537507 | 4.547689 | 40 | 0 |
| 1 | 22 | 20 | 30 | 457689 | 470148 | 482227 | 493947 | 505327 | 516384 | 527135 | 537593 | 547773 | 38 | 0 |
| 1 | 24 | 21 | 0 | 457795 | 470250 | 482327 | 494044 | 505421 | 516475 | 527223 | 537679 | 547857 | 36 | 0 |
| 1 | 26 | 21 | 30 | 457900 | 470353 | 482426 | 494140 | 505514 | 516566 | 527311 | 537765 | 547940 | 34 | 0 |
| 1 | 28 | 22 | 0 | 4.458006 | 4.470455 | 4.482525 | 4.494236 | 4.505608 | 4.516657 | 4.527400 | 4.537851 | 4.548024 | 32 | 0 |
| 1 | 30 | 22 | 30 | 458111 | 470557 | 482624 | 494332 | 505701 | 516748 | 527488 | 537937 | 548108 | 30 | 0 |
| 1 | 32 | 23 | 0 | 458216 | 470659 | 482723 | 494428 | 505794 | 516838 | 527576 | 538023 | 548191 | 28 | 0 |
| 1 | 34 | 23 | 30 | 458322 | 470761 | 482822 | 494524 | 505888 | 516929 | 527664 | 538108 | 548275 | 26 | 0 |
| 1 | 36 | 24 | 0 | 4.458427 | 4.470863 | 4.482921 | 4.494620 | 4.505981 | 4.517020 | 4.527753 | 4.538194 | 4.548358 | 24 | 0 |
| 1 | 38 | 24 | 30 | 458532 | 470965 | 483020 | 494717 | 506074 | 517110 | 527841 | 538280 | 548442 | 22 | 0 |
| 1 | 40 | 25 | 0 | 458638 | 471067 | 483119 | 494813 | 506168 | 517201 | 527929 | 538366 | 548526 | 20 | 0 |
| 1 | 42 | 25 | 30 | 458743 | 471169 | 483218 | 494909 | 506261 | 517292 | 528017 | 538452 | 548609 | 18 | 0 |
| 1 | 44 | 26 | 0 | 4.458848 | 4.471271 | 4.483316 | 4.495005 | 4.506354 | 4.517382 | 4.528105 | 4.538537 | 4.548693 | 16 | 0 |
| 1 | 46 | 26 | 30 | 458953 | 471373 | 483415 | 495100 | 506447 | 517473 | 528193 | 538623 | 548776 | 14 | 0 |
| 1 | 48 | 27 | 0 | 459058 | 471475 | 483514 | 495196 | 506541 | 517564 | 528281 | 538709 | 548860 | 12 | 0 |
| 1 | 50 | 27 | 30 | 459163 | 471577 | 483613 | 495292 | 506634 | 517654 | 528370 | 538795 | 548943 | 10 | 0 |
| 1 | 52 | 28 | 0 | 4.459268 | 4.471678 | 4.483712 | 4.495388 | 4.506727 | 4.517745 | 4.528458 | 4.538880 | 4.549027 | 8 | 0 |
| 1 | 54 | 28 | 30 | 459373 | 471780 | 483810 | 495484 | 506820 | 517835 | 528546 | 538966 | 549110 | 6 | 0 |
| 1 | 56 | 29 | 0 | 459478 | 471882 | 483909 | 49558c | 506913 | 517926 | 528634 | 539052 | 549193 | 4 | 0 |
| 1 | 58 | 29 | 30 | 459583 | 471984 | 484008 | 495676 | 507006 | 518016 | 528722 | 539137 | 549277 | 2 | 0 |
| 2 | 0 | 30 | 0 | 4.459688 | 4.472086 | 4.484107 | 4.495772 | 4.507099 | 4.518107 | 4.528810 | 4.539223 | 4.549360 | 0 | 0 |
| m | s | | | 46m | 42m | 38m | 34m | 30m | 26m | 22m | 18m | 14m | m | s |
| Time | | | | | | | | | | | | | Time | |

| Time h m s | Arc. ° ′ ″ | 14m 33° 30′ | 18m 34° 30′ | 22m 35° 30′ | 26m 36° 30′ | 30m 37° 30′ | 34m 38° 30′ | 38m 39° 30′ | 42m 40° 30′ | 46m 41° 30′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| › 0 | 30 0 | 4.459688 | 4.472086 | 4.484107 | 4.495772 | 4.507099 | 4.518107 | 4.528810 | 4.539223 | 4.549360 | 0 2 |
| › 2 | 30 30 | 459793 | 472187 | 484205 | 495867 | 507192 | 518197 | 528898 | 539309 | 549443 | 58 1 |
| › 4 | 31 0 | 459898 | 472289 | 484304 | 495963 | 507285 | 518287 | 528986 | 539394 | 549527 | 56 1 |
| › 6 | 31 30 | 460003 | 472391 | 484402 | 496059 | 507378 | 518378 | 529073 | 539480 | 549610 | 54 1 |
| › 8 | 32 0 | 4.460108 | 4.472492 | 4.484501 | 4.496154 | 4.507471 | 4.518468 | 4.529161 | 4.539565 | 4.549693 | 52 1 |
| › 10 | 32 30 | 460213 | 472594 | 484600 | 496250 | 507564 | 518559 | 529249 | 539651 | 549777 | 50 1 |
| › 12 | 33 0 | 460317 | 472695 | 484698 | 496346 | 507657 | 518649 | 529337 | 539736 | 549860 | 48 1 |
| › 14 | 33 30 | 460422 | 472797 | 484797 | 496441 | 507750 | 518739 | 529425 | 539822 | 549943 | 46 1 |
| › 16 | 34 0 | 4.460527 | 4.472898 | 4.484895 | 4.496537 | 4.507843 | 4.518829 | 4.529513 | 4.539907 | 4.550026 | 44 1 |
| › 18 | 34 30 | 460632 | 473000 | 484994 | 496633 | 507936 | 518920 | 529601 | 539993 | 550110 | 42 1 |
| › 20 | 35 0 | 460736 | 473101 | 485092 | 496728 | 508028 | 519010 | 529688 | 540078 | 550193 | 40 1 |
| › 22 | 35 30 | 460841 | 473203 | 485190 | 496824 | 508121 | 519100 | 529776 | 540163 | 550276 | 38 1 |
| › 24 | 36 0 | 4.460946 | 4.473304 | 4.485289 | 4.496919 | 4.508214 | 4.519190 | 4.529864 | 4.540249 | 4.550359 | 36 1 |
| › 26 | 36 30 | 461050 | 473406 | 485387 | 497015 | 508307 | 519281 | 529951 | 540334 | 550442 | 34 1 |
| › 28 | 37 0 | 461155 | 473507 | 485485 | 497110 | 508400 | 519371 | 530039 | 540420 | 550525 | 32 1 |
| › 30 | 37 30 | 461259 | 473608 | 485584 | 497206 | 508492 | 519461 | 530127 | 540505 | 550608 | 30 1 |
| › 32 | 38 0 | 4.461364 | 4.473710 | 4.485682 | 4.497301 | 4.508585 | 4.519551 | 4.530215 | 4.540590 | 4.550692 | 28 1 |
| › 34 | 38 30 | 461468 | 473811 | 485780 | 497396 | 508678 | 519641 | 530302 | 540676 | 550775 | 26 1 |
| › 36 | 39 0 | 461573 | 473912 | 485878 | 497492 | 508770 | 519731 | 530390 | 540761 | 550858 | 24 1 |
| › 38 | 39 30 | 461677 | 474013 | 485977 | 497587 | 508863 | 519821 | 530477 | 540846 | 550941 | 22 1 |
| › 40 | 40 0 | 4.461782 | 4.474115 | 4.486075 | 4.497682 | 4.508956 | 4.519911 | 4.530565 | 4.540931 | 4.551024 | 20 1 |
| › 42 | 40 30 | 461886 | 474216 | 486173 | 497778 | 509048 | 520001 | 530652 | 541017 | 551107 | 18 1 |
| › 44 | 41 0 | 461990 | 474317 | 486271 | 497873 | 509141 | 520091 | 530740 | 541102 | 551190 | 16 1 |
| › 46 | 41 30 | 462095 | 474418 | 486369 | 497968 | 509233 | 520181 | 530828 | 541187 | 551273 | 14 1 |
| › 48 | 42 0 | 4.462199 | 4.474519 | 4.486467 | 4.498063 | 4.509326 | 4.520271 | 4.530915 | 4.541272 | 4.551356 | 12 1 |
| › 50 | 42 30 | 462303 | 474620 | 486565 | 498159 | 509418 | 520361 | 531002 | 541357 | 551438 | 10 1 |
| › 52 | 43 0 | 462407 | 474721 | 486663 | 498254 | 509511 | 520451 | 531090 | 541442 | 551521 | 8 1 |
| › 54 | 43 30 | 462512 | 474822 | 486761 | 498349 | 509603 | 520541 | 531177 | 541527 | 551604 | 6 1 |
| › 56 | 44 0 | 4.462616 | 4.474923 | 4.486859 | 4.498444 | 4.509696 | 4.520631 | 4.531265 | 4.541613 | 4.551687 | 4 1 |
| › 58 | 44 30 | 462720 | 475024 | 486957 | 498539 | 509788 | 520720 | 531352 | 541698 | 551770 | 2 1 |
| ‹ 0 | 45 0 | 462824 | 475125 | 487055 | 498634 | 509880 | 520810 | 531440 | 541783 | 551853 | 0 1 |
| ‹ 2 | 45 30 | 462928 | 475226 | 487153 | 498729 | 509973 | 520900 | 531527 | 541868 | 551936 | 58 0 |
| ‹ 4 | 46 0 | 4.463032 | 4.475327 | 4.487251 | 4.498824 | 4.510065 | 4.520990 | 4.531614 | 4.541953 | 4.552018 | 56 0 |
| ‹ 6 | 46 30 | 463136 | 475428 | 487349 | 498919 | 510157 | 521080 | 531702 | 542038 | 552101 | 54 0 |
| ‹ 8 | 47 0 | 463240 | 475529 | 487447 | 499014 | 510250 | 521169 | 531789 | 542123 | 552184 | 52 0 |
| ‹ 10 | 47 30 | 463344 | 475630 | 487545 | 499109 | 510342 | 521259 | 531876 | 542208 | 552267 | 50 0 |
| ‹ 12 | 48 0 | 4.463448 | 4.475730 | 4.487643 | 4.499204 | 4.510434 | 4.521349 | 4.531963 | 4.542293 | 4.552349 | 48 0 |
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| ‹ 18 | 49 30 | 463760 | 476033 | 487936 | 499489 | 510711 | 521618 | 532225 | 542547 | 552597 | 42 0 |
| ‹ 20 | 50 0 | 4.463864 | 4.476133 | 4.488033 | 4.499584 | 4.510803 | 4.521707 | 4.532312 | 4.542632 | 4.552680 | 40 0 |
| ‹ 22 | 50 30 | 463968 | 476234 | 488131 | 499679 | 510895 | 521797 | 532399 | 542717 | 552763 | 38 0 |
| ‹ 24 | 51 0 | 464071 | 476335 | 488229 | 499774 | 510987 | 521886 | 532487 | 542802 | 552845 | 36 0 |
| ‹ 26 | 51 30 | 464175 | 476435 | 488326 | 499868 | 511079 | 521976 | 532574 | 542887 | 552928 | 34 0 |
| ‹ 28 | 52 0 | 4.464279 | 4.476536 | 4.488424 | 4.499963 | 4.511172 | 4.522066 | 4.532661 | 4.542971 | 4.553010 | 32 0 |
| ‹ 30 | 52 30 | 464383 | 476636 | 488522 | 500058 | 511264 | 522155 | 532748 | 543056 | 553093 | 30 0 |
| ‹ 32 | 53 0 | 464486 | 476737 | 488619 | 500153 | 511356 | 522245 | 532835 | 543141 | 553175 | 28 0 |
| ‹ 34 | 53 30 | 464590 | 476837 | 488717 | 500247 | 511448 | 522334 | 532922 | 543226 | 553258 | 26 0 |
| ‹ 36 | 54 0 | 4.464694 | 4.476938 | 4.488814 | 4.500342 | 4.511540 | 4.522423 | 4.533009 | 4.543310 | 4.553341 | 24 0 |
| ‹ 38 | 54 30 | 464797 | 477038 | 488912 | 500437 | 511632 | 522513 | 533096 | 543395 | 553423 | 22 0 |
| ‹ 40 | 55 0 | 464901 | 477139 | 489009 | 500531 | 511724 | 522602 | 533183 | 543480 | 553505 | 20 0 |
| ‹ 42 | 55 30 | 465004 | 477239 | 489107 | 500626 | 511815 | 522692 | 533270 | 543564 | 553588 | 18 0 |
| ‹ 44 | 56 0 | 4.465108 | 4.477340 | 4.489204 | 4.500721 | 4.511907 | 4.522781 | 4.533357 | 4.543649 | 4.553670 | 16 0 |
| ‹ 46 | 56 30 | 465212 | 477440 | 489301 | 500815 | 511999 | 522870 | 533444 | 543733 | 553753 | 14 0 |
| ‹ 48 | 57 0 | 465315 | 477540 | 489399 | 500910 | 512091 | 522960 | 533531 | 543818 | 553835 | 12 0 |
| ‹ 50 | 57 30 | 465418 | 477641 | 489496 | 501004 | 512183 | 523049 | 533618 | 543903 | 553918 | 10 0 |
| ‹ 52 | 58 0 | 4.465522 | 4.477741 | 4.489593 | 4.501099 | 4.512275 | 4.523138 | 4.533704 | 4.543987 | 4.554000 | 8 0 |
| ‹ 54 | 58 30 | 465625 | 477841 | 489691 | 501193 | 512367 | 523228 | 533791 | 544072 | 554082 | 6 0 |
| ‹ 56 | 59 0 | 465729 | 477941 | 489788 | 501288 | 512458 | 523317 | 533878 | 544156 | 554165 | 4 0 |
| ‹ 58 | 59 30 | 465832 | 478042 | 489885 | 501382 | 512550 | 523406 | 533965 | 544241 | 554247 | 2 0 |
| 0 | 60 0 | 4.465935 | 4.478142 | 4.489982 | 4.501476 | 4.512642 | 4.523495 | 4.534052 | 4.544325 | 4.554329 | 0 0 |
| s Time | | 44m | 40m | 36m | 32m | 28m | 24m | 20m | 16m | 12m | s m Time |

| Time m | s | Arc. ′ | ″ | 48m 42° | 52m 43° | 56m 44° | 3h 0m 45° | 4m 46° | 8m 47° | 12m 48° | 16m 49° | 20m 50° | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 4.554329 | 4.564075 | 4.573575 | 4.582840 | 4.591878 | 4.600700 | 4.609313 | 4.617727 | 4.625948 | 0 | 1 |
| 0 | 2 | 0 | 30 | 554411 | 564156 | 573654 | 582916 | 591952 | 600772 | 609384 | 617796 | 626016 | 58 | 1 |
| 0 | 4 | 1 | 0 | 554494 | 564236 | 573732 | 582992 | 592027 | 600845 | 609455 | 617865 | 626084 | 56 | 1 |
| 0 | 6 | 1 | 30 | 554576 | 564316 | 573810 | 583068 | 592101 | 600917 | 609526 | 617935 | 626151 | 54 | 1 |
| 0 | 8 | 2 | 0 | 4.554658 | 4.564396 | 4.573888 | 4.583144 | 4.592175 | 4.600990 | 4.609597 | 4.618004 | 4.626219 | 52 | 1 |
| 0 | 10 | 2 | 30 | 554740 | 564476 | 573966 | 583221 | 592250 | 601063 | 609668 | 618073 | 626287 | 50 | 1 |
| 0 | 12 | 3 | 0 | 554822 | 564556 | 574044 | 583297 | 592324 | 601135 | 609739 | 618142 | 626354 | 48 | 1 |
| 0 | 14 | 3 | 30 | 554905 | 564636 | 574122 | 583373 | 592398 | 601208 | 609809 | 618212 | 626422 | 46 | 1 |
| 0 | 16 | 4 | 0 | 4.554987 | 4.564716 | 4.574200 | 4.583449 | 4.592473 | 4.601280 | 4.609880 | 4.618281 | 4.626490 | 44 | 1 |
| 0 | 18 | 4 | 30 | 555069 | 564796 | 574278 | 583525 | 592547 | 601353 | 609951 | 618350 | 626557 | 42 | 1 |
| 0 | 20 | 5 | 0 | 555151 | 564876 | 574356 | 583601 | 592621 | 601425 | 610022 | 618419 | 626625 | 40 | 1 |
| 0 | 22 | 5 | 30 | 555233 | 564956 | 574434 | 583677 | 592696 | 601498 | 610093 | 618488 | 626692 | 38 | 1 |
| 0 | 24 | 6 | 0 | 4.555315 | 4.565036 | 4.574512 | 4.583753 | 4.592770 | 4.601570 | 4.610163 | 4.618558 | 4.626760 | 36 | 1 |
| 0 | 26 | 6 | 30 | 555397 | 565116 | 574590 | 583830 | 592844 | 601643 | 610234 | 618627 | 626828 | 34 | 1 |
| 0 | 28 | 7 | 0 | 555479 | 565196 | 574668 | 583906 | 592918 | 601715 | 610305 | 618696 | 626895 | 32 | 1 |
| 0 | 30 | 7 | 30 | 555561 | 565276 | 574746 | 583982 | 592992 | 601788 | 610376 | 618765 | 626963 | 30 | 1 |
| 0 | 32 | 8 | 0 | 4.555643 | 4.565356 | 4.574824 | 4.584058 | 4.593067 | 4.601860 | 4.610446 | 4.618834 | 4.627030 | 28 | 1 |
| 0 | 34 | 8 | 30 | 555725 | 565436 | 574902 | 584134 | 593141 | 601932 | 610517 | 618903 | 627098 | 26 | 1 |
| 0 | 36 | 9 | 0 | 555807 | 565516 | 574980 | 584210 | 593215 | 602005 | 610588 | 618972 | 627165 | 24 | 1 |
| 0 | 38 | 9 | 30 | 555889 | 565596 | 575058 | 584285 | 593289 | 602077 | 610659 | 619041 | 627233 | 22 | 1 |
| 0 | 40 | 10 | 0 | 4.555971 | 4.565676 | 4.575136 | 4.584361 | 4.593363 | 4.602149 | 4.610729 | 4.619110 | 4.627300 | 20 | 1 |
| 0 | 42 | 10 | 30 | 556053 | 565755 | 575213 | 584437 | 593437 | 602222 | 610800 | 619179 | 627368 | 18 | 1 |
| 0 | 44 | 11 | 0 | 556135 | 565835 | 575291 | 584513 | 593511 | 602294 | 610870 | 619248 | 627435 | 16 | 1 |
| 0 | 46 | 11 | 30 | 556217 | 565915 | 575369 | 584589 | 593585 | 602366 | 610941 | 619317 | 627503 | 14 | 1 |
| 0 | 48 | 12 | 0 | 4.556299 | 4.565995 | 4.575447 | 4.584665 | 4.593659 | 4.602439 | 4.611012 | 4.619386 | 4.627570 | 12 | 1 |
| 0 | 50 | 12 | 30 | 556380 | 566074 | 575525 | 584741 | 593733 | 602511 | 611082 | 619455 | 627637 | 10 | 1 |
| 0 | 52 | 13 | 0 | 556462 | 566154 | 575602 | 584817 | 593807 | 602583 | 611153 | 619524 | 627705 | 8 | 1 |
| 0 | 54 | 13 | 30 | 556544 | 566234 | 575680 | 584893 | 593881 | 602656 | 611223 | 619593 | 627772 | 6 | 1 |
| 0 | 56 | 14 | 0 | 4.556626 | 4.566314 | 4.575758 | 4.584968 | 4.593955 | 4.602728 | 4.611294 | 4.619662 | 4.627840 | 4 | 1 |
| 0 | 58 | 14 | 30 | 556708 | 566393 | 575835 | 585044 | 594029 | 602800 | 611365 | 619731 | 627907 | 2 | 1 |
| 1 | 0 | 15 | 0 | 556789 | 566473 | 575913 | 585120 | 594103 | 602872 | 611435 | 619800 | 627974 | 0 | 1 |
| 1 | 2 | 15 | 30 | 556871 | 566553 | 575991 | 585196 | 594177 | 602944 | 611506 | 619869 | 628042 | 58 | 0 |
| 1 | 4 | 16 | 0 | 4.556953 | 4.566632 | 4.576068 | 4.585272 | 4.594251 | 4.603017 | 4.611576 | 4.619938 | 4.628109 | 56 | 0 |
| 1 | 6 | 16 | 30 | 557035 | 566712 | 576146 | 585347 | 594325 | 603089 | 611647 | 620007 | 628176 | 54 | 0 |
| 1 | 8 | 17 | 0 | 557116 | 566792 | 576224 | 585423 | 594399 | 603161 | 611717 | 620075 | 628244 | 52 | 0 |
| 1 | 10 | 17 | 30 | 557198 | 566871 | 576301 | 585499 | 594473 | 603233 | 611788 | 620144 | 628311 | 50 | 0 |
| 1 | 12 | 18 | 0 | 4.557280 | 4.566951 | 4.576379 | 4.585574 | 4.594547 | 4.603305 | 4.611858 | 4.620213 | 4.628378 | 48 | 0 |
| 1 | 14 | 18 | 30 | 557361 | 567030 | 576457 | 585650 | 594621 | 603377 | 611928 | 620282 | 628445 | 46 | 0 |
| 1 | 16 | 19 | 0 | 557443 | 567110 | 576534 | 585726 | 594695 | 603449 | 611999 | 620351 | 628513 | 44 | 0 |
| 1 | 18 | 19 | 30 | 557524 | 567189 | 576612 | 585801 | 594768 | 603521 | 612069 | 620420 | 628580 | 42 | 0 |
| 1 | 20 | 20 | 0 | 4.557606 | 4.567269 | 4.576689 | 4.585877 | 4.594842 | 4.603594 | 4.612140 | 4.620488 | 4.628647 | 40 | 0 |
| 1 | 22 | 20 | 30 | 557687 | 567348 | 576767 | 585953 | 594916 | 603666 | 612210 | 620557 | 628714 | 38 | 0 |
| 1 | 24 | 21 | 0 | 557769 | 567428 | 576844 | 586028 | 594990 | 603738 | 612280 | 620626 | 628782 | 36 | 0 |
| 1 | 26 | 21 | 30 | 557851 | 567507 | 576922 | 586104 | 595064 | 603810 | 612351 | 620695 | 628849 | 34 | 0 |
| 1 | 28 | 22 | 0 | 4.557932 | 4.567587 | 4.576999 | 4.586179 | 4.595137 | 4.603882 | 4.612421 | 4.620763 | 4.628916 | 32 | 0 |
| 1 | 30 | 22 | 30 | 558014 | 567666 | 577077 | 586255 | 595211 | 603954 | 612491 | 620832 | 628983 | 30 | 0 |
| 1 | 32 | 23 | 0 | 558095 | 567746 | 577154 | 586330 | 595285 | 604026 | 612562 | 620901 | 629050 | 28 | 0 |
| 1 | 34 | 23 | 30 | 558176 | 567825 | 577231 | 586406 | 595358 | 604098 | 612632 | 620969 | 629117 | 26 | 0 |
| 1 | 36 | 24 | 0 | 4.558258 | 4.567904 | 4.577309 | 4.586482 | 4.595432 | 4.604170 | 4.612702 | 4.621038 | 4.629184 | 24 | 0 |
| 1 | 38 | 24 | 30 | 558339 | 567984 | 577386 | 586557 | 595506 | 604242 | 612773 | 621107 | 629252 | 22 | 0 |
| 1 | 40 | 25 | 0 | 558421 | 568063 | 577464 | 586632 | 595579 | 604313 | 612843 | 621175 | 629319 | 20 | 0 |
| 1 | 42 | 25 | 30 | 558502 | 568142 | 577541 | 586708 | 595653 | 604385 | 612913 | 621244 | 629386 | 18 | 0 |
| 1 | 44 | 26 | 0 | 4.558583 | 4.568222 | 4.577618 | 4.586783 | 4.595727 | 4.604457 | 4.612983 | 4.621313 | 4.629453 | 16 | 0 |
| 1 | 46 | 26 | 30 | 558665 | 568301 | 577696 | 586859 | 595800 | 604529 | 613053 | 621381 | 629520 | 14 | 0 |
| 1 | 48 | 27 | 0 | 558746 | 568380 | 577773 | 586934 | 595874 | 604601 | 613124 | 621450 | 629587 | 12 | 0 |
| 1 | 50 | 27 | 30 | 558827 | 568459 | 577850 | 587010 | 595948 | 604673 | 613194 | 621518 | 629654 | 10 | 0 |
| 1 | 52 | 28 | 0 | 4.558909 | 4.568539 | 4.577927 | 4.587085 | 4.596021 | 4.604745 | 4.613264 | 4.621587 | 4.629721 | 8 | 0 |
| 1 | 54 | 28 | 30 | 558990 | 568618 | 578005 | 587160 | 596095 | 604817 | 613334 | 621656 | 629788 | 6 | 0 |
| 1 | 56 | 29 | 0 | 559071 | 568697 | 578082 | 587236 | 596168 | 604888 | 613404 | 621724 | 629855 | 4 | 0 |
| 1 | 58 | 29 | 30 | 559152 | 568776 | 578159 | 587311 | 596242 | 604960 | 613474 | 621793 | 629922 | 2 | 0 |
| 2 | 0 | 30 | 0 | 4.559234 | 4.568855 | 4.578236 | 4.587386 | 4.596315 | 4.605032 | 4.613545 | 4.621861 | 4.629989 | 0 | 0 |
| m Time′ | | | | 10m | 6m | 2m 21h | 58m | 54m | 50m | 46m | 42m | 38m | Time | s m |

| Time | Arc. | 50m | 54m | 58m | 3h 2m | 6m | 10m | 14m | 18m | 22m | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| m s | ′ ″ | 42° 30′ | 43° 30′ | 44° 30′ | 45° 30′ | 46° 30′ | 47° 30′ | 48° 30′ | 49° 30′ | 50° 30′ | s m |
| 0 0 | 30 0 | 4.559234 | 4.568855 | 4.578236 | 4.587386 | 4.596315 | 4.605032 | 4.613545 | 4.621861 | 4.629989 | 0 2 |
| 0 2 | 30 30 | 559315 | 568935 | 578314 | 587462 | 596389 | 605104 | 613615 | 621930 | 630056 | 58 1 |
| 0 4 | 31 0 | 559396 | 569014 | 578391 | 587537 | 596462 | 605175 | 613685 | 621998 | 630123 | 56 1 |
| 0 6 | 31 30 | 559477 | 569093 | 578468 | 587612 | 596536 | 605247 | 613755 | 622067 | 630190 | 54 1 |
| 0 8 | 32 0 | 4.559558 | 4.569172 | 4.578545 | 4.587688 | 4.596609 | 4.605319 | 4.613825 | 4.622135 | 4.630257 | 52 1 |
| 0 10 | 32 30 | 559640 | 569251 | 578622 | 587763 | 596683 | 605391 | 613895 | 622204 | 630324 | 50 1 |
| 0 12 | 33 0 | 559721 | 569330 | 578699 | 587838 | 596756 | 605462 | 613965 | 622272 | 630391 | 48 1 |
| 0 14 | 33 30 | 559802 | 569409 | 578776 | 587913 | 596830 | 605534 | 614035 | 622340 | 630457 | 46 1 |
| 0 16 | 34 0 | 4.559883 | 4.569488 | 4.578853 | 4.587988 | 4.596903 | 4.605606 | 4.614105 | 4.622409 | 4.630524 | 44 1 |
| 0 18 | 34 30 | 559964 | 569567 | 578930 | 588064 | 596976 | 605677 | 614175 | 622477 | 630591 | 42 1 |
| 0 20 | 35 0 | 560045 | 569646 | 579008 | 588139 | 597050 | 605749 | 614245 | 622546 | 630658 | 40 1 |
| 0 22 | 35 30 | 560126 | 569725 | 579085 | 588214 | 597123 | 605821 | 614315 | 622614 | 630725 | 38 1 |
| 0 24 | 36 0 | 4.560207 | 4.569804 | 4.579162 | 4.588289 | 4.597196 | 4.605892 | 4.614385 | 4.622682 | 4.630792 | 36 1 |
| 0 26 | 36 30 | 560288 | 569883 | 579239 | 588364 | 597270 | 605964 | 614455 | 622751 | 630858 | 34 1 |
| 0 28 | 37 0 | 560369 | 569962 | 579316 | 588439 | 597343 | 606035 | 614525 | 622819 | 630925 | 32 1 |
| 0 30 | 37 30 | 560450 | 570041 | 579393 | 588514 | 597416 | 606107 | 614595 | 622887 | 630992 | 30 1 |
| 0 32 | 38 0 | 4.560531 | 4.570120 | 4.579469 | 4.588590 | 4.597490 | 4.606179 | 4.614665 | 4.622956 | 4.631059 | 28 1 |
| 0 34 | 38 30 | 560612 | 570199 | 579546 | 588665 | 597563 | 606250 | 614735 | 623024 | 631126 | 26 1 |
| 0 36 | 39 0 | 560693 | 570278 | 579623 | 588740 | 597636 | 606322 | 614804 | 623092 | 631192 | 24 1 |
| 0 38 | 39 30 | 560774 | 570357 | 579700 | 588815 | 597709 | 606393 | 614874 | 623160 | 631259 | 22 1 |
| 0 40 | 40 0 | 4.560855 | 4.570435 | 4.579777 | 4.588890 | 4.597783 | 4.606465 | 4.614944 | 4.623229 | 4.631326 | 20 1 |
| 0 42 | 40 30 | 560935 | 570514 | 579854 | 588965 | 597856 | 606536 | 615014 | 623297 | 631392 | 18 1 |
| 0 44 | 41 0 | 561016 | 570593 | 579931 | 589040 | 597929 | 606608 | 615084 | 623365 | 631459 | 16 1 |
| 0 46 | 41 30 | 561097 | 570672 | 580008 | 589115 | 598002 | 606679 | 615154 | 623433 | 631526 | 14 1 |
| 0 48 | 42 0 | 4.561178 | 4.570751 | 4.580084 | 4.589190 | 4.598075 | 4.606751 | 4.615223 | 4.623502 | 4.631593 | 12 1 |
| 0 50 | 42 30 | 561259 | 570829 | 580161 | 589265 | 598149 | 606822 | 615293 | 623570 | 631659 | 10 1 |
| 0 52 | 43 0 | 561339 | 570908 | 580238 | 589339 | 598222 | 606893 | 615363 | 623638 | 631726 | 8 1 |
| 0 54 | 43 30 | 561420 | 570987 | 580315 | 589414 | 598295 | 606965 | 615433 | 623706 | 631792 | 6 1 |
| 0 56 | 44 0 | 4.561501 | 4.571066 | 4.580392 | 4.589489 | 4.598368 | 4.607036 | 4.615502 | 4.623774 | 4.631859 | 4 1 |
| 0 58 | 44 30 | 561582 | 571144 | 580468 | 589564 | 598441 | 607108 | 615572 | 623842 | 631926 | 2 1 |
| 1 0 | 45 0 | 561662 | 571223 | 580545 | 589639 | 598514 | 607179 | 615642 | 623911 | 631992 | 0 1 |
| 1 2 | 45 30 | 561743 | 571302 | 580622 | 589714 | 598587 | 607250 | 615712 | 623979 | 632059 | 58 0 |
| 1 4 | 46 0 | 4.561824 | 4.571380 | 4.580699 | 4.589789 | 4.598660 | 4.607322 | 4.615781 | 4.624047 | 4.632125 | 56 0 |
| 1 6 | 46 30 | 561904 | 571459 | 580775 | 589864 | 598733 | 607393 | 615851 | 624115 | 632192 | 54 0 |
| 1 8 | 47 0 | 561985 | 571537 | 580852 | 589938 | 598806 | 607464 | 615921 | 624183 | 632259 | 52 0 |
| 1 10 | 47 30 | 562066 | 571616 | 580929 | 590013 | 598879 | 607535 | 615990 | 624251 | 632325 | 50 0 |
| 1 12 | 48 0 | 4.562146 | 4.571695 | 4.581005 | 4.590088 | 4.598952 | 4.607607 | 4.616060 | 4.624319 | 4.632392 | 48 0 |
| 1 14 | 48 30 | 562227 | 571773 | 581082 | 590163 | 599025 | 607678 | 616129 | 624387 | 632458 | 46 0 |
| 1 16 | 49 0 | 562307 | 571852 | 581158 | 590237 | 599098 | 607749 | 616199 | 624455 | 632525 | 44 0 |
| 1 18 | 49 30 | 562388 | 571930 | 581235 | 590312 | 599171 | 607821 | 616269 | 624523 | 632591 | 42 0 |
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| 1 22 | 50 30 | 562549 | 572087 | 581388 | 590462 | 599317 | 607963 | 616408 | 624659 | 632724 | 38 0 |
| 1 24 | 51 0 | 562629 | 572166 | 581465 | 590536 | 599390 | 608034 | 616477 | 624727 | 632790 | 36 0 |
| 1 26 | 51 30 | 562710 | 572244 | 581541 | 590611 | 599463 | 608105 | 616547 | 624795 | 932857 | 34 0 |
| 1 28 | 52 0 | 4.562790 | 4.572323 | 4.581618 | 4.590686 | 4.599536 | 4.608176 | 4.616616 | 4.624863 | 4.632923 | 32 0 |
| 1 30 | 52 30 | 562871 | 572401 | 581694 | 590760 | 599608 | 608248 | 616686 | 624931 | 632990 | 30 0 |
| 1 32 | 53 0 | 562951 | 572479 | 581771 | 590835 | 599681 | 608319 | 616755 | 624999 | 633056 | 28 0 |
| 1 34 | 53 30 | 563032 | 572558 | 581847 | 590909 | 599754 | 608390 | 616825 | 625067 | 633122 | 26 0 |
| 1 36 | 54 0 | 4.563112 | 4.572636 | 4.581924 | 4.590984 | 4.599827 | 4.608461 | 4.616894 | 4.625135 | 4.633189 | 24 0 |
| 1 38 | 54 30 | 563192 | 572715 | 582000 | 591059 | 599900 | 608532 | 616964 | 625202 | 633255 | 22 0 |
| 1 40 | 55 0 | 563273 | 572793 | 582076 | 591133 | 599973 | 608603 | 617033 | 625270 | 633322 | 20 0 |
| 1 42 | 55 30 | 563353 | 572871 | 582153 | 591208 | 600045 | 608674 | 617103 | 625338 | 633388 | 18 0 |
| 1 44 | 56 0 | 4.563433 | 4.572949 | 4.582229 | 4.591282 | 4.600118 | 4.608745 | 4.617172 | 4.625406 | 4.633454 | 16 0 |
| 1 46 | 56 30 | 563514 | 573028 | 582305 | 591357 | 600191 | 608816 | 617241 | 625474 | 633520 | 14 0 |
| 1 48 | 57 0 | 563594 | 573106 | 582382 | 591431 | 600264 | 608887 | 617311 | 625542 | 633587 | 12 0 |
| 1 50 | 57 30 | 563674 | 573184 | 582458 | 591506 | 600336 | 608958 | 617380 | 625609 | 633653 | 10 0 |
| 1 52 | 58 0 | 4.563755 | 4.573263 | 4.582534 | 4.591580 | 4.600409 | 4.609029 | 4.617450 | 4.625677 | 4.633719 | 8 0 |
| 1 54 | 58 30 | 563835 | 573341 | 582611 | 591655 | 600482 | 609100 | 617519 | 625745 | 633786 | 6 0 |
| 1 56 | 59 0 | 563915 | 573419 | 582687 | 591729 | 600554 | 609171 | 617588 | 625813 | 633852 | 4 0 |
| 1 58 | 59 30 | 563995 | 573497 | 582763 | 591804 | 600627 | 609242 | 617658 | 625880 | 633918 | 2 0 |
| 2 0 | 60 0 | 4.564075 | 4.573575 | 4.582840 | 4.591878 | 4.600700 | 4.609313 | 4.617727 | 4.625948 | 4.633984 | 0 0 |
| s m Time | | 8m | 4m | 0m 21h | 56m | 52m | 48m | 44m | 40m | 36m | s m Time |

| Time m | s | Arc. ° | ′ | ″ | 24m | 28m | 32m | 36m | 40m | 44m | 48m | 52m | 56m | Time h | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | | |
| 0 | 0 | 0 | 0 | 0 | 4.633984 | 4.641842 | 4.649527 | 4.657047 | 4.664406 | 4.671609 | 4.678663 | 4.685571 | 4.692339 | 0 | 2 |
| 0 | 2 | 0 | 30 | | 634051 | 641907 | 649591 | 657109 | 664466 | 671669 | 678721 | 685628 | 692395 | 58 | 1 |
| 0 | 4 | 1 | 0 | | 634117 | 641971 | 649654 | 657171 | 664527 | 671728 | 678779 | 685685 | 692450 | 56 | 1 |
| 0 | 6 | 1 | 30 | | 634183 | 642036 | 649717 | 657233 | 664588 | 671787 | 678837 | 685742 | 692506 | 54 | 1 |
| 0 | 8 | 2 | 0 | | 4.634249 | 4.642101 | 4.649781 | 4.657295 | 4.664648 | 4.671847 | 4.678895 | 4.685799 | 4.692562 | 52 | 1 |
| 0 | 10 | 2 | 30 | | 634315 | 642166 | 649844 | 657356 | 664709 | 671906 | 678954 | 685856 | 692618 | 50 | 1 |
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| 0 | 14 | 3 | 30 | | 634447 | 642295 | 649971 | 657480 | 664830 | 672025 | 679070 | 685970 | 692729 | 46 | 1 |
| 0 | 16 | 4 | 0 | | 4.634514 | 4.642360 | 4.650034 | 4.657542 | 4.664891 | 4.672084 | 4.679128 | 4.686027 | 4.692785 | 44 | 1 |
| 0 | 18 | 4 | 30 | | 634580 | 642424 | 650097 | 657604 | 664951 | 672143 | 679186 | 686084 | 692841 | 42 | 1 |
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| 0 | 24 | 6 | 0 | | 4.634778 | 4.642618 | 4.650287 | 4.657790 | 4.665133 | 4.672321 | 4.679360 | 4.686254 | 4.693008 | 36 | 1 |
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| 0 | 28 | 7 | 0 | | 634910 | 642747 | 650413 | 657913 | 665254 | 672440 | 679476 | 686368 | 693119 | 32 | 1 |
| 0 | 30 | 7 | 30 | | 634976 | 642812 | 650476 | 657975 | 665314 | 672499 | 679534 | 686425 | 693175 | 30 | 1 |
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| 0 | 34 | 8 | 30 | | 635108 | 642941 | 650603 | 658099 | 665435 | 672618 | 679650 | 686538 | 693286 | 26 | 1 |
| 0 | 36 | 9 | 0 | | 635174 | 643006 | 650666 | 658161 | 665496 | 672677 | 679708 | 686595 | 693342 | 24 | 1 |
| 0 | 38 | 9 | 30 | | 635240 | 643070 | 650729 | 658222 | 665556 | 672736 | 679766 | 686652 | 693398 | 22 | 1 |
| 0 | 40 | 10 | 0 | | 4.635306 | 4.643135 | 4.650792 | 4.658284 | 4.665617 | 4.672795 | 4.679824 | 4.686709 | 4.693453 | 20 | 1 |
| 0 | 42 | 10 | 30 | | 635372 | 643199 | 650855 | 658346 | 665677 | 672854 | 679882 | 686766 | 693509 | 18 | 1 |
| 0 | 44 | 11 | 0 | | 635438 | 643264 | 650918 | 658408 | 665738 | 672913 | 679940 | 686822 | 693565 | 16 | 1 |
| 0 | 46 | 11 | 30 | | 635504 | 643328 | 650981 | 658469 | 665798 | 672973 | 679998 | 686879 | 693620 | 14 | 1 |
| 0 | 48 | 12 | 0 | | 4.635570 | 4.643393 | 4.651044 | 4.658531 | 4.665859 | 4.673032 | 4.680056 | 4.686936 | 4.693676 | 12 | 1 |
| 0 | 50 | 12 | 30 | | 635636 | 643457 | 651107 | 658593 | 665919 | 673091 | 680114 | 686993 | 693731 | 10 | 1 |
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| 0 | 54 | 13 | 30 | | 635768 | 643586 | 651234 | 658716 | 666040 | 673209 | 680230 | 687106 | 693843 | 6 | 1 |
| 0 | 56 | 14 | 0 | | 4.635833 | 4.643650 | 4.651297 | 4.658778 | 4.666100 | 4.673268 | 4.680288 | 4.687163 | 4.693898 | 4 | 1 |
| 0 | 58 | 14 | 30 | | 635899 | 643715 | 651360 | 658840 | 666160 | 673327 | 680345 | 687219 | 693954 | 2 | 1 |
| 1 | 0 | 15 | 0 | | 635965 | 643779 | 651423 | 658901 | 666221 | 673387 | 680403 | 687276 | 694009 | 0 | 1 |
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| 1 | 8 | 17 | 0 | | 636228 | 644037 | 651674 | 659148 | 666462 | 673623 | 680635 | 687503 | 694231 | 52 | 0 |
| 1 | 10 | 17 | 30 | | 636294 | 644101 | 651737 | 659209 | 666522 | 673682 | 680693 | 687559 | 694287 | 50 | 0 |
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| 1 | 14 | 18 | 30 | | 636426 | 644230 | 651863 | 659333 | 666643 | 673800 | 680808 | 687673 | 694398 | 46 | 0 |
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| 1 | 20 | 20 | 0 | | 4.636623 | 4.644423 | 4.652052 | 4.659517 | 4.666824 | 4.673977 | 4.680982 | 4.687842 | 4.694564 | 40 | 0 |
| 1 | 22 | 20 | 30 | | 636689 | 644487 | 652115 | 659579 | 666884 | 674036 | 681039 | 687899 | 694620 | 38 | 0 |
| 1 | 24 | 21 | 0 | | 636754 | 644551 | 652178 | 659640 | 666944 | 674095 | 681097 | 687956 | 694675 | 36 | 0 |
| 1 | 26 | 21 | 30 | | 636820 | 644615 | 652241 | 659702 | 667004 | 674154 | 681155 | 688012 | 694730 | 34 | 0 |
| 1 | 28 | 22 | 0 | | 4.636886 | 4.644680 | 4.652303 | 4.659763 | 4.667065 | 4.674213 | 4.681213 | 4.688069 | 4.694786 | 32 | 0 |
| 1 | 30 | 22 | 30 | | 636951 | 644744 | 652366 | 659825 | 667125 | 674272 | 681270 | 688125 | 694841 | 30 | 0 |
| 1 | 32 | 23 | 0 | | 637017 | 644808 | 652429 | 659886 | 667185 | 674331 | 681328 | 688182 | 694897 | 28 | 0 |
| 1 | 34 | 23 | 30 | | 637083 | 644872 | 652492 | 659948 | 667245 | 674390 | 681386 | 688238 | 694952 | 26 | 0 |
| 1 | 36 | 24 | 0 | | 4.637148 | 4.644936 | 4.652555 | 4.660009 | 4.667305 | 4.674448 | 4.681443 | 4.688295 | 4.695007 | 24 | 0 |
| 1 | 38 | 24 | 30 | | 637214 | 645001 | 652618 | 660071 | 667366 | 674507 | 681501 | 688351 | 695063 | 22 | 0 |
| 1 | 40 | 25 | 0 | | 637280 | 645065 | 652680 | 660132 | 667426 | 674566 | 681559 | 688408 | 695118 | 20 | 0 |
| 1 | 42 | 25 | 30 | | 637345 | 645129 | 652743 | 660194 | 667486 | 674625 | 681616 | 688464 | 695173 | 18 | 0 |
| 1 | 44 | 26 | 0 | | 4.637411 | 4.645193 | 4.652806 | 4.660255 | 4.667546 | 4.674684 | 4.681674 | 4.688521 | 4.695229 | 16 | 0 |
| 1 | 46 | 26 | 30 | | 637476 | 645257 | 652869 | 660316 | 667606 | 674743 | 681732 | 688577 | 695284 | 14 | 0 |
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| 1 | 50 | 27 | 30 | | 637607 | 645385 | 652994 | 660439 | 667726 | 674860 | 681847 | 688690 | 695395 | 10 | 0 |
| 1 | 52 | 28 | 0 | | 4.637673 | 4.645450 | 4.653057 | 4.660500 | 4.667786 | 4.674919 | 4.681905 | 4.688747 | 4.695450 | 8 | 0 |
| 1 | 54 | 28 | 30 | | 637739 | 645514 | 653119 | 660562 | 667846 | 674978 | 681962 | 688803 | 695505 | 6 | 0 |
| 1 | 56 | 29 | 0 | | 637804 | 645578 | 653182 | 660623 | 667906 | 675037 | 682020 | 688859 | 695561 | 4 | 0 |
| 1 | 58 | 29 | 30 | | 637870 | 645642 | 653245 | 660685 | 667966 | 675096 | 682077 | 688916 | 695616 | 2 | 0 |
| 2 | 0 | 30 | 0 | | 4.637935 | 4.645706 | 4.653307 | 4.660746 | 4.668026 | 4.675155 | 4.682135 | 4.688972 | 4.695671 | 0 | 0 |
| m | s Time | | | | 34m | 30m | 26m | 22m | 18m | 14m | 10m | 6m | 2m | m | s Time |

| Time m s | Arc. ′ ″ | 26m 51° 30′ | 30m 52° 30′ | 34m 53° 30′ | 38m 54° 30′ | 42m 55° 30′ | 46m 56° 30′ | 50m 57° 30′ | 54m 58° 30′ | 58m 59° 30′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 30 0 | 4.637935 | 4.645706 | 4.653307 | 4.660746 | 4.668026 | 4.675155 | 4.682135 | 4.688972 | 4.695671 | 0 2 |
| 0 2 | 30 30 | 638000 | 645770 | 653370 | 660807 | 668086 | 675213 | 682192 | 689029 | 695726 | 58 1 |
| 0 4 | 31 0 | 638066 | 645834 | 653433 | 660868 | 668147 | 675272 | 682250 | 689085 | 695782 | 56 1 |
| 0 6 | 31 30 | 638131 | 645898 | 653495 | 660930 | 668207 | 675331 | 682308 | 689141 | 695837 | 54 1 |
| 0 8 | 32 0 | 4.638197 | 4.645962 | 4.653558 | 4.660991 | 4.668266 | 4.675390 | 4.682365 | 4.689198 | 4.695892 | 52 1 |
| 0 10 | 32 30 | 638262 | 646026 | 653621 | 661052 | 668326 | 675448 | 682423 | 689254 | 695947 | 50 1 |
| 0 12 | 33 0 | 638328 | 646090 | 653683 | 661114 | 668386 | 675507 | 682480 | 689310 | 696003 | 48 1 |
| 0 14 | 33 30 | 638393 | 646154 | 653746 | 661175 | 668446 | 675566 | 682538 | 689367 | 696058 | 46 1 |
| 0 16 | 34 0 | 4.638458 | 4.646218 | 4.653808 | 4.661236 | 4.668506 | 4.675624 | 4.682595 | 4.689423 | 4.696113 | 44 1 |
| 0 18 | 34 30 | 638524 | 646282 | 653871 | 661297 | 668566 | 675683 | 682653 | 689479 | 696168 | 42 1 |
| 0 20 | 35 0 | 638589 | 646346 | 653933 | 661359 | 668626 | 675742 | 682710 | 689536 | 696223 | 40 1 |
| 0 22 | 35 30 | 638655 | 646410 | 653996 | 661420 | 668686 | 675800 | 682768 | 689592 | 696278 | 38 1 |
| 0 24 | 36 0 | 4.638720 | 4.646473 | 4.654059 | 4.661481 | 4.668746 | 4.675859 | 4.682825 | 4.689648 | 4.696334 | 36 1 |
| 0 26 | 36 30 | 638785 | 646537 | 654121 | 661542 | 668806 | 675918 | 682882 | 689705 | 696389 | 34 1 |
| 0 28 | 37 0 | 638851 | 646601 | 654184 | 661603 | 668866 | 675976 | 682940 | 689761 | 696444 | 32 1 |
| 0 30 | 37 30 | 638916 | 646665 | 654246 | 661664 | 668926 | 676035 | 682997 | 689817 | 696499 | 30 1 |
| 0 32 | 38 0 | 4.638981 | 4.646729 | 4.654309 | 4.661726 | 4.668986 | 4.676094 | 4.683055 | 4.689873 | 4.696554 | 28 1 |
| 0 34 | 38 30 | 639046 | 646793 | 654371 | 661787 | 669045 | 676152 | 683112 | 689930 | 696609 | 26 1 |
| 0 36 | 39 0 | 639112 | 646857 | 654433 | 661848 | 669105 | 676211 | 683170 | 689986 | 696664 | 24 1 |
| 0 38 | 39 30 | 639177 | 646920 | 654496 | 661909 | 669165 | 676269 | 683227 | 690042 | 696719 | 22 1 |
| 0 40 | 40 0 | 4.639242 | 4.646984 | 4.654558 | 4.661970 | 4.669225 | 4.676328 | 4.683284 | 4.690098 | 4.696774 | 20 1 |
| 0 42 | 40 30 | 639307 | 647048 | 654621 | 662031 | 669285 | 676387 | 683342 | 690154 | 696830 | 18 1 |
| 0 44 | 41 0 | 639373 | 647112 | 654683 | 662092 | 669345 | 676445 | 683399 | 690211 | 696885 | 16 1 |
| 0 46 | 41 30 | 639438 | 647176 | 654746 | 662153 | 669404 | 676504 | 683456 | 690267 | 696940 | 14 1 |
| 0 48 | 42 0 | 4.639503 | 4.647239 | 4.654808 | 4.662214 | 4.669464 | 4.676562 | 4.683514 | 4.690323 | 4.696995 | 12 1 |
| 0 50 | 42 30 | 639568 | 647303 | 654870 | 662275 | 669524 | 676621 | 683571 | 690379 | 697050 | 10 1 |
| 0 52 | 43 0 | 639633 | 647367 | 654933 | 662337 | 669584 | 676679 | 683628 | 690435 | 697105 | 8 1 |
| 0 54 | 43 30 | 639698 | 647431 | 654995 | 662398 | 669643 | 676738 | 683686 | 690491 | 697160 | 6 1 |
| 0 56 | 44 0 | 4.639764 | 4.647494 | 4.655057 | 4.662459 | 4.669703 | 4.676796 | 4.683743 | 4.690548 | 4.697215 | 4 1 |
| 0 58 | 44 30 | 639829 | 647558 | 655120 | 662520 | 669763 | 676855 | 683800 | 690604 | 697270 | 2 1 |
| 1 0 | 45 0 | 639894 | 647622 | 655182 | 662581 | 669823 | 676913 | 683857 | 690660 | 697325 | 0 1 |
| 1 2 | 45 30 | 639959 | 647686 | 655244 | 662642 | 669882 | 676972 | 683915 | 690716 | 697380 | 58 0 |
| 1 4 | 46 0 | 4.640024 | 4.647749 | 4.655307 | 4.662703 | 4.669942 | 4.677030 | 4.683972 | 4.690772 | 4.697435 | 56 0 |
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| 1 8 | 47 0 | 640154 | 647877 | 655431 | 662824 | 670061 | 677147 | 684086 | 690884 | 697545 | 52 0 |
| 1 10 | 47 30 | 640219 | 647940 | 655494 | 662885 | 670121 | 677205 | 684144 | 690940 | 697600 | 50 0 |
| 1 12 | 48 0 | 4.640284 | 4.648004 | 4.655556 | 4.662946 | 4.670181 | 4.677264 | 4.684201 | 4.690996 | 4.697654 | 48 0 |
| 1 14 | 48 30 | 640349 | 648067 | 655618 | 663007 | 970240 | 677322 | 684258 | 691052 | 697709 | 46 0 |
| 1 16 | 49 0 | 640414 | 648131 | 655680 | 663068 | 670300 | 677381 | 684315 | 691108 | 697764 | 44 0 |
| 1 18 | 49 30 | 640479 | 648195 | 655743 | 663129 | 670360 | 677439 | 684373 | 691164 | 697819 | 42 0 |
| 1 20 | 50 0 | 4.640544 | 4.648258 | 4.655805 | 4.663190 | 4.670419 | 4.677497 | 4.684430 | 4.691220 | 4.697874 | 40 0 |
| 1 22 | 50 30 | 640609 | 648322 | 655867 | 663251 | 670479 | 677556 | 684487 | 691276 | 697929 | 38 0 |
| 1 24 | 51 0 | 640674 | 648385 | 655929 | 663312 | 670538 | 677614 | 684544 | 691332 | 697984 | 36 0 |
| 1 26 | 51 30 | 640739 | 648449 | 655991 | 663373 | 670598 | 677673 | 684601 | 691388 | 698039 | 34 0 |
| 1 28 | 52 0 | 4.640804 | 4.648512 | 4.656054 | 4.663433 | 4.670658 | 4.677731 | 4.684658 | 4.691444 | 4.698094 | 32 0 |
| 1 30 | 52 30 | 640869 | 648576 | 656116 | 663494 | 670717 | 677789 | 684715 | 691500 | 698148 | 30 0 |
| 1 32 | 53 0 | 640934 | 648639 | 656178 | 663555 | 670777 | 677848 | 684773 | 691556 | 698203 | 28 0 |
| 1 34 | 53 30 | 640999 | 648703 | 656240 | 663616 | 670836 | 677906 | 684830 | 691612 | 698258 | 26 0 |
| 1 36 | 54 0 | 4.641064 | 4.648766 | 4.656302 | 4.663677 | 4.670896 | 4.677964 | 4.684887 | 4.691668 | 4.698313 | 24 0 |
| 1 38 | 54 30 | 641129 | 648830 | 656364 | 663738 | 670955 | 678022 | 684944 | 691724 | 698368 | 22 0 |
| 1 40 | 55 0 | 641194 | 648893 | 656426 | 663798 | 671015 | 678081 | 685001 | 691780 | 698422 | 20 0 |
| 1 42 | 55 30 | 641259 | 648957 | 656488 | 663859 | 671074 | 678139 | 685058 | 691836 | 698477 | 18 0 |
| 1 44 | 56 0 | 4.641323 | 4.649020 | 4.656550 | 4.663920 | 4.671134 | 4.678197 | 4.685115 | 4.691892 | 4.698532 | 16 0 |
| 1 46 | 56 30 | 641388 | 649084 | 656613 | 663981 | 671193 | 678255 | 685172 | 691948 | 698587 | 14 0 |
| 1 48 | 57 0 | 641453 | 649147 | 656675 | 664041 | 671253 | 678314 | 685229 | 692004 | 698642 | 12 0 |
| 1 50 | 57 30 | 641518 | 649211 | 656737 | 664102 | 671312 | 678372 | 685286 | 692060 | 698696 | 10 0 |
| 1 52 | 58 0 | 4.641583 | 4.649274 | 4.656799 | 4.664163 | 4.671372 | 4.678430 | 4.685343 | 4.692115 | 4.698751 | 8 0 |
| 1 54 | 58 30 | 641648 | 649337 | 656861 | 664223 | 671431 | 678488 | 685400 | 692171 | 698806 | 6 0 |
| 1 56 | 59 0 | 641712 | 649401 | 656923 | 664284 | 671490 | 678546 | 685457 | 692227 | 698861 | 4 0 |
| 1 58 | 59 30 | 641777 | 649464 | 656985 | 664345 | 671550 | 678605 | 685514 | 692283 | 698915 | 2 0 |
| 2 0 | 60 0 | 4.641842 | 4.649527 | 4.657047 | 4.664406 | 4.671609 | 4.678663 | 4.685571 | 4.692339 | 4.698970 | 0 0 |
| h m s Time | | 32m | 28m | 24m | 20m | 16m | 12m | 8m | 4m | 0m | s m Time |

| Time m s | Arc. ′ | 0m 60° | 4m 61° | 8m 62° | 12m 63° | 16m 64° | 20m 65° | 24m 66° | 28m 67° | 32m 68° | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4.698970 | 4.705469 | 4.711839 | 4.718085 | 4.724210 | 4.730216 | 4.736109 | 4.741889 | 4.747562 | 0 4 |
| 0 4 | 1 | 699079 | 705576 | 711944 | 718188 | 724311 | 730316 | 736206 | 741985 | 747655 | 56 3 |
| 0 8 | 2 | 699189 | 705683 | 712049 | 718291 | 724412 | 730415 | 736303 | 742080 | 747749 | 52 3 |
| 0 12 | 3 | 699298 | 705790 | 712155 | 718394 | 724513 | 730514 | 736400 | 742176 | 747842 | 48 3 |
| 0 16 | 4 | 4.699407 | 4.705897 | 4.712260 | 4.718497 | 4.724614 | 4.730613 | 4.736498 | 4.742271 | 4.747936 | 44 3 |
| 0 20 | 5 | 699517 | 706005 | 712364 | 718600 | 724715 | 730712 | 736595 | 742366 | 748029 | 40 3 |
| 0 24 | 6 | 699626 | 706112 | 712469 | 718703 | 724816 | 730811 | 736692 | 742462 | 748123 | 36 3 |
| 0 28 | 7 | 699735 | 706219 | 712574 | 718806 | 724916 | 730910 | 736789 | 742557 | 748216 | 32 3 |
| 0 32 | 8 | 4.699844 | 4.706326 | 4.712679 | 4.718909 | 4.725017 | 4.731009 | 4.736886 | 4.742652 | 4.748310 | 28 3 |
| 0 36 | 9 | 699953 | 706432 | 712784 | 719011 | 725118 | 731108 | 736983 | 742747 | 748403 | 24 3 |
| 0 40 | 10 | 700062 | 706539 | 712889 | 719114 | 725219 | 731206 | 737080 | 742842 | 748497 | 20 3 |
| 0 44 | 11 | 700171 | 706646 | 712994 | 719217 | 725320 | 731305 | 737177 | 742937 | 748590 | 16 3 |
| 0 48 | 12 | 4.700280 | 4.706753 | 4.713098 | 4.719320 | 4.725420 | 4.731404 | 4.737274 | 4.743032 | 4.748683 | 12 3 |
| 0 52 | 13 | 700389 | 706860 | 713203 | 719422 | 725521 | 731503 | 737371 | 743128 | 748777 | 8 3 |
| 0 56 | 14 | 700498 | 706967 | 713308 | 719525 | 725622 | 731601 | 737467 | 743223 | 748870 | 4 3 |
| 1 0 | 15 | 700607 | 707073 | 713412 | 719627 | 725722 | 731700 | 737564 | 743318 | 748963 | 0 3 |
| 1 4 | 16 | 4.700716 | 4.707180 | 4.713517 | 4.719730 | 4.725823 | 4.731799 | 4.737661 | 4.743413 | 4.749056 | 56 2 |
| 1 8 | 17 | 700825 | 707287 | 713621 | 719833 | 725923 | 731897 | 737758 | 743507 | 749149 | 52 2 |
| 1 12 | 18 | 700933 | 707393 | 713726 | 719935 | 726024 | 731996 | 737855 | 743602 | 749242 | 48 2 |
| 1 16 | 19 | 701042 | 707500 | 713830 | 720037 | 726124 | 732095 | 737951 | 743697 | 749336 | 44 2 |
| 1 20 | 20 | 4.701151 | 4.707606 | 4.713935 | 4.720140 | 4.726225 | 4.732193 | 4.738048 | 4.743792 | 4.749429 | 40 2 |
| 1 24 | 21 | 701259 | 707713 | 714039 | 720242 | 726325 | 732292 | 738145 | 743887 | 749522 | 36 2 |
| 1 28 | 22 | 701368 | 707819 | 714144 | 720345 | 726426 | 732390 | 738241 | 743982 | 749615 | 32 2 |
| 1 32 | 23 | 701477 | 707926 | 714248 | 720447 | 726526 | 732489 | 738338 | 744076 | 749708 | 28 2 |
| 1 36 | 24 | 4.701585 | 4.708032 | 4.714352 | 4.720549 | 4.726626 | 4.732587 | 4.738434 | 4.744171 | 4.749801 | 24 2 |
| 1 40 | 25 | 701694 | 708139 | 714457 | 720651 | 726727 | 732685 | 738531 | 744266 | 749894 | 20 2 |
| 1 44 | 26 | 701802 | 708245 | 714561 | 720754 | 726827 | 732784 | 738627 | 744361 | 749987 | 16 2 |
| 1 48 | 27 | 701911 | 708351 | 714665 | 720856 | 726927 | 732882 | 738724 | 744455 | 750079 | 12 2 |
| 1 52 | 28 | 5.702019 | 4.708457 | 4.714769 | 4.720958 | 4.727027 | 4.732980 | 4.738820 | 4.744550 | 4.750172 | 8 2 |
| 1 56 | 29 | 702127 | 708564 | 714873 | 721060 | 727127 | 733079 | 738916 | 744644 | 750265 | 4 2 |
| 2 0 | 30 | 702236 | 708670 | 714978 | 721162 | 727228 | 733177 | 739013 | 744739 | 750358 | 0 2 |
| 2 4 | 31 | 702344 | 708776 | 715082 | 721264 | 727328 | 733275 | 739109 | 744833 | 750451 | 56 1 |
| 2 8 | 32 | 4.702452 | 4.708882 | 4.715186 | 4.721366 | 4.727428 | 4.733373 | 4.739205 | 4.744928 | 4.750543 | 52 1 |
| 2 12 | 33 | 702560 | 708988 | 715290 | 721468 | 727528 | 733471 | 739302 | 745022 | 750636 | 48 1 |
| 2 16 | 34 | 702669 | 709094 | 715394 | 721570 | 727628 | 733569 | 739398 | 745117 | 750729 | 44 1 |
| 2 20 | 35 | 702777 | 709200 | 715498 | 721672 | 727726 | 733667 | 739494 | 745211 | 750821 | 40 1 |
| 2 24 | 36 | 4.702885 | 4.709306 | 4.715601 | 4.721774 | 4.727828 | 4.733765 | 4.739590 | 4.745306 | 4.750914 | 36 1 |
| 2 28 | 37 | 702993 | 709412 | 715705 | 721876 | 727928 | 733863 | 739686 | 745400 | 751007 | 32 1 |
| 2 32 | 38 | 703101 | 709518 | 715809 | 721978 | 728027 | 733961 | 739783 | 745494 | 751099 | 28 1 |
| 2 36 | 39 | 703209 | 709624 | 715913 | 722080 | 728127 | 734059 | 739879 | 745589 | 751192 | 24 1 |
| 2 40 | 40 | 4.703317 | 4.709730 | 4.716017 | 4.722181 | 4.728227 | 4.734157 | 4.739975 | 4.745683 | 4.751284 | 20 1 |
| 2 44 | 41 | 703425 | 709836 | 716120 | 722283 | 728327 | 734255 | 740071 | 745777 | 751377 | 16 1 |
| 2 48 | 42 | 703533 | 709941 | 716224 | 722385 | 728427 | 734353 | 740167 | 745871 | 751469 | 12 1 |
| 2 52 | 43 | 703641 | 710047 | 716328 | 722486 | 728526 | 734451 | 740263 | 745965 | 751561 | 8 1 |
| 2 56 | 44 | 4.703749 | 4.710153 | 4.716432 | 4.722588 | 4.728626 | 4.734548 | 4.740359 | 4.746059 | 4.751654 | 4 1 |
| 3 0 | 45 | 703856 | 710259 | 716535 | 722690 | 728726 | 734646 | 740455 | 746154 | 751746 | 0 1 |
| 3 4 | 46 | 703964 | 710364 | 716639 | 722791 | 728825 | 734744 | 740550 | 746248 | 751838 | 56 0 |
| 3 8 | 47 | 704072 | 710470 | 716742 | 722893 | 728925 | 734842 | 740646 | 746342 | 751931 | 52 0 |
| 3 12 | 48 | 4.704179 | 4.710575 | 4.716846 | 4.722994 | 4.729024 | 4.734939 | 4.740742 | 4.746436 | 4.752023 | 48 0 |
| 3 16 | 49 | 704287 | 710681 | 716949 | 723096 | 729124 | 735037 | 740838 | 746530 | 752115 | 44 0 |
| 3 20 | 50 | 704395 | 710786 | 717053 | 723197 | 729223 | 735134 | 740934 | 746624 | 752207 | 40 0 |
| 3 24 | 51 | 704502 | 710892 | 717156 | 723299 | 729323 | 735232 | 741029 | 746718 | 752300 | 36 0 |
| 3 28 | 52 | 4.704610 | 4.710997 | 4.717259 | 4.723400 | 4.729422 | 4.735330 | 4.741125 | 4.746811 | 4.752392 | 32 0 |
| 3 32 | 53 | 704717 | 711103 | 717363 | 723501 | 729522 | 735427 | 741221 | 746905 | 752484 | 28 0 |
| 3 36 | 54 | 704825 | 711208 | 717466 | 723603 | 729621 | 735525 | 741316 | 746999 | 752576 | 24 0 |
| 3 40 | 55 | 704932 | 711313 | 717569 | 723704 | 729720 | 735622 | 741412 | 747093 | 752668 | 20 0 |
| 3 44 | 56 | 4.705040 | 4.711419 | 4.717672 | 4.723805 | 4.729820 | 4.735719 | 4.741507 | 4.747187 | 4.752760 | 16 0 |
| 3 48 | 57 | 705147 | 711524 | 717776 | 723906 | 729919 | 735817 | 741603 | 747281 | 752852 | 12 0 |
| 3 52 | 58 | 705254 | 711629 | 717879 | 724007 | 730018 | 735914 | 741699 | 747374 | 752944 | 8 0 |
| 3 56 | 59 | 705362 | 711734 | 717982 | 724109 | 730117 | 736011 | 741794 | 747468 | 753036 | 4 0 |
| 4 0 | 60 | 4.705469 | 4.711839 | 4.718085 | 4.724210 | 4.730216 | 4.736109 | 4.741889 | 4.747562 | 4.753128 | 0 0 |
| m s Time | | 56m | 52m | 48m | 44m | 40m | 36m | 32m | 28m | 24m | s m Time |

| Time m s | Arc. ′ | 36m | 40m | 44m | 48m | 52m | 56m | 5h 0m | 4m | 8m | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 69° | 70° | 71° | 72° | 73° | 74° | 75° | 76° | 77° | |
| 0 0 | 0 | 4·753128 | 4·758591 | 4·763954 | 4·769219 | 4·774386 | 4·779463 | 4·784447 | 4·789342 | 4·794150 | 0 4 |
| 0 4 | 1 | 753220 | 758681 | 764043 | 769306 | 774473 | 779547 | 784529 | 789423 | 794229 | 56 3 |
| 0 8 | 2 | 753312 | 758772 | 764131 | 769392 | 774558 | 779631 | 784612 | 789504 | 794308 | 52 3 |
| 0 12 | 3 | 753404 | 758862 | 764220 | 769479 | 774644 | 779714 | 784694 | 789584 | 794388 | 48 3 |
| 0 16 | 4 | 4·753495 | 4·758952 | 4·764308 | 4·769566 | 4·774729 | 4·779798 | 4·784776 | 4·789665 | 4·794467 | 44 3 |
| 0 20 | 5 | 753587 | 759042 | 764396 | 769653 | 774814 | 779882 | 784858 | 789746 | 794546 | 40 3 |
| 0 24 | 6 | 753679 | 759132 | 764485 | 769740 | 774899 | 779965 | 784941 | 789827 | 794626 | 36 3 |
| 0 28 | 7 | 753771 | 759222 | 764573 | 769827 | 774984 | 780049 | 785023 | 789907 | 794705 | 32 3 |
| 0 32 | 8 | 4·753862 | 4·759312 | 4·764662 | 4·769913 | 4·775070 | 4·780133 | 4·785105 | 4·789988 | 4·794784 | 28 3 |
| 0 36 | 9 | 753954 | 759402 | 764750 | 770000 | 775155 | 780216 | 785187 | 790069 | 794863 | 24 3 |
| 0 40 | 10 | 754046 | 759492 | 764838 | 770087 | 775240 | 780300 | 785269 | 790149 | 794942 | 20 3 |
| 0 44 | 11 | 754137 | 759582 | 764926 | 770173 | 775325 | 780384 | 785351 | 790230 | 795022 | 16 3 |
| 0 48 | 12 | 4·754229 | 4·759672 | 4·765015 | 4·770260 | 4·775410 | 4·780467 | 4·785433 | 4·790310 | 4·795101 | 12 3 |
| 0 52 | 13 | 754320 | 759762 | 765103 | 770347 | 775495 | 780551 | 785514 | 790391 | 795180 | 8 3 |
| 0 56 | 14 | 754412 | 759851 | 765191 | 770433 | 775580 | 780634 | 785597 | 790471 | 795259 | 4 3 |
| 1 0 | 15 | 754503 | 759941 | 765279 | 770520 | 775665 | 780717 | 785679 | 790552 | 795338 | 0 3 |
| 1 4 | 16 | 4·754595 | 4·760031 | 4·765367 | 4·770606 | 4·775750 | 4·780801 | 4·785761 | 4·790632 | 4·795417 | 56 2 |
| 1 8 | 17 | 754686 | 760121 | 765455 | 770693 | 775835 | 780884 | 785843 | 790713 | 795496 | 52 2 |
| 1 12 | 18 | 754778 | 760211 | 765544 | 770779 | 775920 | 780968 | 785925 | 790793 | 795575 | 48 2 |
| 1 16 | 19 | 754869 | 760300 | 765632 | 770866 | 776005 | 781051 | 786007 | 790874 | 795654 | 44 2 |
| 1 20 | 20 | 4·754960 | 4·760390 | 4·765720 | 4·770952 | 4·776090 | 4·781134 | 4·786089 | 4·790954 | 4·795733 | 40 2 |
| 1 24 | 21 | 755052 | 760480 | 765808 | 771039 | 776174 | 781218 | 786170 | 791034 | 795812 | 36 2 |
| 1 28 | 22 | 755143 | 760569 | 765896 | 771125 | 776259 | 781301 | 786252 | 791115 | 795891 | 32 2 |
| 1 32 | 23 | 755234 | 760659 | 765984 | 771211 | 776344 | 781384 | 786334 | 791195 | 795970 | 28 2 |
| 1 36 | 24 | 4·755326 | 4·760748 | 4·766071 | 4·771298 | 4·776429 | 4·781467 | 4·786416 | 4·791275 | 4·796049 | 24 2 |
| 1 40 | 25 | 755417 | 760838 | 766159 | 771384 | 776514 | 781551 | 786497 | 791356 | 796127 | 20 2 |
| 1 44 | 26 | 755508 | 760927 | 766247 | 771470 | 776598 | 781634 | 786579 | 791436 | 796206 | 16 2 |
| 1 48 | 27 | 755599 | 761017 | 766335 | 771556 | 776683 | 781717 | 786661 | 791516 | 796285 | 12 2 |
| 1 52 | 28 | 4·755690 | 4·761106 | 4·766423 | 4·771643 | 4·776768 | 4·781800 | 4·786742 | 4·791596 | 4·796364 | 8 2 |
| 1 56 | 29 | 755781 | 761196 | 766511 | 771729 | 776852 | 781883 | 786824 | 791676 | 796442 | 4 2 |
| 2 0 | 30 | 755872 | 761285 | 766598 | 771815 | 776937 | 781966 | 786906 | 791757 | 796521 | 0 2 |
| 2 4 | 31 | 755963 | 761374 | 766686 | 771901 | 777021 | 782049 | 786987 | 791837 | 796600 | 56 1 |
| 2 8 | 32 | 4·756054 | 4·761464 | 4·766774 | 4·771987 | 4·777106 | 4·782132 | 4·787069 | 4·791917 | 4·796679 | 52 1 |
| 2 12 | 33 | 756145 | 761553 | 766862 | 772073 | 777190 | 782215 | 787150 | 791997 | 796757 | 48 1 |
| 2 16 | 34 | 756236 | 761642 | 766949 | 772159 | 777275 | 782298 | 787232 | 792077 | 796836 | 44 1 |
| 2 20 | 35 | 756327 | 761732 | 767037 | 772245 | 777359 | 782381 | 787313 | 792157 | 796914 | 40 1 |
| 2 24 | 36 | 4·756418 | 4·761821 | 4·767124 | 4·772331 | 4·777444 | 4·782464 | 4·787395 | 4·792237 | 4·796993 | 36 1 |
| 2 28 | 37 | 756509 | 761910 | 767212 | 772417 | 777528 | 782547 | 787476 | 792317 | 797072 | 32 1 |
| 2 32 | 38 | 756600 | 761999 | 767300 | 772503 | 777613 | 782630 | 787557 | 792397 | 797150 | 28 1 |
| 2 36 | 39 | 756691 | 762088 | 767387 | 772589 | 777697 | 782713 | 787639 | 792477 | 797229 | 24 1 |
| 2 40 | 40 | 4·756781 | 4·762177 | 4·767475 | 4·772675 | 4·777781 | 4·782796 | 4·787720 | 4·792557 | 4·797307 | 20 1 |
| 2 44 | 41 | 756872 | 762267 | 767562 | 772761 | 777866 | 782879 | 787801 | 792636 | 797386 | 16 1 |
| 2 48 | 42 | 756963 | 762356 | 767649 | 772847 | 777950 | 782961 | 787883 | 792716 | 797464 | 12 1 |
| 2 52 | 43 | 757054 | 762445 | 767737 | 772933 | 778034 | 783044 | 787964 | 792796 | 797542 | 8 1 |
| 2 56 | 44 | 4·757144 | 4·762534 | 4·767824 | 4·773018 | 4·778119 | 4·783127 | 4·788045 | 4·792876 | 4·797621 | 4 1 |
| 3 0 | 45 | 757235 | 762623 | 767912 | 773104 | 778203 | 783209 | 788126 | 792956 | 797699 | 0 1 |
| 3 4 | 46 | 757326 | 762712 | 767999 | 773190 | 778287 | 783292 | 788208 | 793035 | 797777 | 56 0 |
| 3 8 | 47 | 757416 | 762800 | 768086 | 773276 | 778371 | 783375 | 788289 | 793115 | 797856 | 52 0 |
| 3 12 | 48 | 4·757507 | 4·762889 | 4·768173 | 4·773361 | 4·778455 | 4·783457 | 4·788370 | 4·793195 | 4·797934 | 48 0 |
| 3 16 | 49 | 757597 | 762978 | 768261 | 773447 | 778539 | 783540 | 788451 | 793275 | 798012 | 44 0 |
| 3 20 | 50 | 757688 | 763067 | 768348 | 773533 | 778623 | 783623 | 788532 | 793354 | 798091 | 40 0 |
| 3 24 | 51 | 757778 | 763156 | 768435 | 773616 | 778708 | 783705 | 788613 | 793434 | 798169 | 36 0 |
| 3 28 | 52 | 4·757869 | 4·763245 | 4·768522 | 4·773704 | 4·778792 | 4·783788 | 4·788694 | 4·793513 | 4·798247 | 32 0 |
| 3 32 | 53 | 757959 | 763333 | 768609 | 773789 | 778876 | 783870 | 788775 | 793593 | 798325 | 28 0 |
| 3 36 | 54 | 758049 | 763422 | 768697 | 773875 | 778960 | 783953 | 788856 | 793673 | 798403 | 24 0 |
| 3 40 | 55 | 758140 | 763511 | 768784 | 773960 | 779044 | 784035 | 788937 | 793752 | 798481 | 20 0 |
| 3 44 | 56 | 4·758230 | 4·763600 | 4·768871 | 4·774046 | 4·779127 | 4·784118 | 4·789018 | 4·793832 | 4·798560 | 16 0 |
| 3 48 | 57 | 758320 | 763688 | 768958 | 774131 | 779211 | 784200 | 789099 | 793911 | 798638 | 12 0 |
| 3 52 | 58 | 758411 | 763777 | 769045 | 774217 | 779295 | 784282 | 789180 | 793991 | 798716 | 8 0 |
| 3 56 | 59 | 758501 | 763865 | 769132 | 774302 | 779379 | 784365 | 789261 | 794070 | 798794 | 4 0 |
| 4 0 | 60 | 4·758591 | 4·763954 | 4·769219 | 4·774388 | 4·779463 | 4·784447 | 4·789342 | 4·794150 | 4·798872 | 0 0 |
| m s Time | | 20m | 16m | 12m | 8m | 4m | 0m 19h | 56m | 52m | 48m | s m Time |

| Time m | s | Arc. ′ | 12m | 16m | 20m | 24m | 28m | 32m | 36m | 40m | 44m | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 78° | 79° | 80° | 81° | 82° | 83° | 84° | 85° | 86° | | |
| 0 | 0 | 0 | 4.798872 | 4.803510 | 4.808067 | 4.812544 | 4.816943 | 4.821265 | 4.825511 | 4.829683 | 4.833783 | 0 | 4 |
| 0 | 4 | 1 | 798950 | 803587 | 808143 | 812618 | 817016 | 821336 | 825581 | 829752 | 833851 | 56 | 3 |
| 0 | 8 | 2 | 799028 | 803664 | 808218 | 812692 | 817088 | 821407 | 825651 | 829821 | 833919 | 52 | 3 |
| 0 | 12 | 3 | 799106 | 803740 | 808293 | 812766 | 817161 | 821479 | 825721 | 829890 | 833986 | 48 | 3 |
| 0 | 16 | 4 | 4.799184 | 4.803817 | 4.808368 | 4.812840 | 4.817233 | 4.821550 | 4.825791 | 4.829959 | 4.834054 | 44 | 3 |
| 0 | 20 | 5 | 799261 | 803893 | 808444 | 812914 | 817306 | 821621 | 825861 | 830028 | 834122 | 40 | 3 |
| 0 | 24 | 6 | 799339 | 803970 | 808519 | 812988 | 817378 | 821693 | 825931 | 830097 | 834189 | 36 | 3 |
| 0 | 28 | 7 | 799417 | 804046 | 808594 | 813062 | 817451 | 821764 | 826001 | 830165 | 834257 | 32 | 3 |
| 0 | 32 | 8 | 4.799495 | 4.804123 | 4.808669 | 4.813135 | 4.817523 | 4.821835 | 4.826071 | 4.830234 | 4.834325 | 28 | 3 |
| 0 | 36 | 9 | 7995.73 | 804199 | 808744 | 813209 | 817596 | 821906 | 826141 | 830303 | 834392 | 24 | 3 |
| 0 | 40 | 10 | 799651 | 804276 | 808819 | 813283 | 817668 | 821977 | 826211 | 830372 | 834460 | 20 | 3 |
| 0 | 44 | 11 | 799728 | 804352 | 808894 | 813357 | 817741 | 822049 | 826281 | 830440 | 834527 | 16 | 3 |
| 0 | 48 | 12 | 4.799806 | 4.804428 | 4.808969 | 4.813430 | 4.817813 | 4.822120 | 4.826351 | 4.830509 | 4.834595 | 12 | 3 |
| 0 | 52 | 13 | 799884 | 804505 | 809044 | 813504 | 817886 | 822191 | 826421 | 830578 | 834662 | 8 | 3 |
| 0 | 56 | 14 | 799962 | 804581 | 809119 | 813578 | 817958 | 822262 | 826491 | 830646 | 834730 | 4 | 3 |
| 1 | 0 | 15 | 800039 | 804657 | 809194 | 813651 | 818030 | 822333 | 826561 | 830715 | 834797 | 0 | 3 |
| 1 | 4 | 16 | 4.800117 | 4.804734 | 4.809269 | 4.813725 | 4.818103 | 4.822404 | 4.826631 | 4.830784 | 4.834865 | 56 | 2 |
| 1 | 8 | 17 | 800194 | 804810 | 809344 | 813799 | 818175 | 822475 | 826700 | 830852 | 834932 | 52 | 2 |
| 1 | 12 | 18 | 800272 | 804886 | 809419 | 813872 | 818247 | 822546 | 826770 | 830921 | 834999 | 48 | 2 |
| 1 | 16 | 19 | 800350 | 804962 | 809494 | 813946 | 818320 | 822617 | 826840 | 830989 | 835067 | 44 | 2 |
| 1 | 20 | 20 | 4.800427 | 4.805038 | 4.809569 | 4.814019 | 4.818392 | 4.822688 | 4.826910 | 4.831058 | 4.835134 | 40 | 2 |
| 1 | 24 | 21 | 800505 | 805115 | 809643 | 814093 | 818464 | 822759 | 826980 | 831126 | 835201 | 36 | 2 |
| 1 | 28 | 22 | 800582 | 805191 | 809718 | 814166 | 818536 | 822830 | 827049 | 831195 | 835269 | 32 | 2 |
| 1 | 32 | 23 | 800660 | 805267 | 809793 | 814240 | 818609 | 822901 | 827119 | 831263 | 835336 | 28 | 2 |
| 1 | 36 | 24 | 4.800737 | 4.805343 | 4.809868 | 4.814313 | 4.818681 | 4.822972 | 4.827189 | 4.831332 | 4.835403 | 24 | 2 |
| 1 | 40 | 25 | 800815 | 805419 | 809942 | 814387 | 818753 | 823043 | 827258 | 831400 | 835471 | 20 | 2 |
| 1 | 44 | 26 | 800892 | 805495 | 810017 | 814460 | 818825 | 823114 | 827328 | 831469 | 835538 | 16 | 2 |
| 1 | 48 | 27 | 800969 | 805571 | 810092 | 814533 | 818897 | 823185 | 827398 | 831537 | 835605 | 12 | 2 |
| 1 | 52 | 28 | 4.801047 | 4.805647 | 4.810167 | 4.814607 | 4.818969 | 4.823255 | 4.827467 | 4.831606 | 4.835672 | 8 | 2 |
| 1 | 56 | 29 | 801124 | 805723 | 810241 | 814680 | 819041 | 823326 | 827537 | 831674 | 835739 | 4 | 2 |
| 2 | 0 | 30 | 801201 | 805799 | 810316 | 814753 | 819113 | 823397 | 827606 | 831742 | 835807 | 0 | 2 |
| 2 | 4 | 31 | 801279 | 805876 | 810390 | 814827 | 819185 | 823468 | 827676 | 831811 | 835874 | 56 | 1 |
| 2 | 8 | 32 | 4.801356 | 4.805951 | 4.810465 | 4.814900 | 4.819257 | 4.823539 | 4.827745 | 4.831879 | 4.835941 | 52 | 1 |
| 2 | 12 | 33 | 801433 | 806027 | 810540 | 814973 | 819329 | 823609 | 827815 | 831947 | 836008 | 48 | 1 |
| 2 | 16 | 34 | 801511 | 806103 | 810614 | 815046 | 819401 | 823680 | 827844 | 832015 | 836075 | 44 | 1 |
| 2 | 20 | 35 | 801588 | 806179 | 810689 | 815120 | 819473 | 823751 | 827954 | 832084 | 836142 | 40 | 1 |
| 2 | 24 | 36 | 4.801665 | 4.806254 | 4.810763 | 4.815193 | 4.819545 | 4.823821 | 4.828023 | 4.832152 | 4.836209 | 36 | 1 |
| 2 | 28 | 37 | 801742 | 806330 | 810838 | 815266 | 819617 | 823892 | 828092 | 832220 | 836276 | 32 | 1 |
| 2 | 32 | 38 | 801819 | 806406 | 810912 | 815339 | 819689 | 823963 | 828162 | 832288 | 836343 | 28 | 1 |
| 2 | 36 | 39 | 801896 | 806482 | 810986 | 815412 | 819761 | 824033 | 828231 | 832356 | 836410 | 24 | 1 |
| 2 | 40 | 40 | 4.801973 | 4.806557 | 4.811061 | 4.815485 | 4.819832 | 4.824104 | 4.828301 | 4.832425 | 4.836477 | 20 | 1 |
| 2 | 44 | 41 | 802050 | 806633 | 811135 | 815558 | 819904 | 824174 | 828370 | 832493 | 836544 | 16 | 1 |
| 2 | 48 | 42 | 802128 | 806709 | 811210 | 815631 | 819976 | 824245 | 828439 | 832561 | 836611 | 12 | 1 |
| 2 | 52 | 43 | 902205 | 806785 | 811284 | 815704 | 820048 | 824315 | 828509 | 832629 | 836678 | 8 | 1 |
| 2 | 56 | 44 | 4.802282 | 4.806860 | 4.811358 | 4.815778 | 4.820120 | 4.824386 | 4.828578 | 4.832697 | 4.836745 | 4 | 1 |
| 3 | 0 | 45 | 802359 | 806936 | 811433 | 815851 | 820191 | 824456 | 828647 | 832765 | 836812 | 0 | 1 |
| 3 | 4 | 46 | 802435 | 807011 | 811507 | 815923 | 820263 | 824527 | 828716 | 832833 | 836878 | 56 | 0 |
| 3 | 8 | 47 | 802512 | 807087 | 811581 | 815996 | 820335 | 824597 | 828785 | 832901 | 836945 | 52 | 0 |
| 3 | 12 | 48 | 4.802589 | 4.807163 | 4.811655 | 4.816069 | 4.820406 | 4.824668 | 4.828855 | 4.832969 | 4.837012 | 48 | 0 |
| 3 | 16 | 49 | 802666 | 807238 | 811730 | 816142 | 820478 | 824738 | 828924 | 833037 | 837079 | 44 | 0 |
| 3 | 20 | 50 | 802743 | 807314 | 811804 | 816215 | 820550 | 824808 | 828993 | 833105 | 837146 | 40 | 0 |
| 3 | 24 | 51 | 802820 | 807389 | 811878 | 816288 | 820621 | 824879 | 829062 | 833173 | 837212 | 36 | 0 |
| 3 | 28 | 52 | 4.802897 | 4.807465 | 4.811952 | 4.816361 | 4.820693 | 4.824949 | 4.829131 | 4.833241 | 4.837279 | 32 | 0 |
| 3 | 32 | 53 | 802974 | 807540 | 812026 | 816434 | 820764 | 825019 | 829200 | 833309 | 837346 | 28 | 0 |
| 3 | 36 | 54 | 803050 | 807615 | 812100 | 816507 | 820836 | 825090 | 829269 | 833377 | 837412 | 24 | 0 |
| 3 | 40 | 55 | 803127 | 807691 | 812174 | 816579 | 820907 | 825160 | 829338 | 833444 | 837479 | 20 | 0 |
| 3 | 44 | 56 | 4.803204 | 4.807766 | 4.812248 | 4.816652 | 4.820979 | 4.825230 | 4.829407 | 4.833512 | 4.837546 | 16 | 0 |
| 3 | 48 | 57 | 803280 | 807842 | 812322 | 816725 | 821050 | 825300 | 829476 | 833580 | 837612 | 12 | 0 |
| 3 | 52 | 58 | 803357 | 807917 | 812396 | 816797 | 821122 | 825370 | 829545 | 833648 | 837679 | 8 | 0 |
| 3 | 56 | 59 | 803434 | 807992 | 812470 | 816870 | 821193 | 825441 | 829614 | 833716 | 837746 | 4 | 0 |
| 4 | 0 | 60 | 4.803510 | 4.808067 | 4.812544 | 4.816943 | 4.821265 | 4.825511 | 4.829683 | 4.833783 | 4.837812 | 0 | 0 |
| m | s | | 44m | 40m | 36m | 32m | 28m | 24m | 20m | 16m | 12m | s | m |
| Time | | | | | | | | | | | | Time | |

| Time m s | Arc. ′ | 48m | 52m | 56m | 6h 0m | 4m | 8m | 12m | 16m | 20m | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 87° | 88° | 89° | 90° | 91° | 92° | 93° | 94° | 95° | |
| 0 0 | 0 | 4.837812 | 4.841771 | 4.845662 | 4.849485 | 4.853242 | 4.856934 | 4.860562 | 4.864127 | 4.867631 | 0 4 |
| 0 4 | 1 | 837879 | 841837 | 845726 | 849548 | 853304 | 856995 | 860622 | 864186 | 867689 | 56 3 |
| 0 8 | 2 | 837945 | 841902 | 845790 | 849611 | 853366 | 857056 | 860682 | 864245 | 867747 | 52 3 |
| 0 12 | 3 | 838012 | 841967 | 845854 | 849674 | 853428 | 857117 | 860742 | 864304 | 867804 | 48 3 |
| 0 16 | 4 | 4.838078 | 4.842033 | 4.845919 | 4.849737 | 4.853490 | 4.857178 | 4.860802 | 4.864363 | 4.867862 | 44 3 |
| 0 20 | 5 | 838145 | 842098 | 845983 | 849801 | 853552 | 857239 | 860862 | 864422 | 867920 | 40 3 |
| 0 24 | 6 | 838211 | 842163 | 846047 | 849864 | 853614 | 857300 | 860921 | 864481 | 867978 | 36 3 |
| 0 28 | 7 | 838278 | 842229 | 846111 | 849927 | 853676 | 857361 | 860981 | 864539 | 868036 | 32 3 |
| 0 32 | 8 | 4.838344 | 4.842294 | 4.846175 | 4.849990 | 4.853738 | 4.857421 | 4.861041 | 4.864598 | 4.868093 | 28 3 |
| 0 36 | 9 | 838410 | 842359 | 846239 | 850053 | 853800 | 857482 | 861101 | 864657 | 868151 | 24 3 |
| 0 40 | 10 | 838477 | 842424 | 846304 | 850116 | 853862 | 857543 | 861161 | 864716 | 868209 | 20 3 |
| 0 44 | 11 | 838543 | 842490 | 846368 | 850179 | 853924 | 857604 | 861220 | 864774 | 868266 | 16 3 |
| 0 48 | 12 | 4.838610 | 4.842555 | 4.846432 | 4.850242 | 4.853986 | 4.857665 | 4.861280 | 4.864833 | 4.868324 | 12 3 |
| 0 52 | 13 | 838676 | 842620 | 846496 | 850305 | 854047 | 857726 | 861340 | 864892 | 868362 | 8 3 |
| 0 56 | 14 | 838742 | 842685 | 846560 | 850367 | 854109 | 857786 | 861400 | 864950 | 868440 | 4 3 |
| 1 0 | 15 | 838808 | 842750 | 846624 | 850430 | 854171 | 857847 | 861459 | 865009 | 868497 | 0 3 |
| 1 4 | 16 | 4.838875 | 4.842815 | 4.846688 | 4.850493 | 4.854233 | 4.857908 | 4.861519 | 4.865068 | 4.868555 | 56 2 |
| 1 8 | 17 | 838941 | 842880 | 846752 | 850556 | 854295 | 857968 | 861579 | 865126 | 868612 | 52 2 |
| 1 12 | 18 | 839007 | 842946 | 846816 | 850619 | 854356 | 858029 | 861638 | 865185 | 868670 | 48 2 |
| 1 16 | 19 | 839073 | 843011 | 846880 | 850682 | 854418 | 858090 | 861698 | 865243 | 868728 | 44 2 |
| 1 20 | 20 | 4.839140 | 4.843076 | 4.846944 | 4.850745 | 4.854480 | 4.858150 | 4.861758 | 4.865302 | 4.868785 | 40 2 |
| 1 24 | 21 | 839206 | 843141 | 847007 | 850807 | 854542 | 858211 | 861817 | 865361 | 868843 | 36 2 |
| 1 28 | 22 | 839272 | 843206 | 847071 | 850870 | 854603 | 858272 | 861877 | 865419 | 868900 | 32 2 |
| 1 32 | 23 | 839338 | 843271 | 847135 | 850933 | 854665 | 858332 | 861936 | 865478 | 868958 | 28 2 |
| 1 36 | 24 | 4.839404 | 4.843336 | 4.847199 | 4.850996 | 4.854727 | 4.858393 | 4.861996 | 4.865536 | 4.869015 | 24 2 |
| 1 40 | 25 | 839470 | 843401 | 847263 | 851058 | 854788 | 858453 | 862055 | 865595 | 869073 | 20 2 |
| 1 44 | 26 | 839536 | 843465 | 847327 | 851121 | 854850 | 858514 | 862115 | 865653 | 869130 | 16 2 |
| 1 48 | 27 | 839602 | 843530 | 847390 | 851184 | 854911 | 858575 | 862174 | 865712 | 869187 | 12 2 |
| 1 52 | 28 | 4.839668 | 4.843595 | 4.847454 | 4.851246 | 4.854973 | 4.858635 | 4.862234 | 4.865770 | 4.869245 | 8 2 |
| 1 56 | 29 | 839734 | 843660 | 847518 | 851309 | 855035 | 858696 | 862293 | 865828 | 869302 | 4 2 |
| 2 0 | 30 | 839800 | 843725 | 847582 | 851372 | 855096 | 858756 | 862353 | 865887 | 869360 | 0 2 |
| 2 4 | 31 | 839866 | 843790 | 847645 | 851434 | 855158 | 858816 | 862412 | 865945 | 869417 | 56 1 |
| 2 8 | 32 | 4.839932 | 4.843855 | 4.847709 | 4.851497 | 4.855219 | 4.858877 | 4.862471 | 4.866004 | 4.869474 | 52 1 |
| 2 12 | 33 | 839998 | 843919 | 847773 | 851559 | 855281 | 858937 | 862531 | 866062 | 869532 | 48 1 |
| 2 16 | 34 | 840064 | 843984 | 847836 | 851662 | 855342 | 858998 | 862590 | 866120 | 869589 | 44 1 |
| 2 20 | 35 | 840130 | 844049 | 847900 | 851685 | 855404 | 859058 | 862649 | 866179 | 869646 | 40 1 |
| 2 24 | 36 | 4.840196 | 4.844114 | 4.847964 | 4.851747 | 4.855465 | 4.859119 | 4.862709 | 4.866237 | 4.869704 | 36 1 |
| 2 28 | 37 | 840262 | 844178 | 848027 | 851810 | 855526 | 859179 | 862768 | 866295 | 869761 | 32 1 |
| 2 32 | 38 | 840328 | 844243 | 848091 | 851872 | 855588 | 859239 | 862827 | 866353 | 869818 | 28 1 |
| 2 36 | 39 | 840393 | 844308 | 848154 | 851934 | 855649 | 859300 | 862887 | 866412 | 869875 | 24 1 |
| 2 40 | 40 | 4.840459 | 4.844372 | 4.848218 | 4.851997 | 4.855711 | 4.859360 | 4.862946 | 4.866470 | 4.869933 | 20 1 |
| 2 44 | 41 | 840525 | 844437 | 848281 | 852059 | 855772 | 859420 | 863005 | 866528 | 869990 | 16 1 |
| 2 48 | 42 | 840591 | 844502 | 848345 | 852122 | 855833 | 859480 | 863064 | 866586 | 870047 | 12 1 |
| 2 52 | 43 | 840656 | 844566 | 848408 | 852184 | 855894 | 859541 | 863124 | 866644 | 870104 | 8 1 |
| 2 56 | 44 | 4.840722 | 4.844631 | 4.848472 | 4.852247 | 4.855956 | 4.859601 | 4.863183 | 4.866703 | 4.870161 | 4 1 |
| 3 0 | 45 | 840788 | 844695 | 848535 | 852309 | 856017 | 859661 | 863242 | 866761 | 870218 | 0 1 |
| 3 4 | 46 | 840854 | 844760 | 848599 | 852371 | 856078 | 859721 | 863301 | 866819 | 870276 | 56 0 |
| 3 8 | 47 | 840919 | 844825 | 848662 | 852434 | 856140 | 859781 | 863360 | 866877 | 870333 | 52 0 |
| 3 12 | 48 | 4.840985 | 4.844889 | 4.848726 | 4.852496 | 4.856201 | 4.859842 | 4.863419 | 4.866935 | 4.870390 | 48 0 |
| 3 16 | 49 | 841051 | 844954 | 848789 | 852558 | 856262 | 859902 | 863478 | 866993 | 870447 | 44 0 |
| 3 20 | 50 | 841116 | 845018 | 848852 | 852620 | 856323 | 859962 | 863538 | 867051 | 870504 | 40 0 |
| 3 24 | 51 | 841182 | 845082 | 848916 | 852683 | 856384 | 860022 | 863597 | 867109 | 870561 | 36 0 |
| 3 28 | 52 | 4.841247 | 4.845147 | 4.848979 | 4.852745 | 4.856445 | 4.860082 | 4.863656 | 4.867167 | 4.870618 | 32 0 |
| 3 32 | 53 | 841313 | 845211 | 849042 | 852807 | 856507 | 860142 | 863715 | 867225 | 870675 | 28 0 |
| 3 36 | 54 | 841378 | 845276 | 849106 | 852869 | 856568 | 860202 | 863774 | 867283 | 870732 | 24 0 |
| 3 40 | 55 | 841444 | 845340 | 849169 | 852931 | 856630 | 860262 | 863833 | 867341 | 870789 | 20 0 |
| 3 44 | 56 | 4.841509 | 4.845404 | 4.849232 | 4.852994 | 4.856690 | 4.860322 | 4.863892 | 4.867399 | 4.870846 | 16 0 |
| 3 48 | 57 | 841575 | 845469 | 849295 | 853056 | 856751 | 860382 | 863951 | 867457 | 870903 | 12 0 |
| 3 52 | 58 | 841640 | 845533 | 849359 | 853118 | 856812 | 860442 | 864010 | 867515 | 870960 | 8 0 |
| 3 56 | 59 | 841706 | 845597 | 849422 | 853180 | 856873 | 860502 | 864069 | 867573 | 871017 | 4 0 |
| 4 0 | 60 | 4.841771 | 4.845662 | 4.849485 | 4.853242 | 4.856934 | 4.860562 | 4.864127 | 4.867631 | 4.871073 | 0 0 |
| s m Time | | 8m | 4m | 0m 18h | 56m | 52m | 48m | 44m | 40m | 36m | s m Time |

| Time m | s | Arc. ′ | 24m 96° | 28m 97° | 32m 98° | 36m 99° | 40m 100° | 44m 101° | 48m 102° | 52m 103° | 56m 104° | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 4.871073 | 4.874456 | 4.877780 | 4.881045 | 4.884254 | 4.887406 | 4.890503 | 4.893544 | 4.896532 | 0 | 4 |
| 0 | 4 | 1 | 871130 | 874512 | 877835 | 881099 | 884307 | 887458 | 890554 | 893595 | 896581 | 56 | 3 |
| 0 | 8 | 2 | 871187 | 874568 | 877890 | 881153 | 884360 | 887510 | 890605 | 893645 | 896631 | 52 | 3 |
| 0 | 12 | 3 | 871244 | 874624 | 877944 | 881207 | 884413 | 887562 | 890656 | 893695 | 896680 | 48 | 3 |
| 0 | 16 | 4 | 4.871301 | 4.874680 | 4.877999 | 4.881261 | 4.884466 | 4.887614 | 4.890707 | 4.893745 | 4.896729 | 44 | 3 |
| 0 | 20 | 5 | 871358 | 874735 | 878054 | 881315 | 884519 | 887666 | 890758 | 893795 | 896779 | 40 | 3 |
| 0 | 24 | 6 | 871414 | 874791 | 878109 | 881369 | 884572 | 887718 | 890809 | 893846 | 896828 | 36 | 3 |
| 0 | 28 | 7 | 871471 | 874847 | 878164 | 881423 | 884625 | 887770 | 890860 | 893896 | 896877 | 32 | 3 |
| 0 | 32 | 8 | 4.871528 | 4.874903 | 4.878219 | 4.881477 | 4.884677 | 4.887822 | 4.890911 | 4.893946 | 4.896926 | 28 | 3 |
| 0 | 36 | 9 | 871585 | 874958 | 878273 | 881530 | 884730 | 887874 | 890962 | 893996 | 896976 | 24 | 3 |
| 0 | 40 | 10 | 871641 | 875014 | 878328 | 881584 | 884783 | 887926 | 891013 | 894046 | 897025 | 20 | 3 |
| 0 | 44 | 11 | 871698 | 875070 | 878383 | 881638 | 884836 | 887978 | 891064 | 894096 | 897074 | 16 | 3 |
| 0 | 48 | 12 | 4.871755 | 4.875126 | 4.878438 | 4.881692 | 4.884889 | 4.888030 | 4.891115 | 4.894146 | 4.897123 | 12 | 3 |
| 0 | 52 | 13 | 871811 | 875181 | 878492 | 881745 | 884942 | 888082 | 891166 | 894196 | 897172 | 8 | 3 |
| 0 | 56 | 14 | 871868 | 875237 | 878547 | 881799 | 884994 | 888133 | 891217 | 894246 | 897222 | 4 | 3 |
| 1 | 0 | 15 | 871925 | 875293 | 878602 | 881853 | 885047 | 888185 | 891268 | 894296 | 897271 | 0 | 3 |
| 1 | 4 | 16 | 4.871981 | 4.875348 | 4.878656 | 4.881907 | 4.885100 | 4.888237 | 4.891319 | 4.894346 | 4.897320 | 56 | 2 |
| 1 | 8 | 17 | 872038 | 875404 | 878711 | 881960 | 885153 | 888289 | 891370 | 894396 | 897369 | 52 | 2 |
| 1 | 12 | 18 | 872094 | 875459 | 878766 | 882014 | 885205 | 888341 | 891421 | 894446 | 897418 | 48 | 2 |
| 1 | 16 | 19 | 872151 | 875515 | 878820 | 882068 | 885258 | 888393 | 891472 | 894496 | 897467 | 44 | 2 |
| 1 | 20 | 20 | 4.872208 | 4.875571 | 4.878875 | 4.882121 | 4.885311 | 4.888444 | 4.891523 | 4.894546 | 4.897516 | 40 | 2 |
| 1 | 24 | 21 | 872264 | 875626 | 878929 | 882175 | 885364 | 888496 | 891573 | 894596 | 897565 | 36 | 2 |
| 1 | 28 | 22 | 872321 | 875682 | 878984 | 882228 | 885416 | 888548 | 891624 | 894646 | 897614 | 32 | 2 |
| 1 | 32 | 23 | 872377 | 875737 | 879038 | 882282 | 885469 | 888600 | 891675 | 894696 | 897663 | 28 | 2 |
| 1 | 36 | 24 | 4.872434 | 4.875793 | 4.879093 | 4.882336 | 4.885521 | 4.888651 | 4.891726 | 4.894746 | 4.897712 | 24 | 2 |
| 1 | 40 | 25 | 872490 | 875848 | 879148 | 882389 | 885574 | 888703 | 891777 | 894796 | 897761 | 20 | 2 |
| 1 | 44 | 26 | 872547 | 875904 | 879202 | 882443 | 885627 | 888755 | 891827 | 894846 | 897810 | 16 | 2 |
| 1 | 48 | 27 | 872603 | 875959 | 879256 | 882496 | 885679 | 888806 | 891878 | 894895 | 897859 | 12 | 2 |
| 1 | 52 | 28 | 4.872659 | 4.876014 | 4.879311 | 4.882550 | 4.885732 | 4.888858 | 4.891929 | 4.894945 | 4.897908 | 8 | 2 |
| 1 | 56 | 29 | 872716 | 876070 | 879365 | 882603 | 885784 | 888910 | 891980 | 894995 | 897957 | 4 | 2 |
| 2 | 0 | 30 | 872772 | 876125 | 879420 | 882657 | 885837 | 888961 | 892030 | 895045 | 898006 | 0 | 2 |
| 2 | 4 | 31 | 872829 | 876181 | 879474 | 882710 | 885889 | 889013 | 892081 | 895095 | 898055 | 56 | 1 |
| 2 | 8 | 32 | 4.872885 | 4.876236 | 4.879529 | 4.882764 | 4.885942 | 4.889064 | 4.892132 | 4.895144 | 4.898104 | 52 | 1 |
| 2 | 12 | 33 | 872941 | 876291 | 879583 | 882817 | 885994 | 889116 | 892182 | 895194 | 898153 | 48 | 1 |
| 2 | 16 | 34 | 872998 | 876347 | 879637 | 882871 | 886047 | 889167 | 892233 | 895244 | 898201 | 44 | 1 |
| 2 | 20 | 35 | 873054 | 876402 | 879692 | 882924 | 886099 | 889219 | 892284 | 895294 | 898250 | 40 | 1 |
| 2 | 24 | 36 | 4.873110 | 4.876457 | 4.879746 | 4.882977 | 4.886152 | 4.889271 | 4.892334 | 4.895343 | 4.898299 | 36 | 1 |
| 2 | 28 | 37 | 873166 | 876513 | 879800 | 883031 | 886204 | 889322 | 892385 | 895393 | 898348 | 32 | 1 |
| 2 | 32 | 38 | 873223 | 876568 | 879855 | 883084 | 886257 | 889374 | 892435 | 895443 | 898397 | 28 | 1 |
| 2 | 36 | 39 | 873279 | 876623 | 879909 | 883137 | 886309 | 889425 | 892486 | 895492 | 898446 | 24 | 1 |
| 2 | 40 | 40 | 4.873335 | 4.876678 | 4.879963 | 4.883191 | 4.886362 | 4.889476 | 4.892536 | 4.895542 | 4.898494 | 20 | 1 |
| 2 | 44 | 41 | 873391 | 876734 | 880018 | 883244 | 886414 | 889528 | 892587 | 895592 | 898543 | 16 | 1 |
| 2 | 48 | 42 | 873448 | 876789 | 880072 | 883297 | 886466 | 889579 | 892637 | 895641 | 898592 | 12 | 1 |
| 2 | 52 | 43 | 873504 | 876844 | 880126 | 883351 | 886519 | 889631 | 892688 | 895691 | 898641 | 8 | 1 |
| 2 | 56 | 44 | 4.873560 | 4.876899 | 4.880180 | 4.883404 | 4.886571 | 4.889682 | 4.892738 | 4.895741 | 4.898689 | 4 | 1 |
| 3 | 0 | 45 | 873616 | 876954 | 880234 | 883457 | 886623 | 889734 | 892789 | 895790 | 898738 | 0 | 1 |
| 3 | 4 | 46 | 873672 | 877010 | 880289 | 883510 | 886676 | 889785 | 892839 | 895840 | 898787 | 56 | 0 |
| 3 | 8 | 47 | 873728 | 877065 | 880343 | 883564 | 886728 | 889836 | 892890 | 895889 | 898835 | 52 | 0 |
| 3 | 12 | 48 | 4.873784 | 4.877120 | 4.880397 | 4.883617 | 4.886780 | 4.889888 | 4.892940 | 4.895939 | 4.898884 | 48 | 0 |
| 3 | 16 | 49 | 873840 | 877175 | 880451 | 883670 | 886832 | 889939 | 892991 | 895988 | 898933 | 44 | 0 |
| 3 | 20 | 50 | 873896 | 877230 | 880505 | 883723 | 886885 | 889990 | 893041 | 896038 | 898981 | 40 | 0 |
| 3 | 24 | 51 | 873952 | 877285 | 880559 | 883776 | 886937 | 890042 | 893092 | 896087 | 899030 | 36 | 0 |
| 3 | 28 | 52 | 4.874008 | 4.877340 | 4.880613 | 4.883829 | 4.886989 | 4.890093 | 4.893142 | 4.896137 | 4.899078 | 32 | 0 |
| 3 | 32 | 53 | 874065 | 877395 | 880667 | 883883 | 887041 | 890144 | 893192 | 896186 | 899127 | 28 | 0 |
| 3 | 36 | 54 | 874120 | 877450 | 880721 | 883936 | 887093 | 890195 | 893243 | 896236 | 899176 | 24 | 0 |
| 3 | 40 | 55 | 874176 | 877505 | 880776 | 883989 | 887145 | 890247 | 893293 | 896285 | 899224 | 20 | 0 |
| 3 | 44 | 56 | 4.874232 | 4.877560 | 4.880830 | 4.884042 | 4.887198 | 4.890298 | 4.893343 | 4.896335 | 4.899273 | 16 | 0 |
| 3 | 48 | 57 | 874288 | 877615 | 880884 | 884095 | 887250 | 890349 | 893394 | 896384 | 899321 | 12 | 0 |
| 3 | 52 | 58 | 874344 | 877670 | 880938 | 884148 | 887302 | 890400 | 893444 | 896433 | 899370 | 8 | 0 |
| 3 | 56 | 59 | 874400 | 877725 | 880992 | 884201 | 887354 | 890451 | 893494 | 896483 | 899418 | 4 | 0 |
| 4 | 0 | 60 | 4.874456 | 4.877780 | 4.881045 | 4.884254 | 4.887406 | 4.890503 | 4.893544 | 4.896532 | 4.899467 | 0 | 0 |
| m | s Time | | 32m | 28m | 24m | 20m | 16m | 12m | 8m | 4m | 0m 17h | s | m Time |

| Time m s | Arc. ′ | 0m 105° | 4m 106° | 8m 107° | 12m 108° | 16m 109° | 20m 110° | 24m 111° | 28m 112° | 32m 113° | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4.899467 | 4.902349 | 4.905179 | 4.907958 | 4.910686 | 4.913364 | 4.915994 | 4.918574 | 4.921107 | 0 4 |
| 0 4 | 1 | 899515 | 902396 | 905225 | 908003 | 910731 | 913409 | 916037 | 918617 | 921148 | 56 3 |
| 0 8 | 2 | 899564 | 902444 | 905272 | 908049 | 910776 | 913453 | 916080 | 918659 | 921190 | 52 3 |
| 0 12 | 3 | 899612 | 902491 | 905319 | 908095 | 910821 | 913497 | 916124 | 918702 | 921232 | 48 3 |
| 0 16 | 4 | 4.899660 | 4.902539 | 4.905366 | 4.908141 | 4.910866 | 4.913541 | 4.916167 | 4.918744 | 4.921274 | 44 3 |
| 0 20 | 5 | 899709 | 902586 | 905412 | 908187 | 910911 | 913585 | 916211 | 918787 | 921315 | 40 3 |
| 0 24 | 6 | 899757 | 902634 | 905459 | 908233 | 910956 | 913630 | 916254 | 918830 | 921357 | 36 3 |
| 0 28 | 7 | 899806 | 902681 | 905506 | 908278 | 911001 | 913674 | 916297 | 918872 | 921399 | 32 3 |
| 0 32 | 8 | 4.899854 | 4.902729 | 4.905552 | 4.908324 | 4.911046 | 4.913718 | 4.916341 | 4.918915 | 4.921441 | 28 3 |
| 0 36 | 9 | 899902 | 902776 | 905599 | 908370 | 911091 | 913762 | 916384 | 918957 | 921482 | 24 3 |
| 0 40 | 10 | 899951 | 902824 | 905645 | 908416 | 911136 | 913806 | 916427 | 919000 | 921524 | 20 3 |
| 0 44 | 11 | 899999 | 902871 | 905692 | 908462 | 911181 | 913850 | 916470 | 919042 | 921566 | 16 3 |
| 0 48 | 12 | 4.900047 | 4.902919 | 4.905739 | 4.908507 | 4.911226 | 4.913894 | 4.916514 | 4.919084 | 4.921607 | 12 3 |
| 0 52 | 13 | 900095 | 902966 | 905785 | 908553 | 911271 | 913938 | 916557 | 919127 | 921649 | 8 3 |
| 0 56 | 14 | 900144 | 903014 | 905832 | 908599 | 911315 | 913982 | 916600 | 919169 | 921691 | 4 3 |
| 1 0 | 15 | 900192 | 903061 | 905878 | 908644 | 911360 | 914026 | 916643 | 919212 | 921732 | 0 3 |
| 1 4 | 16 | 4.900240 | 4.903108 | 4.905925 | 4.908690 | 4.911405 | 4.914070 | 4.916687 | 4.919254 | 4.921774 | 56 2 |
| 1 8 | 17 | 900288 | 903156 | 905971 | 908736 | 911450 | 914114 | 916730 | 919297 | 921815 | 52 2 |
| 1 12 | 18 | 900337 | 903203 | 906018 | 908781 | 911495 | 914158 | 916773 | 919339 | 921857 | 48 2 |
| 1 16 | 19 | 900385 | 903250 | 906064 | 908827 | 911540 | 914202 | 916816 | 919381 | 921899 | 44 2 |
| 1 20 | 20 | 4.900433 | 4.903298 | 4.906111 | 4.908873 | 4.911584 | 4.914246 | 4.916859 | 4.919424 | 4.921940 | 40 2 |
| 1 24 | 21 | 900481 | 903345 | 906157 | 908918 | 911629 | 914290 | 916902 | 919466 | 921982 | 36 2 |
| 1 28 | 22 | 900529 | 903392 | 906204 | 908964 | 911674 | 914334 | 916945 | 919508 | 922023 | 32 2 |
| 1 32 | 23 | 900578 | 903440 | 906250 | 909009 | 911719 | 914378 | 916989 | 919551 | 922065 | 28 2 |
| 1 36 | 24 | 4.900626 | 4.903487 | 4.906296 | 4.909055 | 4.911763 | 4.914422 | 4.917032 | 4.919593 | 4.922106 | 24 2 |
| 1 40 | 25 | 900674 | 903534 | 906343 | 909101 | 911808 | 914466 | 917075 | 919635 | 922148 | 20 2 |
| 1 44 | 26 | 900722 | 903581 | 906389 | 909146 | 911853 | 914510 | 917118 | 919677 | 922189 | 16 2 |
| 1 48 | 27 | 900770 | 903628 | 906435 | 909192 | 911897 | 914554 | 917161 | 919720 | 922231 | 12 2 |
| 1 52 | 28 | 4.900818 | 4.903676 | 4.906482 | 4.909237 | 4.911942 | 4.914598 | 4.917204 | 4.919762 | 4.922272 | 8 2 |
| 1 56 | 29 | 900866 | 903723 | 906528 | 909283 | 911987 | 914641 | 917247 | 919804 | 922313 | 4 2 |
| 2 0 | 30 | 900914 | 903770 | 906574 | 909328 | 912031 | 914685 | 917290 | 919846 | 922355 | 0 2 |
| 2 4 | 31 | 900962 | 903817 | 906621 | 909374 | 912076 | 914729 | 917333 | 919889 | 922396 | 56 1 |
| 2 8 | 32 | 4.901010 | 4.903864 | 4.906667 | 4.909419 | 4.912121 | 4.914773 | 4.917376 | 4.919931 | 4.922438 | 52 1 |
| 2 12 | 33 | 901058 | 903911 | 906713 | 909464 | 912165 | 914817 | 917419 | 919973 | 922479 | 48 1 |
| 2 16 | 34 | 901106 | 903959 | 906760 | 909510 | 912210 | 914860 | 917462 | 920015 | 922520 | 44 1 |
| 2 20 | 35 | 901154 | 904006 | 906806 | 909555 | 912254 | 914904 | 917505 | 920057 | 922562 | 40 1 |
| 2 24 | 36 | 4.901202 | 4.904053 | 4.906852 | 4.909601 | 4.912299 | 4.914948 | 4.917548 | 4.920099 | 4.922603 | 36 1 |
| 2 28 | 37 | 901250 | 904100 | 906898 | 909646 | 912344 | 914992 | 917591 | 920141 | 922644 | 32 1 |
| 2 32 | 38 | 901298 | 904147 | 906945 | 909691 | 912388 | 915035 | 917634 | 920184 | 922686 | 28 1 |
| 2 36 | 39 | 901346 | 904194 | 906991 | 909737 | 912433 | 915079 | 917676 | 920226 | 922727 | 24 1 |
| 2 40 | 40 | 4.901394 | 4.904241 | 4.907037 | 4.909782 | 4.912477 | 4.915123 | 4.917719 | 4.920268 | 4.922768 | 20 1 |
| 2 44 | 41 | 901442 | 904288 | 907083 | 909827 | 912522 | 915166 | 917762 | 920310 | 922810 | 16 1 |
| 2 48 | 42 | 901489 | 904335 | 907129 | 909873 | 912566 | 915210 | 917805 | 920352 | 922851 | 12 1 |
| 2 52 | 43 | 901537 | 904382 | 907175 | 909918 | 912611 | 915254 | 917848 | 920394 | 922892 | 8 1 |
| 2 56 | 44 | 4.901585 | 4.904429 | 4.907222 | 4.909963 | 4.912655 | 4.915297 | 4.917891 | 4.920437 | 4.922933 | 4 1 |
| 3 0 | 45 | 901633 | 904476 | 907268 | 910009 | 912699 | 915341 | 917934 | 920478 | 922975 | 0 1 |
| 3 4 | 46 | 901681 | 904523 | 907314 | 910054 | 912744 | 915385 | 917976 | 920520 | 923016 | 56 0 |
| 3 8 | 47 | 901729 | 904570 | 907360 | 910099 | 912788 | 915428 | 918019 | 920562 | 923057 | 52 0 |
| 3 12 | 48 | 4.901776 | 4.904617 | 4.907406 | 4.910144 | 4.912833 | 4.915472 | 4.918062 | 4.920604 | 4.923098 | 48 0 |
| 3 16 | 49 | 901824 | 904664 | 907452 | 910190 | 912877 | 915515 | 918105 | 920646 | 923139 | 44 0 |
| 3 20 | 50 | 901872 | 904711 | 907498 | 910235 | 912921 | 915559 | 918147 | 920688 | 923180 | 40 0 |
| 3 24 | 51 | 901920 | 904757 | 907544 | 910280 | 912966 | 915602 | 918190 | 920730 | 923222 | 36 0 |
| 3 28 | 52 | 4.901967 | 4.904804 | 4.907590 | 4.910325 | 4.913010 | 4.915646 | 4.918233 | 4.920772 | 4.923263 | 32 0 |
| 3 32 | 53 | 902015 | 904851 | 907636 | 910370 | 913055 | 915689 | 918276 | 920814 | 923304 | 28 0 |
| 3 36 | 54 | 902063 | 904898 | 907682 | 910415 | 913099 | 915733 | 918318 | 920855 | 923345 | 24 0 |
| 3 40 | 55 | 902110 | 904945 | 907728 | 910461 | 913143 | 915776 | 918361 | 920897 | 923386 | 20 0 |
| 3 44 | 56 | 4.902158 | 4.904992 | 4.907774 | 4.910506 | 4.913187 | 4.915820 | 4.918404 | 4.920939 | 4.923427 | 16 0 |
| 3 48 | 57 | 902206 | 905038 | 907820 | 910551 | 913232 | 915863 | 918446 | 920981 | 923468 | 12 0 |
| 3 52 | 58 | 902253 | 905085 | 907866 | 910596 | 913276 | 915907 | 918489 | 921023 | 923509 | 8 0 |
| 3 56 | 59 | 902301 | 905132 | 907912 | 910641 | 913320 | 915950 | 918532 | 921065 | 923550 | 4 0 |
| 4 0 | 60 | 4.902349 | 4.905179 | 4.907958 | 4.910686 | 4.913364 | 4.915994 | 4.918574 | 4.921107 | 4.923591 | 0 0 |
| m s Time | | 56m | 52m | 48m | 44m | 40m | 36m | 32m | 28m | 24m | s m Time |

| Time m s | Arc. ′ ″ | 12m 33° | 16m 34° | 20m 35° | 24m 36° | 28m 37° | 32m 38° | 36m 39° | 40m 40° | 44m 41° | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 0 | 4.453342 | 4.465935 | 4.478142 | 4.489982 | 4.501476 | 4.512642 | 4.523495 | 4.534052 | 4.544325 | 0 2 |
| 0 2 | 0 30 | 453448 | 466039 | 478242 | 490080 | 501571 | 512734 | 523584 | 534138 | 544410 | 58 1 |
| 0 4 | 1 0 | 453555 | 466142 | 478342 | 490177 | 501665 | 512825 | 523674 | 534225 | 544494 | 56 1 |
| 0 6 | 1 30 | 453661 | 466245 | 478442 | 490274 | 501759 | 512917 | 523763 | 534312 | 544579 | 54 1 |
| 0 8 | 2 0 | 4.453768 | 4.466348 | 4.478542 | 4.490371 | 4.501854 | 4.513009 | 4.523852 | 4.534399 | 4.544663 | 52 1 |
| 0 10 | 2 30 | 453875 | 466451 | 478642 | 490468 | 501948 | 513100 | 523941 | 534485 | 544747 | 50 1 |
| 0 12 | 3 0 | 453981 | 466555 | 478742 | 490565 | 502042 | 513192 | 524030 | 534572 | 544832 | 48 1 |
| 0 14 | 3 30 | 454087 | 466658 | 478842 | 490662 | 502137 | 513283 | 524119 | 534659 | 544916 | 46 1 |
| 0 16 | 4 0 | 4.454194 | 4.466761 | 4.478942 | 4.490759 | 4.502231 | 4.513375 | 4.524208 | 4.534745 | 4.545000 | 44 1 |
| 0 18 | 4 30 | 454300 | 466864 | 479042 | 490856 | 502325 | 513466 | 524297 | 534832 | 545085 | 42 1 |
| 0 20 | 5 0 | 454407 | 466967 | 479142 | 490953 | 502419 | 513558 | 524386 | 534918 | 545169 | 40 1 |
| 0 22 | 5 30 | 454513 | 467070 | 479242 | 491050 | 502513 | 513650 | 524475 | 535005 | 545253 | 38 1 |
| 0 24 | 6 0 | 4.454619 | 4.467173 | 4.479342 | 4.491147 | 4.502607 | 4.513741 | 4.524564 | 4.535091 | 4.545338 | 36 1 |
| 0 26 | 6 30 | 454725 | 467276 | 479442 | 491244 | 502702 | 513832 | 524653 | 535178 | 545422 | 34 1 |
| 0 28 | 7 0 | 454832 | 467379 | 479542 | 491341 | 502796 | 513924 | 524742 | 535265 | 545505 | 32 1 |
| 0 30 | 7 30 | 454938 | 467482 | 479642 | 491438 | 502890 | 514015 | 524831 | 535351 | 545590 | 30 1 |
| 0 32 | 8 0 | 4.455044 | 4.467585 | 4.479741 | 4.491534 | 4.502984 | 4.514107 | 4.524920 | 4.535437 | 4.545674 | 28 1 |
| 0 34 | 8 30 | 455150 | 467688 | 479841 | 491631 | 503078 | 514198 | 525008 | 535524 | 545759 | 26 1 |
| 0 36 | 9 0 | 455256 | 467790 | 479941 | 491728 | 503172 | 514289 | 525097 | 535610 | 545843 | 24 1 |
| 0 38 | 9 30 | 455362 | 467893 | 480040 | 491825 | 503266 | 514381 | 525186 | 535697 | 545927 | 22 1 |
| 0 40 | 10 0 | 4.455469 | 4.467996 | 4.480140 | 4.491922 | 4.503360 | 4.514472 | 4.525275 | 4.535783 | 4.546011 | 20 1 |
| 0 42 | 10 30 | 455575 | 468099 | 480240 | 492018 | 503454 | 514563 | 525364 | 535870 | 546095 | 18 1 |
| 0 44 | 11 0 | 455681 | 468201 | 480339 | 492115 | 503547 | 514655 | 525452 | 535956 | 546179 | 16 1 |
| 0 46 | 11 30 | 455787 | 468304 | 480439 | 492212 | 503641 | 514746 | 525541 | 536042 | 546263 | 14 1 |
| 0 48 | 12 0 | 4.455893 | 4.468407 | 4.480538 | 4.492308 | 4.503735 | 4.514837 | 4.525630 | 4.536129 | 4.546347 | 12 1 |
| 0 50 | 12 30 | 455998 | 468509 | 480638 | 492405 | 503829 | 514928 | 525718 | 536215 | 546431 | 10 1 |
| 0 52 | 13 0 | 456104 | 468612 | 480738 | 492501 | 503923 | 515019 | 525807 | 536301 | 546515 | 8 1 |
| 0 54 | 13 30 | 456210 | 468715 | 480837 | 492598 | 504017 | 515111 | 525896 | 536387 | 546599 | 6 1 |
| 0 56 | 14 0 | 4.456316 | 4.468817 | 4.480937 | 4.492695 | 4.504110 | 4.515202 | 4.525984 | 4.536474 | 4.546683 | 4 1 |
| 0 58 | 14 30 | 456422 | 468920 | 481036 | 492791 | 504204 | 515293 | 526073 | 536560 | 546767 | 2 1 |
| 1 0 | 15 0 | 456528 | 469022 | 481135 | 492888 | 504298 | 515384 | 526162 | 536646 | 546851 | 0 1 |
| 1 2 | 15 30 | 456633 | 469125 | 481235 | 492984 | 504392 | 515475 | 526250 | 536732 | 546935 | 58 0 |
| 1 4 | 16 0 | 4.456739 | 4.469227 | 4.481334 | 4.493081 | 4.504485 | 4.515566 | 4.526339 | 4.536818 | 4.547019 | 56 0 |
| 1 6 | 16 30 | 456845 | 469330 | 481434 | 493177 | 504579 | 515657 | 526427 | 536904 | 547103 | 54 0 |
| 1 8 | 17 0 | 456951 | 469432 | 481533 | 493273 | 504673 | 515748 | 526516 | 536991 | 547187 | 52 0 |
| 1 10 | 17 30 | 457056 | 469535 | 481632 | 493370 | 504766 | 515839 | 526604 | 537077 | 547270 | 50 0 |
| 1 12 | 18 0 | 4.457162 | 4.469637 | 4.481731 | 4.493466 | 4.504860 | 4.515930 | 4.526693 | 4.537163 | 4.547354 | 48 0 |
| 1 14 | 18 30 | 457267 | 469739 | 481831 | 493562 | 504953 | 516021 | 526781 | 537249 | 547438 | 46 0 |
| 1 16 | 19 0 | 457373 | 469842 | 481930 | 493659 | 505047 | 516112 | 526870 | 537335 | 547522 | 44 0 |
| 1 18 | 19 30 | 457478 | 469944 | 482029 | 493755 | 505140 | 516203 | 526958 | 537421 | 547605 | 42 0 |
| 1 20 | 20 0 | 4.457584 | 4.470046 | 4.482128 | 4.493851 | 4.505234 | 4.516294 | 4.527046 | 4.537507 | 4.547689 | 40 0 |
| 1 22 | 20 30 | 457689 | 470148 | 482227 | 493947 | 505327 | 516384 | 527135 | 537593 | 547773 | 38 0 |
| 1 24 | 21 0 | 457795 | 470250 | 482327 | 494044 | 505421 | 516475 | 527223 | 537679 | 547857 | 36 0 |
| 1 26 | 21 30 | 457900 | 470353 | 482426 | 494140 | 505514 | 516566 | 527311 | 537765 | 547940 | 34 0 |
| 1 28 | 22 0 | 4.458006 | 4.470455 | 4.482525 | 4.494236 | 4.505608 | 4.516657 | 4.527400 | 4.537851 | 4.548024 | 32 0 |
| 1 30 | 22 30 | 458111 | 470557 | 482624 | 494332 | 505701 | 516748 | 527488 | 537937 | 548108 | 30 0 |
| 1 32 | 23 0 | 458216 | 470659 | 482723 | 494428 | 505794 | 516838 | 527576 | 538023 | 548191 | 28 0 |
| 1 34 | 23 30 | 458322 | 470761 | 482822 | 494524 | 505888 | 516929 | 527664 | 538108 | 548275 | 26 0 |
| 1 36 | 24 0 | 4.458427 | 4.470863 | 4.482921 | 4.494620 | 4.505981 | 4.517020 | 4.527753 | 4.538194 | 4.548358 | 24 0 |
| 1 38 | 24 30 | 458532 | 470965 | 483020 | 494717 | 506074 | 517110 | 527841 | 538280 | 548442 | 22 0 |
| 1 40 | 25 0 | 458638 | 471067 | 483119 | 494813 | 506168 | 517201 | 527929 | 538366 | 548526 | 20 0 |
| 1 42 | 25 30 | 458743 | 471169 | 483218 | 494909 | 506261 | 517292 | 528017 | 538452 | 548609 | 18 0 |
| 1 44 | 26 0 | 4.458848 | 4.471271 | 4.483316 | 4.495005 | 4.506354 | 4.517382 | 4.528105 | 4.538537 | 4.548693 | 16 0 |
| 1 46 | 26 30 | 458953 | 471373 | 483415 | 495100 | 506447 | 517473 | 528193 | 538623 | 548776 | 14 0 |
| 1 48 | 27 0 | 459058 | 471475 | 483514 | 495196 | 506541 | 517564 | 528281 | 538709 | 548860 | 12 0 |
| 1 50 | 27 30 | 459163 | 471577 | 483613 | 495292 | 506634 | 517654 | 528370 | 538795 | 548943 | 10 0 |
| 1 52 | 28 0 | 4.459268 | 4.471678 | 4.483712 | 4.495388 | 4.506727 | 4.517745 | 4.528458 | 4.53888c | 4.549027 | 8 0 |
| 1 54 | 28 30 | 459373 | 471780 | 483810 | 495484 | 506820 | 517835 | 528546 | 538966 | 549110 | 6 0 |
| 1 56 | 29 0 | 459478 | 471882 | 483909 | 49558c | 506913 | 517926 | 528634 | 539052 | 549193 | 4 0 |
| 1 58 | 29 30 | 459583 | 471984 | 484008 | 495676 | 507006 | 518016 | 528722 | 539137 | 549277 | 2 0 |
| 2 0 | 30 0 | 4.459688 | 4.472086 | 4.484107 | 4.495772 | 4.507099 | 4.518107 | 4.528810 | 4.539223 | 4.549360 | 0 0 |
| m s Time | | 46m | 42m | 38m | 34m | 30m | 26m | 22m | 18m | 14m | s m Time |

| Time m | s | Arc. ′ | 12m 123° | 16m 124° | 20m 125° | 24m 126° | 28m 127° | 32m 128° | 36m 129° | 40m 130° | 44m 131° | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 4.943898 | 4.945935 | 4.947929 | 4.949881 | 4.951791 | 4.953660 | 4.955488 | 4.957276 | 4.959023 | 0 | 4 |
| 0 | 4 | 1 | 943933 | 945968 | 947962 | 949913 | 951823 | 953691 | 955518 | 957305 | 959052 | 56 | 3 |
| 0 | 8 | 2 | 943967 | 946002 | 947995 | 949945 | 951854 | 953722 | 955548 | 957335 | 959080 | 52 | 3 |
| 0 | 12 | 3 | 944001 | 946036 | 948027 | 949977 | 951886 | 953753 | 955579 | 957364 | 959109 | 48 | 3 |
| 0 | 16 | 4 | 4.944036 | 4.946069 | 4.948060 | 4.950009 | 4.951917 | 4.953783 | 4.955609 | 4.957393 | 4.959138 | 44 | 3 |
| 0 | 20 | 5 | 944070 | 946103 | 948093 | 950042 | 951948 | 953814 | 955639 | 957423 | 959167 | 40 | 3 |
| 0 | 24 | 6 | 944104 | 946136 | 948126 | 950074 | 951980 | 953845 | 955669 | 957452 | 959195 | 36 | 3 |
| 0 | 28 | 7 | 944138 | 946170 | 948159 | 950106 | 952011 | 953876 | 955699 | 957482 | 959224 | 32 | 3 |
| 0 | 32 | 8 | 4.944172 | 4.946203 | 4.948192 | 4.950138 | 4.952043 | 4.953906 | 4.955729 | 4.957511 | 4.959253 | 28 | 3 |
| 0 | 36 | 9 | 944207 | 946237 | 948224 | 950170 | 952074 | 953937 | 955759 | 957540 | 959281 | 24 | 3 |
| 0 | 40 | 10 | 944241 | 946270 | 948257 | 950202 | 952105 | 953968 | 955789 | 957570 | 959310 | 20 | 3 |
| 0 | 44 | 11 | 944275 | 946304 | 948290 | 950234 | 952137 | 953998 | 955819 | 957599 | 959339 | 16 | 3 |
| 0 | 48 | 12 | 4.944309 | 4.946337 | 4.948323 | 4.950266 | 4.952168 | 4.954029 | 4.955849 | 4.957628 | 4.959367 | 12 | 3 |
| 0 | 52 | 13 | 944343 | 946370 | 948355 | 950298 | 952200 | 954060 | 955879 | 957658 | 959396 | 8 | 3 |
| 0 | 56 | 14 | 944377 | 946404 | 948388 | 950330 | 952231 | 954090 | 955909 | 957687 | 959425 | 4 | 3 |
| 1 | 0 | 15 | 944412 | 946437 | 948421 | 950362 | 952262 | 954121 | 955939 | 957716 | 959453 | 0 | 3 |
| 1 | 4 | 16 | 4.944446 | 4.946471 | 4.948453 | 4.950394 | 4.952294 | 4.954152 | 4.955969 | 4.957746 | 4.959482 | 56 | 2 |
| 1 | 8 | 17 | 944480 | 946504 | 948486 | 950426 | 952325 | 954182 | 955999 | 957775 | 959511 | 52 | 2 |
| 1 | 12 | 18 | 944514 | 946538 | 948519 | 950458 | 952356 | 954213 | 956029 | 957804 | 959539 | 48 | 2 |
| 1 | 16 | 19 | 944548 | 946571 | 948552 | 950490 | 952387 | 954243 | 956059 | 957833 | 959568 | 44 | 2 |
| 1 | 20 | 20 | 4.944582 | 4.946604 | 4.948584 | 4.950522 | 4.952419 | 4.954274 | 4.956089 | 4.957863 | 4.959596 | 40 | 2 |
| 1 | 24 | 21 | 944616 | 946638 | 948617 | 950554 | 952450 | 954305 | 956118 | 957892 | 959625 | 36 | 2 |
| 1 | 28 | 22 | 944650 | 946671 | 948649 | 950586 | 952481 | 954335 | 956148 | 957921 | 959653 | 32 | 2 |
| 1 | 32 | 23 | 944684 | 946704 | 948682 | 950618 | 952512 | 954366 | 956178 | 957950 | 959682 | 28 | 2 |
| 1 | 36 | 24 | 4.944718 | 4.946738 | 4.948715 | 4.950650 | 4.952544 | 4.954396 | 4.956208 | 4.957979 | 4.959711 | 24 | 2 |
| 1 | 40 | 25 | 944752 | 946771 | 948747 | 950682 | 952575 | 954427 | 956238 | 958009 | 959739 | 20 | 2 |
| 1 | 44 | 26 | 944786 | 946804 | 948780 | 950714 | 952606 | 954457 | 956268 | 958038 | 959768 | 16 | 2 |
| 1 | 48 | 27 | 944820 | 946837 | 948812 | 950746 | 952637 | 954488 | 956298 | 958067 | 959796 | 12 | 2 |
| 1 | 52 | 28 | 4.944854 | 4.946871 | 4.948845 | 4.950777 | 4.952668 | 4.954518 | 4.956327 | 4.958096 | 4.959825 | 8 | 2 |
| 1 | 56 | 29 | 944888 | 946904 | 948878 | 950809 | 952700 | 954549 | 956357 | 958125 | 959853 | 4 | 2 |
| 2 | 0 | 30 | 944922 | 946937 | 948910 | 950841 | 952731 | 954579 | 956387 | 958154 | 959881 | 0 | 2 |
| 2 | 4 | 31 | 944956 | 946970 | 948943 | 950873 | 952762 | 954610 | 956417 | 958183 | 959910 | 56 | 1 |
| 2 | 8 | 32 | 4.944990 | 4.947004 | 4.948975 | 4.950905 | 4.952793 | 4.954640 | 4.956447 | 4.958212 | 4.959938 | 52 | 1 |
| 2 | 12 | 33 | 945024 | 947037 | 949008 | 950937 | 952824 | 954671 | 956476 | 958242 | 959967 | 48 | 1 |
| 2 | 16 | 34 | 945058 | 947070 | 949040 | 950968 | 952855 | 954701 | 956506 | 958271 | 959995 | 44 | 1 |
| 2 | 20 | 35 | 945092 | 947103 | 949073 | 951000 | 952886 | 954731 | 956536 | 958300 | 960024 | 40 | 1 |
| 2 | 24 | 36 | 4.945125 | 4.947136 | 4.949105 | 4.951032 | 4.952917 | 4.954762 | 4.956566 | 4.958329 | 4.960052 | 36 | 1 |
| 2 | 28 | 37 | 945159 | 947169 | 949138 | 951064 | 952949 | 954792 | 956595 | 958358 | 960080 | 32 | 1 |
| 2 | 32 | 38 | 945193 | 947203 | 949170 | 951096 | 952980 | 954823 | 956625 | 958387 | 960109 | 28 | 1 |
| 2 | 36 | 39 | 945227 | 947236 | 949202 | 951127 | 953011 | 954853 | 956655 | 958416 | 960137 | 24 | 1 |
| 2 | 40 | 40 | 4.945261 | 4.947269 | 4.949235 | 4.951159 | 4.953042 | 4.954883 | 4.956684 | 4.958445 | 4.960165 | 20 | 1 |
| 2 | 44 | 41 | 945295 | 947302 | 949267 | 951191 | 953073 | 954914 | 956714 | 958474 | 960194 | 16 | 1 |
| 2 | 48 | 42 | 945328 | 947335 | 949300 | 951222 | 953104 | 954944 | 956744 | 958503 | 960222 | 12 | 1 |
| 2 | 52 | 43 | 945362 | 947368 | 949332 | 951254 | 953135 | 954974 | 956773 | 958532 | 960250 | 8 | 1 |
| 2 | 56 | 44 | 4.945396 | 4.947401 | 4.949364 | 4.951286 | 4.953166 | 4.955005 | 4.956803 | 4.958561 | 4.960279 | 4 | 1 |
| 3 | 0 | 45 | 945430 | 947434 | 949397 | 951317 | 953197 | 955035 | 956833 | 958590 | 960307 | 0 | 1 |
| 3 | 4 | 46 | 945464 | 947467 | 949429 | 951349 | 953228 | 955065 | 956862 | 958619 | 960335 | 56 | 0 |
| 3 | 8 | 47 | 945497 | 947500 | 949461 | 951381 | 953259 | 955096 | 956892 | 958648 | 960364 | 52 | 0 |
| 3 | 12 | 48 | 4.945531 | 4.947533 | 4.949494 | 4.951412 | 4.953290 | 4.955126 | 4.956921 | 4.958677 | 4.960392 | 48 | 0 |
| 3 | 16 | 49 | 945565 | 947566 | 949526 | 951444 | 953321 | 955156 | 956951 | 958706 | 960420 | 44 | 0 |
| 3 | 20 | 50 | 945598 | 947600 | 949558 | 951476 | 953351 | 955186 | 956981 | 958734 | 960448 | 40 | 0 |
| 3 | 24 | 51 | 945632 | 947632 | 949591 | 951507 | 953382 | 955217 | 957010 | 958763 | 960477 | 36 | 0 |
| 3 | 28 | 52 | 4.945666 | 4.947665 | 4.949623 | 4.951539 | 4.953413 | 4.955247 | 4.957040 | 4.958792 | 4.960505 | 32 | 0 |
| 3 | 32 | 53 | 945699 | 947698 | 949655 | 951570 | 953444 | 955277 | 957069 | 958821 | 960533 | 28 | 0 |
| 3 | 36 | 54 | 945733 | 947731 | 949688 | 951602 | 953475 | 955307 | 957099 | 958850 | 960561 | 24 | 0 |
| 3 | 40 | 55 | 945767 | 947764 | 949720 | 951634 | 953506 | 955337 | 957128 | 958879 | 960589 | 20 | 0 |
| 3 | 44 | 56 | 4.945800 | 4.947797 | 4.949752 | 4.951665 | 4.953537 | 4.955368 | 4.957158 | 4.958908 | 4.960618 | 16 | 0 |
| 3 | 48 | 57 | 945834 | 947830 | 949784 | 951697 | 953568 | 955398 | 957187 | 958936 | 960646 | 12 | 0 |
| 3 | 52 | 58 | 945868 | 947863 | 949816 | 951728 | 953598 | 955428 | 957217 | 958965 | 960674 | 8 | 0 |
| 3 | 56 | 59 | 945901 | 947896 | 949849 | 951760 | 953629 | 955458 | 957246 | 958994 | 960702 | 4 | 0 |
| 4 | 0 | 60 | 4.945935 | 4.947929 | 4.949881 | 4.951791 | 4.953660 | 4.955488 | 4.957276 | 4.959023 | 4.960730 | 0 | 0 |
| m | s | | 44m | 40m | 36m | 32m | 28m | 24m | 20m | 16m | 12m | s | m |
| Time | | | | | | | | | | | | Time | |

| Time m | s | Arc. ′ | ″ | 48m 42° | 52m 43° | 56m 44° | 3h 0m 45° | 4m 46° | 8m 47° | 12m 48° | 16m 49° | 20m 50° | Time s | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 4.554329 | 4.564075 | 4.573575 | 4.582840 | 4.591878 | 4.600700 | 4.609313 | 4.617727 | 4.625948 | 0 | 2 |
| 0 | 2 | 0 | 30 | 554411 | 564156 | 573654 | 582916 | 591952 | 600772 | 609384 | 617796 | 626016 | 58 | 1 |
| 0 | 4 | 1 | 0 | 554494 | 564236 | 573732 | 582992 | 592027 | 600845 | 609455 | 617865 | 626084 | 56 | 1 |
| 0 | 6 | 1 | 30 | 554576 | 564316 | 573810 | 583068 | 592101 | 600917 | 609526 | 617935 | 626151 | 54 | 1 |
| 0 | 8 | 2 | 0 | 4.554658 | 4.564396 | 4.573888 | 4.583144 | 4.592175 | 4.600990 | 4.609597 | 4.618004 | 4.626219 | 52 | 1 |
| 0 | 10 | 2 | 30 | 554740 | 564476 | 573966 | 583221 | 592250 | 601063 | 609668 | 618073 | 626287 | 50 | 1 |
| 0 | 12 | 3 | 0 | 554822 | 564556 | 574044 | 583297 | 592324 | 601135 | 609739 | 618142 | 626354 | 48 | 1 |
| 0 | 14 | 3 | 30 | 554905 | 564636 | 574122 | 583373 | 592398 | 601208 | 609809 | 618212 | 626422 | 46 | 1 |
| 0 | 16 | 4 | 0 | 4.554987 | 4.564716 | 4.574200 | 4.583449 | 4.592473 | 4.601280 | 4.609880 | 4.618281 | 4.626490 | 44 | 1 |
| 0 | 18 | 4 | 30 | 555069 | 564796 | 574278 | 583525 | 592547 | 601353 | 609951 | 618350 | 626557 | 42 | 1 |
| 0 | 20 | 5 | 0 | 555151 | 564876 | 574356 | 583601 | 592621 | 601425 | 610022 | 618419 | 626625 | 40 | 1 |
| 0 | 22 | 5 | 30 | 555233 | 564956 | 574434 | 583677 | 592696 | 601498 | 610093 | 618488 | 626692 | 38 | 1 |
| 0 | 24 | 6 | 0 | 4.555315 | 4.565036 | 4.574512 | 4.583753 | 4.592770 | 4.601570 | 4.610163 | 4.618558 | 4.626760 | 36 | 1 |
| 0 | 26 | 6 | 30 | 555397 | 565116 | 574590 | 583830 | 592844 | 601643 | 610234 | 618627 | 626828 | 34 | 1 |
| 0 | 28 | 7 | 0 | 555479 | 565196 | 574668 | 583906 | 592918 | 601715 | 610305 | 618696 | 626895 | 32 | 1 |
| 0 | 30 | 7 | 30 | 555561 | 565276 | 574746 | 583982 | 592992 | 601788 | 610376 | 618765 | 626963 | 30 | 1 |
| 0 | 32 | 8 | 0 | 4.555643 | 4.565356 | 4.574824 | 4.584058 | 4.593067 | 4.601860 | 4.610446 | 4.618834 | 4.627030 | 28 | 1 |
| 0 | 34 | 8 | 30 | 555725 | 565436 | 574902 | 584134 | 593141 | 601932 | 610517 | 618903 | 627098 | 26 | 1 |
| 0 | 36 | 9 | 0 | 555807 | 565516 | 574980 | 584210 | 593215 | 602005 | 610588 | 618972 | 627165 | 24 | 1 |
| 0 | 38 | 9 | 30 | 555889 | 565596 | 575058 | 584285 | 593289 | 602077 | 610659 | 619041 | 627233 | 22 | 1 |
| 0 | 40 | 10 | 0 | 4.555971 | 4.565676 | 4.575136 | 4.584361 | 4.593363 | 4.602149 | 4.610729 | 4.619110 | 4.627300 | 20 | 1 |
| 0 | 42 | 10 | 30 | 556053 | 565755 | 575213 | 584437 | 593437 | 602222 | 610800 | 619179 | 627368 | 18 | 1 |
| 0 | 44 | 11 | 0 | 556135 | 565835 | 575291 | 584513 | 593511 | 602294 | 610870 | 619248 | 627435 | 16 | 1 |
| 0 | 46 | 11 | 30 | 556217 | 565915 | 575369 | 584589 | 593585 | 602366 | 610941 | 619317 | 627503 | 14 | 1 |
| 0 | 48 | 12 | 0 | 4.556299 | 4.565995 | 4.575447 | 4.584665 | 4.593659 | 4.602439 | 4.611012 | 4.619386 | 4.627570 | 12 | 1 |
| 0 | 50 | 12 | 30 | 556380 | 566074 | 575525 | 584741 | 593733 | 602511 | 611082 | 619455 | 627637 | 10 | 1 |
| 0 | 52 | 13 | 0 | 556462 | 566154 | 575602 | 584817 | 593807 | 602583 | 611153 | 619524 | 627705 | 8 | 1 |
| 0 | 54 | 13 | 30 | 556544 | 566234 | 575680 | 584893 | 593881 | 602656 | 611223 | 619593 | 627772 | 6 | 1 |
| 0 | 56 | 14 | 0 | 4.556626 | 4.566314 | 4.575758 | 4.584968 | 4.593955 | 4.602728 | 4.611294 | 4.619662 | 4.627840 | 4 | 1 |
| 0 | 58 | 14 | 30 | 556708 | 566393 | 575835 | 585044 | 594029 | 602800 | 611365 | 619731 | 627907 | 2 | 1 |
| 1 | 0 | 15 | 0 | 556789 | 566473 | 575913 | 585120 | 594103 | 602872 | 611435 | 619800 | 627974 | 0 | 1 |
| 1 | 2 | 15 | 30 | 556871 | 566553 | 575991 | 585196 | 594177 | 602944 | 611506 | 619869 | 628042 | 58 | 0 |
| 1 | 4 | 16 | 0 | 4.556953 | 4.566632 | 4.576068 | 4.585272 | 4.594251 | 4.603017 | 4.611576 | 4.619938 | 4.628109 | 56 | 0 |
| 1 | 6 | 16 | 30 | 557035 | 566712 | 576146 | 585347 | 594325 | 603089 | 611647 | 620007 | 628176 | 54 | 0 |
| 1 | 8 | 17 | 0 | 557116 | 566792 | 576224 | 585423 | 594399 | 603161 | 611717 | 620075 | 628244 | 52 | 0 |
| 1 | 10 | 17 | 30 | 557198 | 566871 | 576301 | 585499 | 594473 | 603233 | 611788 | 620144 | 628311 | 50 | 0 |
| 1 | 12 | 18 | 0 | 4.557280 | 4.566951 | 4.576379 | 4.585574 | 4.594547 | 4.603305 | 4.611858 | 4.620213 | 4.628378 | 48 | 0 |
| 1 | 14 | 18 | 30 | 557361 | 567030 | 576457 | 585650 | 594621 | 603377 | 611928 | 620282 | 628445 | 46 | 0 |
| 1 | 16 | 19 | 0 | 557443 | 567110 | 576534 | 585726 | 594695 | 603449 | 611999 | 620351 | 628513 | 44 | 0 |
| 1 | 18 | 19 | 30 | 557524 | 567189 | 576612 | 585801 | 594768 | 603521 | 612069 | 620420 | 628580 | 42 | 0 |
| 1 | 20 | 20 | 0 | 4.557606 | 4.567269 | 4.576689 | 4.585877 | 4.594842 | 4.603594 | 4.612140 | 4.620488 | 4.628647 | 40 | 0 |
| 1 | 22 | 20 | 30 | 557687 | 567348 | 576767 | 585953 | 594916 | 603666 | 612210 | 620557 | 628714 | 38 | 0 |
| 1 | 24 | 21 | 0 | 557769 | 567428 | 576844 | 586028 | 594990 | 603738 | 612280 | 620626 | 628782 | 36 | 0 |
| 1 | 26 | 21 | 30 | 557851 | 567507 | 576922 | 586104 | 595064 | 603810 | 612351 | 620695 | 628849 | 34 | 0 |
| 1 | 28 | 22 | 0 | 4.557932 | 4.567587 | 4.576999 | 4.586179 | 4.595137 | 4.603882 | 4.612421 | 4.620763 | 4.628916 | 32 | 0 |
| 1 | 30 | 22 | 30 | 558014 | 567666 | 577077 | 586255 | 595211 | 603954 | 612491 | 620832 | 628983 | 30 | 0 |
| 1 | 32 | 23 | 0 | 558095 | 567746 | 577154 | 586330 | 595285 | 604026 | 612562 | 620901 | 629050 | 28 | 0 |
| 1 | 34 | 23 | 30 | 558176 | 567825 | 577231 | 586406 | 595358 | 604098 | 612632 | 620969 | 629117 | 26 | 0 |
| 1 | 36 | 24 | 0 | 4.558258 | 4.567904 | 4.577309 | 4.586482 | 4.595432 | 4.604170 | 4.612702 | 4.621038 | 4.629184 | 24 | 0 |
| 1 | 38 | 24 | 30 | 558339 | 567984 | 577386 | 586557 | 595506 | 604242 | 612773 | 621107 | 629252 | 22 | 0 |
| 1 | 40 | 25 | 0 | 558421 | 568063 | 577464 | 586632 | 595579 | 604313 | 612843 | 621175 | 629319 | 20 | 0 |
| 1 | 42 | 25 | 30 | 558502 | 568142 | 577541 | 586708 | 595653 | 604385 | 612913 | 621244 | 629386 | 18 | 0 |
| 1 | 44 | 26 | 0 | 4.558583 | 4.568222 | 4.577618 | 4.586783 | 4.595727 | 4.604457 | 4.612983 | 4.621313 | 4.629453 | 16 | 0 |
| 1 | 46 | 26 | 30 | 558665 | 568301 | 577696 | 586859 | 595800 | 604529 | 613053 | 621381 | 629520 | 14 | 0 |
| 1 | 48 | 27 | 0 | 558746 | 568380 | 577773 | 586934 | 595874 | 604601 | 613124 | 621450 | 629587 | 12 | 0 |
| 1 | 50 | 27 | 30 | 558827 | 568459 | 577850 | 587010 | 595948 | 604673 | 613194 | 621518 | 629654 | 10 | 0 |
| 1 | 52 | 28 | 0 | 4.558909 | 4.568539 | 4.577927 | 4.587085 | 4.596021 | 4.604745 | 4.613264 | 4.621587 | 4.629721 | 8 | 0 |
| 1 | 54 | 28 | 30 | 558990 | 568618 | 578005 | 587160 | 596095 | 604817 | 613334 | 621656 | 629788 | 6 | 0 |
| 1 | 56 | 29 | 0 | 559071 | 568697 | 578082 | 587236 | 596168 | 604888 | 613404 | 621724 | 629855 | 4 | 0 |
| 1 | 58 | 29 | 30 | 559152 | 568776 | 578159 | 587311 | 596242 | 604960 | 613474 | 621793 | 629922 | 2 | 0 |
| 2 | 0 | 30 | 0 | 4.559234 | 4.568855 | 4.578236 | 4.587386 | 4.596315 | 4.605032 | 4.613545 | 4.621861 | 4.629989 | 0 | 0 |
| m | s | | | 10m | 6m | 2m 21h | 58m | 54m | 50m | 46m | 42m | 38m | s | m |

| Time m s | Arc. ′ | 12m 123° | 16m 124° | 20m 125° | 24m 126° | 28m 127° | 32m 128° | 36m 129° | 40m 130° | 44m 131° | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4.943898 | 4.945935 | 4.947929 | 4.949881 | 4.951791 | 4.953660 | 4.955488 | 4.957276 | 4.959023 | 0 4 |
| 0 4 | 1 | 943933 | 945968 | 947962 | 949913 | 951823 | 953691 | 955518 | 957305 | 959052 | 56 3 |
| 0 8 | 2 | 943967 | 946002 | 947995 | 949945 | 951854 | 953722 | 955548 | 957335 | 959080 | 52 3 |
| 0 12 | 3 | 944001 | 946036 | 948027 | 949977 | 951886 | 953753 | 955579 | 957364 | 959109 | 48 3 |
| 0 16 | 4 | 4.944036 | 4.946069 | 4.948060 | 4.950009 | 4.951917 | 4.953783 | 4.955609 | 4.957393 | 4.959138 | 44 3 |
| 0 20 | 5 | 944070 | 946103 | 948093 | 950042 | 951948 | 953814 | 955639 | 957423 | 959167 | 40 3 |
| 0 24 | 6 | 944104 | 946136 | 948126 | 950074 | 951980 | 953845 | 955669 | 957452 | 959195 | 36 3 |
| 0 28 | 7 | 944138 | 946170 | 948159 | 950106 | 952011 | 953876 | 955699 | 957482 | 959224 | 32 3 |
| 0 32 | 8 | 4.944172 | 4.946203 | 4.948192 | 4.950138 | 4.952043 | 4.953906 | 4.955729 | 4.957511 | 4.959253 | 28 3 |
| 0 36 | 9 | 944207 | 946237 | 948224 | 950170 | 952074 | 953937 | 955759 | 957540 | 959281 | 24 3 |
| 0 40 | 10 | 944241 | 946270 | 948257 | 950202 | 952105 | 953968 | 955789 | 957570 | 959310 | 20 3 |
| 0 44 | 11 | 944275 | 946304 | 948290 | 950234 | 952137 | 953998 | 955819 | 957599 | 959339 | 16 3 |
| 0 48 | 12 | 4.944309 | 4.946337 | 4.948323 | 4.950266 | 4.952168 | 4.954029 | 4.955849 | 4.957628 | 4.959367 | 12 3 |
| 0 52 | 13 | 944343 | 946370 | 948355 | 950298 | 952200 | 954060 | 955879 | 957658 | 959396 | 8 3 |
| 0 56 | 14 | 944377 | 946404 | 948388 | 950330 | 952231 | 954090 | 955909 | 957687 | 959425 | 4 3 |
| 1 0 | 15 | 944412 | 946437 | 948421 | 950362 | 952262 | 954121 | 955939 | 957716 | 959453 | 0 3 |
| 1 4 | 16 | 4.944446 | 4.946471 | 4.948453 | 4.950394 | 4.952294 | 4.954152 | 4.955969 | 4.957746 | 4.959482 | 56 2 |
| 1 8 | 17 | 944480 | 946504 | 948486 | 950426 | 952325 | 954182 | 955999 | 957775 | 959511 | 52 2 |
| 1 12 | 18 | 944514 | 946538 | 948519 | 950458 | 952356 | 954213 | 956029 | 957804 | 959539 | 48 2 |
| 1 16 | 19 | 944548 | 946571 | 948552 | 950490 | 952387 | 954243 | 956059 | 957833 | 959568 | 44 2 |
| 1 20 | 20 | 4.944582 | 4.946604 | 4.948584 | 4.950522 | 4.952419 | 4.954274 | 4.956089 | 4.957863 | 4.959596 | 40 2 |
| 1 24 | 21 | 944616 | 946638 | 948617 | 950554 | 952450 | 954305 | 956118 | 957892 | 959625 | 36 2 |
| 1 28 | 22 | 944650 | 946671 | 948649 | 950586 | 952481 | 954335 | 956148 | 957921 | 959653 | 32 2 |
| 1 32 | 23 | 944684 | 946704 | 948682 | 950618 | 952512 | 954366 | 956178 | 957950 | 959682 | 28 2 |
| 1 36 | 24 | 4.944718 | 4.946738 | 4.948715 | 4.950650 | 4.952544 | 4.954396 | 4.956208 | 4.957979 | 4.959711 | 24 2 |
| 1 40 | 25 | 944752 | 946771 | 948747 | 950682 | 952575 | 954427 | 956238 | 958009 | 959739 | 20 2 |
| 1 44 | 26 | 944786 | 946804 | 948780 | 950714 | 952606 | 954457 | 956268 | 958038 | 959768 | 16 2 |
| 1 48 | 27 | 944820 | 946837 | 948812 | 950746 | 952637 | 954488 | 956298 | 958067 | 959796 | 12 2 |
| 1 52 | 28 | 4.944854 | 4.946871 | 4.948845 | 4.950777 | 4.952668 | 4.954518 | 4.956327 | 4.958096 | 4.959825 | 8 2 |
| 1 56 | 29 | 944888 | 946904 | 948878 | 950809 | 952700 | 954549 | 956357 | 958125 | 959853 | 4 2 |
| 2 0 | 30 | 944922 | 946937 | 948910 | 950841 | 952731 | 954579 | 956387 | 958154 | 959881 | 0 2 |
| 2 4 | 31 | 944956 | 946970 | 948943 | 950873 | 952762 | 954610 | 956417 | 958183 | 959910 | 56 1 |
| 2 8 | 32 | 4.944990 | 4.947004 | 4.948975 | 4.950905 | 4.952793 | 4.954640 | 4.956447 | 4.958212 | 4.959938 | 52 1 |
| 2 12 | 33 | 945024 | 947037 | 949008 | 950937 | 952824 | 954671 | 956476 | 958242 | 959967 | 48 1 |
| 2 16 | 34 | 945058 | 947070 | 949040 | 950968 | 952855 | 954701 | 956506 | 958271 | 959995 | 44 1 |
| 2 20 | 35 | 945092 | 947103 | 949073 | 951000 | 952886 | 954731 | 956536 | 958300 | 960024 | 40 1 |
| 2 24 | 36 | 4.945125 | 4.947136 | 4.949105 | 4.951032 | 4.952917 | 4.954762 | 4.956566 | 4.958329 | 4.960052 | 36 1 |
| 2 28 | 37 | 945159 | 947169 | 949138 | 951064 | 952949 | 954792 | 956595 | 958358 | 960080 | 32 1 |
| 2 32 | 38 | 945193 | 947203 | 949170 | 951096 | 952980 | 954823 | 956625 | 958387 | 960109 | 28 1 |
| 2 36 | 39 | 945227 | 947236 | 949202 | 951127 | 953011 | 954853 | 956655 | 958416 | 960137 | 24 1 |
| 2 40 | 40 | 4.945261 | 4.947269 | 4.949235 | 4.951159 | 4.953042 | 4.954883 | 4.956684 | 4.958445 | 4.960165 | 20 1 |
| 2 44 | 41 | 945295 | 947302 | 949267 | 951191 | 953073 | 954914 | 956714 | 958474 | 960194 | 16 1 |
| 2 48 | 42 | 945328 | 947335 | 949300 | 951222 | 953104 | 954944 | 956744 | 958503 | 960222 | 12 1 |
| 2 52 | 43 | 945362 | 947368 | 949332 | 951254 | 953135 | 954974 | 956773 | 958532 | 960250 | 8 1 |
| 2 56 | 44 | 4.945396 | 4.947401 | 4.949364 | 4.951286 | 4.953166 | 4.955005 | 4.956803 | 4.958561 | 4.960279 | 4 1 |
| 3 0 | 45 | 945430 | 947434 | 949397 | 951317 | 953197 | 955035 | 956833 | 958590 | 960307 | 0 1 |
| 3 4 | 46 | 945464 | 947467 | 949429 | 951349 | 953228 | 955065 | 956862 | 958619 | 960335 | 56 0 |
| 3 8 | 47 | 945497 | 947500 | 949461 | 951381 | 953259 | 955096 | 956892 | 958648 | 960364 | 52 0 |
| 3 12 | 48 | 4.945531 | 4.947533 | 4.949494 | 4.951412 | 4.953290 | 4.955126 | 4.956921 | 4.958677 | 4.960392 | 48 0 |
| 3 16 | 49 | 945565 | 947566 | 949526 | 951444 | 953321 | 955156 | 956951 | 958706 | 960420 | 44 0 |
| 3 20 | 50 | 945598 | 947600 | 949558 | 951476 | 953351 | 955186 | 956981 | 958734 | 960448 | 40 0 |
| 3 24 | 51 | 945632 | 947632 | 949591 | 951507 | 953382 | 955217 | 957010 | 958763 | 960477 | 36 0 |
| 3 28 | 52 | 4.945666 | 4.947665 | 4.949623 | 4.951539 | 4.953413 | 4.955247 | 4.957040 | 4.958792 | 4.960505 | 32 0 |
| 3 32 | 53 | 945699 | 947698 | 949655 | 951570 | 953444 | 955277 | 957069 | 958821 | 960533 | 28 0 |
| 3 36 | 54 | 945733 | 947731 | 949688 | 951602 | 953475 | 955307 | 957099 | 958850 | 960561 | 24 0 |
| 3 40 | 55 | 945767 | 947764 | 949720 | 951634 | 953506 | 955337 | 957128 | 958879 | 960589 | 20 0 |
| 3 44 | 56 | 4.945800 | 4.947797 | 4.949752 | 4.951665 | 4.953537 | 4.955368 | 4.957158 | 4.958908 | 4.960618 | 16 0 |
| 3 48 | 57 | 945834 | 947830 | 949784 | 951697 | 953568 | 955398 | 957187 | 958936 | 960646 | 12 0 |
| 3 52 | 58 | 945868 | 947863 | 949816 | 951728 | 953598 | 955428 | 957217 | 958965 | 960674 | 8 0 |
| 3 56 | 59 | 945901 | 947896 | 949849 | 951760 | 953629 | 955458 | 957246 | 958994 | 960702 | 4 0 |
| 4 0 | 60 | 4.945935 | 4.947929 | 4.949881 | 4.951791 | 4.953660 | 4.955488 | 4.957276 | 4.959023 | 4.960730 | 0 0 |
| m s Time | | 44m | 40m | 36m | 32m | 28m | 24m | 20m | 16m | 12m | s m Time |

| Time m s | Arc. ′ | 48m 132° | 52m 133° | 56m 134° | 9h 0m 135° | 4m 136° | 8m 137° | 12m 138° | 16m 139° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4.960730 | 4.962398 | 4.964026 | 4.965615 | 4.967166 | 4.968678 | 4.970152 | 4.971588 | 60 | 0 4 |
| 0 4 | 1 | 960758 | 962425 | 964053 | 965641 | 967191 | 968703 | 970176 | 971611 | 59 | 56 3 |
| 0 8 | 2 | 960786 | 962453 | 964080 | 965668 | 967217 | 968728 | 970200 | 971635 | 58 | 52 3 |
| 0 12 | 3 | 960814 | 962480 | 964106 | 965694 | 967242 | 968752 | 970224 | 971658 | 57 | 48 3 |
| 0 16 | 4 | 4.960843 | 4.962508 | 4.964133 | 4.965720 | 4.967268 | 4.968777 | 4.970249 | 4.971682 | 56 | 44 3 |
| 0 20 | 5 | 960871 | 962535 | 964160 | 965746 | 967293 | 968802 | 970273 | 971706 | 55 | 40 3 |
| 0 24 | 6 | 960899 | 962562 | 964187 | 965772 | 967319 | 968827 | 970297 | 971729 | 54 | 36 3 |
| 0 28 | 7 | 960927 | 962590 | 964213 | 965798 | 967344 | 968852 | 970321 | 971753 | 53 | 32 3 |
| 0 32 | 8 | 4.960955 | 4.962617 | 4.964240 | 4.965824 | 4.967370 | 4.968877 | 4.970345 | 4.971776 | 52 | 28 3 |
| 0 36 | 9 | 960983 | 962644 | 964267 | 965850 | 967395 | 968901 | 970369 | 971800 | 51 | 24 3 |
| 0 40 | 10 | 961011 | 962672 | 964294 | 965876 | 967420 | 968926 | 970394 | 971823 | 50 | 20 3 |
| 0 44 | 11 | 961039 | 962699 | 964320 | 965902 | 967446 | 968951 | 970418 | 971847 | 49 | 16 3 |
| 0 48 | 12 | 4.961067 | 4.962727 | 4.964347 | 4.965928 | 4.967471 | 4.968976 | 4.970442 | 4.971870 | 48 | 12 3 |
| 0 52 | 13 | 961095 | 962754 | 964374 | 965955 | 967497 | 969000 | 970466 | 971894 | 47 | 8 3 |
| 0 56 | 14 | 961123 | 962781 | 964400 | 965981 | 967522 | 969025 | 970490 | 971917 | 46 | 4 3 |
| 1 0 | 15 | 961151 | 962808 | 964427 | 966007 | 967547 | 969050 | 970514 | 971941 | 45 | 0 3 |
| 1 4 | 16 | 4.961179 | 4.962836 | 4.964454 | 4.966033 | 4.967573 | 4.969075 | 4.970538 | 4.971964 | 44 | 56 2 |
| 1 8 | 17 | 961207 | 962863 | 964480 | 966059 | 967598 | 969099 | 970562 | 971988 | 43 | 52 2 |
| 1 12 | 18 | 961235 | 962890 | 964507 | 966085 | 967623 | 969124 | 970586 | 972011 | 42 | 48 2 |
| 1 16 | 19 | 961262 | 962918 | 964534 | 966110 | 967649 | 969149 | 970610 | 972034 | 41 | 44 2 |
| 1 20 | 20 | 4.961290 | 4.962945 | 4.964560 | 4.966136 | 4.967674 | 4.969173 | 4.970635 | 4.972058 | 40 | 40 2 |
| 1 24 | 21 | 961318 | 962972 | 964587 | 966162 | 967699 | 969198 | 970659 | 972081 | 39 | 36 2 |
| 1 28 | 22 | 961346 | 962999 | 964613 | 966188 | 967725 | 969223 | 970683 | 972105 | 38 | 32 2 |
| 1 32 | 23 | 961374 | 963027 | 964640 | 966214 | 967750 | 969247 | 970707 | 972128 | 37 | 28 2 |
| 1 36 | 24 | 4.961402 | 4.963054 | 4.964666 | 4.966240 | 4.967775 | 4.969272 | 4.970731 | 4.972151 | 36 | 24 2 |
| 1 40 | 25 | 961430 | 963081 | 964693 | 966266 | 967800 | 969297 | 970755 | 972175 | 35 | 20 2 |
| 1 44 | 26 | 961458 | 963108 | 964719 | 966292 | 967826 | 969321 | 970779 | 972198 | 34 | 16 2 |
| 1 48 | 27 | 961485 | 963135 | 964746 | 966318 | 967851 | 969346 | 970803 | 972221 | 33 | 12 2 |
| 1 52 | 28 | 4.961513 | 4.963162 | 4.964773 | 4.966344 | 4.967876 | 4.969370 | 4.970826 | 4.972245 | 32 | 8 2 |
| 1 56 | 29 | 961541 | 963190 | 964799 | 966370 | 967901 | 969395 | 970850 | 972268 | 31 | 4 2 |
| 2 0 | 30 | 961569 | 963217 | 964826 | 966395 | 967927 | 969420 | 970874 | 972291 | 30 | 0 2 |
| 2 4 | 31 | 961597 | 963244 | 964852 | 966421 | 967952 | 969444 | 970898 | 972315 | 29 | 56 1 |
| 2 8 | 32 | 4.961624 | 4.963271 | 4.964878 | 4.966447 | 4.967977 | 4.969469 | 4.970922 | 4.972338 | 28 | 52 1 |
| 2 12 | 33 | 961652 | 963298 | 964905 | 966473 | 968002 | 969493 | 970946 | 972361 | 27 | 48 1 |
| 2 16 | 34 | 961680 | 963325 | 964931 | 966499 | 968027 | 969518 | 970970 | 972384 | 26 | 44 1 |
| 2 20 | 35 | 961708 | 963352 | 964958 | 966524 | 968052 | 969542 | 970994 | 972408 | 25 | 40 1 |
| 2 24 | 36 | 4.961735 | 4.963379 | 4.964984 | 4.966550 | 4.968078 | 4.969567 | 4.971018 | 4.972431 | 24 | 36 1 |
| 2 28 | 37 | 961763 | 963406 | 965011 | 966576 | 968103 | 969591 | 971042 | 972454 | 23 | 32 1 |
| 2 32 | 38 | 961791 | 963434 | 965037 | 966602 | 968128 | 969616 | 971065 | 972477 | 22 | 28 1 |
| 2 36 | 39 | 961819 | 963461 | 965063 | 966628 | 968153 | 969640 | 971089 | 972501 | 21 | 24 1 |
| 2 40 | 40 | 4.961846 | 4.963488 | 4.965090 | 4.966653 | 4.968178 | 4.969665 | 4.971113 | 4.972524 | 20 | 20 1 |
| 2 44 | 41 | 961874 | 963515 | 965116 | 966679 | 968203 | 969689 | 971137 | 972547 | 19 | 16 1 |
| 2 48 | 42 | 961902 | 963542 | 965143 | 966705 | 968228 | 969714 | 971161 | 972570 | 18 | 12 1 |
| 2 52 | 43 | 961929 | 963569 | 965169 | 966730 | 968253 | 969738 | 971185 | 972593 | 17 | 8 1 |
| 2 56 | 44 | 4.961957 | 4.963596 | 4.965195 | 4.966756 | 4.968278 | 4.969762 | 4.971208 | 4.972617 | 16 | 4 1 |
| 3 0 | 45 | 961985 | 963623 | 965222 | 966782 | 968303 | 969787 | 971232 | 972640 | 15 | 0 1 |
| 3 4 | 46 | 962012 | 963650 | 965248 | 966807 | 968328 | 969811 | 971256 | 972663 | 14 | 56 0 |
| 3 8 | 47 | 962040 | 963677 | 965274 | 966833 | 968353 | 969836 | 971280 | 972686 | 13 | 52 0 |
| 3 12 | 48 | 4.962067 | 4.963704 | 4.965301 | 4.966859 | 4.968379 | 4.969860 | 4.971303 | 4.972709 | 12 | 48 0 |
| 3 16 | 49 | 962095 | 963730 | 965327 | 966884 | 968404 | 969884 | 971327 | 972732 | 11 | 44 0 |
| 3 20 | 50 | 962123 | 963757 | 965353 | 966910 | 968429 | 969909 | 971351 | 972755 | 10 | 40 0 |
| 3 24 | 51 | 962150 | 963784 | 965379 | 966936 | 968453 | 969933 | 971375 | 972778 | 9 | 36 0 |
| 3 28 | 52 | 4.962178 | 4.963811 | 4.965406 | 4.966961 | 4.968478 | 4.969957 | 4.971398 | 4.972802 | 8 | 32 0 |
| 3 32 | 53 | 962205 | 963838 | 965432 | 966987 | 968503 | 969982 | 971422 | 972825 | 7 | 28 0 |
| 3 36 | 54 | 962233 | 963865 | 965458 | 967012 | 968528 | 970006 | 971446 | 972848 | 6 | 24 0 |
| 3 40 | 55 | 962260 | 963892 | 965484 | 967038 | 968553 | 970030 | 971469 | 972871 | 5 | 20 0 |
| 3 44 | 56 | 4.962288 | 4.963919 | 4.965511 | 4.967064 | 4.968578 | 4.970055 | 4.971493 | 4.972894 | 4 | 16 0 |
| 3 48 | 57 | 962315 | 963946 | 965537 | 967089 | 968603 | 970079 | 971517 | 972917 | 3 | 12 0 |
| 3 52 | 58 | 962343 | 963972 | 965563 | 967115 | 968628 | 970103 | 971540 | 972940 | 2 | 8 0 |
| 3 56 | 59 | 962370 | 963999 | 965589 | 967140 | 968653 | 970127 | 971564 | 972963 | 1 | 4 0 |
| 4 0 | 60 | 4.962398 | 4.964026 | 4.965615 | 4.967166 | 4.968678 | 4.970152 | 4.971588 | 4.972986 | 0 | 0 0 |
| m s Time | Arc. | 227° | 226° | 225° | 224° | 223° | 222° | 221° | 220° | Arc. | s m Time |
| | | 8m | 4m | 0m 15h | 56m | 52m | 48m | 44m | 40m | | |

| Time m s | Arc. ′ | 20m 140° | 24m 141° | 28m 142° | 32m 143° | 36m 144° | 40m 145° | 44m 146° | 48m 147° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4·972986 | 4·974347 | 4·975670 | 4·976957 | 4·978206 | 4·979419 | 4·980596 | 4·981737 | 60 | 0 4 |
| 0 4 | 1 | 973009 | 974369 | 975692 | 976978 | 978227 | 979439 | 980616 | 981756 | 59 | 56 3 |
| 0 8 | 2 | 973032 | 974391 | 975713 | 976999 | 978247 | 979459 | 980635 | 981774 | 58 | 52 3 |
| 0 12 | 3 | 973055 | 974414 | 975735 | 977020 | 978268 | 979479 | 980654 | 981793 | 57 | 48 3 |
| 0 16 | 4 | 4·973078 | 4·974436 | 4·975757 | 4·977041 | 4·978288 | 4·979499 | 4·980673 | 4·981812 | 56 | 44 3 |
| 0 20 | 5 | 973101 | 974458 | 975779 | 977062 | 978309 | 979519 | 980693 | 981830 | 55 | 40 3 |
| 0 24 | 6 | 973124 | 974481 | 975800 | 977083 | 978329 | 979539 | 980712 | 981849 | 54 | 36 3 |
| 0 28 | 7 | 973146 | 974503 | 975822 | 977104 | 978350 | 979559 | 980731 | 981868 | 53 | 32 3 |
| 0 32 | 8 | 4·973169 | 4·974525 | 4·975844 | 4·977125 | 4·978370 | 4·979578 | 4·980750 | 4·981886 | 52 | 28 3 |
| 0 36 | 9 | 973192 | 974547 | 975865 | 977146 | 978391 | 979598 | 980770 | 981905 | 51 | 24 3 |
| 0 40 | 10 | 973215 | 974570 | 975887 | 977167 | 978411 | 979618 | 980789 | 981924 | 50 | 20 3 |
| 0 44 | 11 | 973238 | 974592 | 975909 | 977188 | 978431 | 979638 | 980808 | 981942 | 49 | 16 3 |
| 0 48 | 12 | 4·973261 | 4·974614 | 4·975930 | 4·977209 | 4·978452 | 4·979658 | 4·980827 | 4·981961 | 48 | 12 3 |
| 0 52 | 13 | 973284 | 974636 | 975952 | 977230 | 978472 | 979678 | 980846 | 981979 | 47 | 8 3 |
| 0 56 | 14 | 973307 | 974659 | 975974 | 977251 | 978493 | 979697 | 980866 | 981998 | 46 | 4 3 |
| 1 0 | 15 | 973329 | 974681 | 975995 | 977272 | 978513 | 979717 | 980885 | 982016 | 45 | 0 3 |
| 1 4 | 16 | 4·973352 | 4·974703 | 4·976017 | 4·977293 | 4·978533 | 4·979737 | 4·980904 | 4·982035 | 44 | 56 2 |
| 1 8 | 17 | 973375 | 974725 | 976038 | 977314 | 978554 | 979757 | 980923 | 982054 | 43 | 52 2 |
| 1 12 | 18 | 973398 | 974747 | 976060 | 977335 | 978574 | 979776 | 980942 | 982072 | 42 | 48 2 |
| 1 16 | 19 | 973421 | 974770 | 976081 | 977356 | 978594 | 979796 | 980961 | 982091 | 41 | 44 2 |
| 1 20 | 20 | 4·973443 | 4·974792 | 4·976103 | 4·977377 | 4·978615 | 4·979816 | 4·980980 | 4·982109 | 40 | 40 2 |
| 1 24 | 21 | 973466 | 974814 | 976124 | 977398 | 978635 | 979835 | 981000 | 982128 | 39 | 36 2 |
| 1 28 | 22 | 973489 | 974836 | 976146 | 977419 | 978655 | 979855 | 981019 | 982146 | 38 | 32 2 |
| 1 32 | 23 | 973512 | 974858 | 976168 | 977440 | 978676 | 979875 | 981038 | 982165 | 37 | 28 2 |
| 1 36 | 24 | 4·973535 | 4·974880 | 4·976189 | 4·977461 | 4·978696 | 4·979895 | 4·981057 | 4·982183 | 36 | 24 2 |
| 1 40 | 25 | 973557 | 974902 | 976211 | 977482 | 978716 | 979914 | 981076 | 982202 | 35 | 20 2 |
| 1 44 | 26 | 973580 | 974925 | 976232 | 977503 | 978736 | 979934 | 981095 | 982220 | 34 | 16 2 |
| 1 48 | 27 | 973603 | 974947 | 976254 | 977523 | 978757 | 979954 | 981114 | 982238 | 33 | 12 2 |
| 1 52 | 28 | 4·973625 | 4·974969 | 4·976275 | 4·977544 | 4·978777 | 4·979973 | 4·981133 | 4·982257 | 32 | 8 2 |
| 1 56 | 29 | 973648 | 974991 | 976296 | 977565 | 978797 | 979993 | 981152 | 982275 | 31 | 4 2 |
| 2 0 | 30 | 973671 | 975013 | 976318 | 977586 | 978817 | 980012 | 981171 | 982294 | 30 | 0 2 |
| 2 4 | 31 | 973693 | 975035 | 976339 | 977607 | 978838 | 980032 | 981190 | 982312 | 29 | 56 1 |
| 2 8 | 32 | 4·973716 | 4·975057 | 4·976361 | 4·977628 | 4·978858 | 4·980052 | 4·981209 | 4·982331 | 28 | 52 1 |
| 2 12 | 33 | 973739 | 975079 | 976382 | 977648 | 978878 | 980071 | 981228 | 982349 | 27 | 48 1 |
| 2 16 | 34 | 973761 | 975101 | 976404 | 977669 | 978898 | 980091 | 981247 | 982367 | 26 | 44 1 |
| 2 20 | 35 | 973784 | 975123 | 976425 | 977690 | 978918 | 980110 | 981266 | 982386 | 25 | 40 1 |
| 2 24 | 36 | 4·973807 | 4·975145 | 4·976446 | 4·977711 | 4·978939 | 4·980130 | 4·981285 | 4·982404 | 24 | 36 1 |
| 2 28 | 37 | 973829 | 975167 | 976468 | 977732 | 978959 | 980149 | 981304 | 982422 | 23 | 32 1 |
| 2 32 | 38 | 973852 | 975189 | 976489 | 977752 | 978979 | 980169 | 981323 | 982441 | 22 | 28 1 |
| 2 36 | 39 | 973874 | 975211 | 976510 | 977773 | 978999 | 980189 | 981342 | 982459 | 21 | 24 1 |
| 2 40 | 40 | 4·973897 | 4·975233 | 4·976532 | 4·977794 | 4·979019 | 4·980208 | 4·981361 | 4·982477 | 20 | 20 1 |
| 2 44 | 41 | 973920 | 975255 | 976553 | 977814 | 979039 | 980228 | 981380 | 982496 | 19 | 16 1 |
| 2 48 | 42 | 973942 | 975277 | 976574 | 977835 | 979059 | 980247 | 981399 | 982514 | 18 | 12 1 |
| 2 52 | 43 | 973965 | 975299 | 976596 | 977856 | 979079 | 980267 | 981417 | 982532 | 17 | 8 1 |
| 2 56 | 44 | 4·973987 | 4·975321 | 4·976617 | 4·977877 | 4·979100 | 4·980286 | 4·981436 | 4·982551 | 16 | 4 1 |
| 3 0 | 45 | 974010 | 975343 | 976638 | 977897 | 979120 | 980305 | 981455 | 982569 | 15 | 0 1 |
| 3 4 | 46 | 974032 | 975365 | 976660 | 977918 | 979140 | 980325 | 981474 | 982587 | 14 | 56 0 |
| 3 8 | 47 | 974055 | 975386 | 976681 | 977939 | 979160 | 980344 | 981493 | 982605 | 13 | 52 0 |
| 3 12 | 48 | 4·974077 | 4·975408 | 4·976702 | 4·977959 | 4·979180 | 4·980364 | 4·981512 | 4·982624 | 12 | 48 0 |
| 3 16 | 49 | 974100 | 975430 | 976723 | 977980 | 979200 | 980383 | 981530 | 982642 | 11 | 44 0 |
| 3 20 | 50 | 974122 | 975452 | 976745 | 978001 | 979220 | 980403 | 981549 | 982660 | 10 | 40 0 |
| 3 24 | 51 | 974145 | 975474 | 976766 | 978021 | 979240 | 980422 | 981568 | 982678 | 9 | 36 0 |
| 3 28 | 52 | 4·974167 | 4·975496 | 4·976787 | 4·978042 | 4·979260 | 4·980441 | 4·981587 | 4·982696 | 8 | 32 0 |
| 3 32 | 53 | 974190 | 975518 | 976808 | 978062 | 979280 | 980461 | 981606 | 982715 | 7 | 28 0 |
| 3 36 | 54 | 974212 | 975539 | 976830 | 978083 | 979300 | 980480 | 981624 | 982733 | 6 | 24 0 |
| 3 40 | 55 | 974235 | 975561 | 976851 | 978104 | 979320 | 980500 | 981643 | 982751 | 5 | 20 0 |
| 3 44 | 56 | 4·974257 | 4·975583 | 4·976872 | 4·978124 | 4·979340 | 4·980519 | 4·981662 | 4·982769 | 4 | 16 0 |
| 3 48 | 57 | 974279 | 975605 | 976893 | 978145 | 979360 | 980538 | 981681 | 982787 | 3 | 12 0 |
| 3 52 | 58 | 974302 | 975626 | 976914 | 978165 | 979380 | 980558 | 981699 | 982805 | 2 | 8 0 |
| 3 56 | 59 | 974324 | 975648 | 976935 | 978186 | 979400 | 980577 | 981718 | 982823 | 1 | 4 0 |
| 4 0 | 60 | 4·974347 | 4·975670 | 4·976957 | 4·978206 | 4·979419 | 4·980596 | 4·981737 | 4·982842 | 0 | 0 0 |
| m s Time | Arc. | 219° | 218° | 217° | 16° | 215° | 214° | 213° | 212° | Arc. | s m Time |
| | | 36m | 32m | 28m | 24m | 20m | 16m | 12m | 8m | | |

| Time m s | Arc. ′ | 52m | 56m | 10h 0m | 4m | 8m | 12m | 16m | 20m | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 148° | 149° | 150° | 151° | 152° | 153° | 154° | 155° | | |
| 0 0 | 0 | 4.982842 | 4.983910 | 4.984944 | 4.985942 | 4.986904 | 4.987831 | 4.988724 | 4.989581 | 60 | 0 4 |
| 0 4 | 1 | 982860 | 983928 | 984961 | 985958 | 986920 | 987847 | 988738 | 989595 | 59 | 56 3 |
| 0 8 | 2 | 982878 | 983945 | 984978 | 985974 | 986936 | 987862 | 988753 | 989609 | 58 | 52 3 |
| 0 12 | 3 | 982896 | 983963 | 984994 | 985991 | 986951 | 987877 | 988768 | 989623 | 57 | 48 3 |
| 0 16 | 4 | 4.982914 | 4.983980 | 4.985011 | 4.986007 | 4.986967 | 4.987892 | 4.988782 | 4.989637 | 56 | 44 3 |
| 0 20 | 5 | 982932 | 983998 | 985028 | 986023 | 986983 | 987907 | 988797 | 989651 | 55 | 40 3 |
| 0 24 | 6 | 982950 | 984015 | 985045 | 986039 | 986998 | 987922 | 988811 | 989665 | 54 | 36 3 |
| 0 28 | 7 | 982968 | 984033 | 985062 | 986056 | 987014 | 987937 | 988826 | 989679 | 53 | 32 3 |
| 0 32 | 8 | 4.982986 | 4.984050 | 4.985079 | 4.986072 | 4.987030 | 4.987952 | 4.988840 | 4.989693 | 52 | 28 3 |
| 0 36 | 9 | 983004 | 984068 | 985096 | 986088 | 987045 | 987968 | 988855 | 989707 | 51 | 24 3 |
| 0 40 | 10 | 983022 | 984085 | 985112 | 986104 | 987061 | 987983 | 988869 | 989721 | 50 | 20 3 |
| 0 44 | 11 | 983040 | 984103 | 985129 | 986121 | 987077 | 987998 | 988884 | 989735 | 49 | 16 3 |
| 0 48 | 12 | 4.983058 | 4.984120 | 4.985146 | 4.986137 | 4.987092 | 4.988013 | 4.988898 | 4.989749 | 48 | 12 3 |
| 0 52 | 13 | 983076 | 984137 | 985163 | 986153 | 987108 | 988028 | 988913 | 989763 | 47 | 8 3 |
| 0 56 | 14 | 983094 | 984155 | 985180 | 986169 | 987124 | 988043 | 988927 | 989777 | 46 | 4 3 |
| 1 0 | 15 | 983112 | 984172 | 985196 | 986185 | 987139 | 988058 | 988942 | 989790 | 45 | 0 3 |
| 1 4 | 16 | 4.983130 | 4.984189 | 4.985213 | 4.986202 | 4.987155 | 4.988073 | 4.988956 | 4.989804 | 44 | 56 2 |
| 1 8 | 17 | 983148 | 984207 | 985230 | 986218 | 987170 | 988088 | 988970 | 989818 | 43 | 52 2 |
| 1 12 | 18 | 983166 | 984224 | 985247 | 986234 | 987186 | 988103 | 988985 | 989832 | 42 | 48 2 |
| 1 16 | 19 | 983184 | 984242 | 985264 | 986250 | 987202 | 988118 | 988999 | 989846 | 41 | 44 2 |
| 1 20 | 20 | 4.983202 | 4.984259 | 4.985280 | 4.986266 | 4.987217 | 4.988133 | 4.989014 | 4.989860 | 40 | 40 2 |
| 1 24 | 21 | 983220 | 984276 | 985297 | 986282 | 987233 | 988148 | 989028 | 989873 | 39 | 36 2 |
| 1 28 | 22 | 983238 | 984293 | 985314 | 986299 | 987248 | 988163 | 989042 | 989887 | 38 | 32 2 |
| 1 32 | 23 | 983256 | 984311 | 985330 | 986315 | 987264 | 988178 | 989057 | 989901 | 37 | 28 2 |
| 1 36 | 24 | 4.983273 | 4.984328 | 4.985347 | 4.986331 | 4.987279 | 4.988193 | 4.989071 | 4.989915 | 36 | 24 2 |
| 1 40 | 25 | 983291 | 984345 | 985364 | 986347 | 987295 | 988208 | 989085 | 989929 | 35 | 20 2 |
| 1 44 | 26 | 983309 | 984363 | 985380 | 986363 | 987310 | 988222 | 989100 | 989942 | 34 | 16 2 |
| 1 48 | 27 | 983327 | 984380 | 985397 | 986379 | 987326 | 988237 | 989114 | 989956 | 33 | 12 2 |
| 1 52 | 28 | 4.983345 | 4.984397 | 4.985414 | 4.986395 | 4.987341 | 4.988252 | 4.989128 | 4.989970 | 32 | 8 2 |
| 1 56 | 29 | 983363 | 984414 | 985430 | 986411 | 987357 | 988267 | 989143 | 989984 | 31 | 4 2 |
| 2 0 | 30 | 983380 | 984432 | 985447 | 986427 | 987372 | 988282 | 989157 | 989997 | 30 | 0 2 |
| 2 4 | 31 | 983398 | 984449 | 985464 | 986443 | 987388 | 988297 | 989171 | 990011 | 29 | 56 1 |
| 2 8 | 32 | 4.983416 | 4.984466 | 4.985480 | 4.986459 | 4.987403 | 4.988312 | 4.989186 | 4.990025 | 28 | 52 1 |
| 2 12 | 33 | 983434 | 984483 | 985497 | 986475 | 987418 | 988327 | 989200 | 990038 | 27 | 48 1 |
| 2 16 | 34 | 983452 | 984500 | 985513 | 986491 | 987434 | 988341 | 989214 | 990052 | 26 | 44 1 |
| 2 20 | 35 | 983469 | 984518 | 985530 | 986507 | 987449 | 988356 | 989228 | 990066 | 25 | 40 1 |
| 2 24 | 36 | 4.983487 | 4.984535 | 4.985547 | 4.986523 | 4.987465 | 4.988371 | 4.989243 | 4.990079 | 24 | 36 1 |
| 2 28 | 37 | 983505 | 984552 | 985563 | 986539 | 987480 | 988386 | 989257 | 990093 | 23 | 32 1 |
| 2 32 | 38 | 983523 | 984569 | 985580 | 986555 | 987495 | 988401 | 989271 | 990107 | 22 | 28 1 |
| 2 36 | 39 | 983540 | 984586 | 985596 | 986571 | 987511 | 988416 | 989285 | 990120 | 21 | 24 1 |
| 2 40 | 40 | 4.983558 | 4.984603 | 4.985613 | 4.986587 | 4.987526 | 4.988430 | 4.989300 | 4.990134 | 20 | 20 1 |
| 2 44 | 41 | 983576 | 984620 | 985629 | 986603 | 987542 | 988445 | 989314 | 990148 | 19 | 16 1 |
| 2 48 | 42 | 983594 | 984637 | 985646 | 986619 | 987557 | 988460 | 989328 | 990161 | 18 | 12 1 |
| 2 52 | 43 | 983611 | 984655 | 985662 | 986635 | 987572 | 988475 | 989342 | 990175 | 17 | 8 1 |
| 2 56 | 44 | 4.983629 | 4.984672 | 4.985679 | 4.986651 | 4.987588 | 4.988489 | 4.989356 | 4.990188 | 16 | 4 1 |
| 3 0 | 45 | 983647 | 984689 | 985695 | 986667 | 987603 | 988504 | 989370 | 990202 | 15 | 0 1 |
| 3 4 | 46 | 983664 | 984706 | 985712 | 986683 | 987618 | 988519 | 989384 | 990215 | 14 | 56 0 |
| 3 8 | 47 | 983682 | 984723 | 985728 | 986699 | 987634 | 988533 | 989399 | 990229 | 13 | 52 0 |
| 3 12 | 48 | 4.983700 | 4.984740 | 4.985745 | 4.986714 | 4.987649 | 4.988548 | 4.989413 | 4.990243 | 12 | 48 0 |
| 3 16 | 49 | 983717 | 984757 | 985761 | 986730 | 987664 | 988563 | 989427 | 990256 | 11 | 44 0 |
| 3 20 | 50 | 983735 | 984774 | 985778 | 986746 | 987679 | 988578 | 989441 | 990270 | 10 | 40 0 |
| 3 24 | 51 | 983752 | 984791 | 985794 | 986762 | 987695 | 988592 | 989455 | 990283 | 9 | 36 0 |
| 3 28 | 52 | 4.983770 | 4.984808 | 4.985811 | 4.986778 | 4.987710 | 4.988607 | 4.989469 | 4.990297 | 8 | 32 0 |
| 3 32 | 53 | 983788 | 984825 | 985827 | 986794 | 987725 | 988622 | 989483 | 990310 | 7 | 28 0 |
| 3 36 | 54 | 983805 | 984842 | 985843 | 986809 | 987740 | 988636 | 989497 | 990324 | 6 | 24 0 |
| 3 40 | 55 | 983823 | 984859 | 985860 | 986825 | 987756 | 988651 | 989511 | 990337 | 5 | 20 0 |
| 3 44 | 56 | 4.983840 | 4.984876 | 4.985876 | 4.986841 | 4.987771 | 4.988665 | 4.989525 | 4.990351 | 4 | 16 0 |
| 3 48 | 57 | 983858 | 984893 | 985892 | 986857 | 987786 | 988680 | 989539 | 990364 | 3 | 12 0 |
| 3 52 | 58 | 983875 | 984910 | 985909 | 986873 | 987801 | 988695 | 989553 | 990377 | 2 | 8 0 |
| 3 56 | 59 | 983893 | 984927 | 985925 | 986888 | 987816 | 988709 | 989567 | 990391 | 1 | 4 0 |
| 4 0 | 60 | 4.983910 | 4.984944 | 4.985942 | 4.986904 | 4.987831 | 4.988724 | 4.989581 | 4.990404 | 0 | 0 0 |
| m s Time | Arc. | 211° | 210° | 209° | 208° | 207° | 206° | 205° | 204° | Arc. | s m Time |
| | | 4m | 0m 14s | 56m | 52m | 48m | 44m | 40m | 36m | | |

| Time m s | Arc. ′ | 24m 156° | 28m 157° | 32m 158° | 36m 159° | 40m 160° | 44m 161° | 48m 162° | 52m 163° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4.990404 | 4.991193 | 4.991947 | 4.992666 | 4.993351 | 4.994003 | 4.994620 | 4.995203 | 60 | 0 4 |
| 0 4 | 1 | 990418 | 991206 | 991959 | 992678 | 993363 | 994013 | 994630 | 995213 | 59 | 56 3 |
| 0 8 | 2 | 990431 | 991218 | 991971 | 992689 | 993374 | 994024 | 994640 | 995222 | 58 | 52 3 |
| 0 12 | 3 | 990445 | 991231 | 991983 | 992701 | 993385 | 994034 | 944650 | 995231 | 57 | 48 3 |
| 0 16 | 4 | 4.990458 | 4.991244 | 4.991996 | 4.992713 | 4.993396 | 4.994045 | 4.994660 | 4.995241 | 56 | 44 3 |
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| 0 32 | 8 | 4.990511 | 4.991295 | 4.992044 | 4.992759 | 4.993440 | 4.994087 | 4.994700 | 4.995278 | 52 | 28 3 |
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| 0 44 | 11 | 990551 | 991333 | 992081 | 992794 | 993473 | 994118 | 994729 | 995306 | 49 | 16 3 |
| 0 48 | 12 | 4.990565 | 4.991346 | 4.992093 | 4.992806 | 4.993484 | 4.994129 | 4.994739 | 4.995316 | 48 | 12 3 |
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| 1 4 | 16 | 4.990618 | 4.991397 | 4.992142 | 4.992852 | 4.993528 | 4.994171 | 4.994779 | 4.995353 | 44 | 56 2 |
| 1 8 | 17 | 990631 | 991410 | 992154 | 992864 | 993539 | 994181 | 994789 | 995362 | 43 | 52 2 |
| 1 12 | 18 | 990644 | 991422 | 992166 | 992875 | 993550 | 994191 | 994798 | 995372 | 42 | 48 2 |
| 1 16 | 19 | 990658 | 991435 | 992178 | 992887 | 993561 | 994202 | 994808 | 995381 | 41 | 44 2 |
| 1 20 | 20 | 4.990671 | 4.991448 | 4.992190 | 4.992898 | 4.993572 | 4.994212 | 4.994818 | 4.995390 | 40 | 40 2 |
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| 1 28 | 22 | 990697 | 991473 | 992214 | 992921 | 993594 | 994233 | 994838 | 995409 | 38 | 32 2 |
| 1 32 | 23 | 990711 | 991486 | 992226 | 992933 | 993605 | 994243 | 994847 | 995418 | 37 | 28 2 |
| 1 36 | 24 | 4.990724 | 4.991498 | 4.992238 | 4.992944 | 4.993616 | 4.994254 | 4.994857 | 4.995427 | 36 | 24 2 |
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| 1 44 | 26 | 990750 | 991524 | 992263 | 992967 | 993638 | 994274 | 994877 | 995445 | 34 | 16 2 |
| 1 48 | 27 | 990763 | 991536 | 992275 | 992979 | 993649 | 994285 | 994887 | 995455 | 33 | 12 2 |
| 1 52 | 28 | 4.990777 | 4.991549 | 4.992287 | 4.992990 | 4.993660 | 4.994295 | 4.994896 | 4.995464 | 32 | 8 2 |
| 1 56 | 29 | 990790 | 991561 | 992299 | 993002 | 993670 | 994305 | 994906 | 995473 | 31 | 4 2 |
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| 2 8 | 32 | 4.990829 | 4.991599 | 4.992335 | 4.993036 | 4.993703 | 4.994336 | 4.994935 | 4.995500 | 28 | 52 1 |
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| 2 44 | 41 | 990947 | 991712 | 992442 | 993138 | 993800 | 994428 | 995022 | 995582 | 19 | 16 1 |
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| 2 56 | 44 | 4.990986 | 4.991749 | 4.992478 | 4.993172 | 4.993832 | 4.994459 | 4.995051 | 4.995609 | 16 | 4 1 |
| 3 0 | 45 | 990999 | 991761 | 992489 | 993183 | 993843 | 994469 | 995061 | 995619 | 15 | 0 1 |
| 3 4 | 46 | 991012 | 991774 | 992501 | 993195 | 993854 | 994479 | 995070 | 995628 | 14 | 56 0 |
| 3 8 | 47 | 991025 | 991786 | 992513 | 993206 | 993864 | 994489 | 995080 | 995637 | 13 | 52 0 |
| 3 12 | 48 | 4.991038 | 4.991799 | 4.992525 | 4.993217 | 4.993875 | 4.994499 | 4.995089 | 4.995646 | 12 | 48 0 |
| 3 16 | 49 | 991051 | 991811 | 992537 | 993228 | 993886 | 994509 | 995099 | 995655 | 11 | 44 0 |
| 3 20 | 50 | 991064 | 991823 | 992549 | 993240 | 993896 | 994519 | 995108 | 995663 | 10 | 40 0 |
| 3 24 | 51 | 991077 | 991836 | 992560 | 993251 | 993907 | 994529 | 995118 | 995672 | 9 | 36 0 |
| 3 28 | 52 | 4.991090 | 4.991848 | 4.992572 | 4.993262 | 4.993918 | 4.994540 | 4.995127 | 4.995681 | 8 | 32 0 |
| 3 32 | 53 | 991102 | 991860 | 992584 | 993273 | 993928 | 994550 | 995137 | 995690 | 7 | 28 0 |
| 3 36 | 54 | 991115 | 991873 | 992596 | 993284 | 993939 | 994560 | 995146 | 995699 | 6 | 24 0 |
| 3 40 | 55 | 991128 | 991885 | 992607 | 993296 | 993950 | 994570 | 995156 | 995708 | 5 | 20 0 |
| 3 44 | 56 | 4.991141 | 4.991897 | 4.992619 | 4.993307 | 4.993960 | 4.994580 | 4.995165 | 4.995717 | 4 | 16 0 |
| 3 48 | 57 | 991154 | 991910 | 992631 | 993318 | 993971 | 994590 | 995175 | 995726 | 3 | 12 0 |
| 3 52 | 58 | 991167 | 991922 | 992643 | 993329 | 993981 | 994600 | 995184 | 995735 | 2 | 8 0 |
| 3 56 | 59 | 991180 | 991934 | 992654 | 993340 | 993992 | 994610 | 995194 | 995744 | 1 | 4 0 |
| 4 0 | 60 | 4.991193 | 4.991947 | 4.992666 | 4.993351 | 4.994003 | 4.994620 | 4.995203 | 4.995753 | 0 | 0 0 |
| m s Time | Arc. | 203° | 202° | 201° | 200° | 199° | 198° | 197° | 196° | Arc. | s m Time |
| | | 32m | 28m | 24m | 20m | 16m | 12m | 8m | 4m | | |

| Time m s | Arc. ′ | 10h 56m 164° | 11h 0m 165° | 4m 166° | 8m 167° | 12m 168° | 16m 169° | 20m 170° | 24m 171° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4·995753 | 4·996269 | 4·996751 | 4·997199 | 4·997614 | 4·997996 | 4·998344 | 4·998659 | 60 | 0 4 |
| 0 4 | 1 | 995762 | 996277 | 996758 | 997206 | 997621 | 998002 | 998350 | 998664 | 59 | 56 3 |
| 0 8 | 2 | 995770 | 996285 | 996766 | 997214 | 997628 | 998008 | 998355 | 998669 | 58 | 52 3 |
| 0 12 | 3 | 995779 | 996293 | 996774 | 997221 | 997634 | 998014 | 998361 | 998674 | 57 | 48 3 |
| 0 16 | 4 | 4·995788 | 4·996302 | 4·996781 | 4·997228 | 4·997641 | 4·998020 | 4·998366 | 4·998679 | 56 | 44 3 |
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| 0 24 | 6 | 995806 | 996318 | 996797 | 997242 | 997654 | 998032 | 998377 | 998689 | 54 | 36 3 |
| 0 28 | 7 | 995815 | 996326 | 996805 | 997249 | 997661 | 998038 | 998383 | 998694 | 53 | 32 3 |
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| 0 40 | 10 | 995841 | 996351 | 996828 | 997271 | 997680 | 998056 | 998399 | 998708 | 50 | 20 3 |
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| 0 48 | 12 | 4·995859 | 4·996368 | 4·996843 | 4·997285 | 4·997693 | 4·998068 | 4·998410 | 4·998718 | 48 | 12 3 |
| 0 52 | 13 | 995867 | 996376 | 996851 | 997292 | 997700 | 998074 | 998415 | 998723 | 47 | 8 3 |
| 0 56 | 14 | 995876 | 996384 | 996858 | 997299 | 997706 | 998080 | 998421 | 998728 | 46 | 4 3 |
| 1 0 | 15 | 995885 | 996392 | 996866 | 997306 | 997713 | 998086 | 998426 | 998733 | 45 | 0 3 |
| 1 4 | 16 | 4·995894 | 4·996400 | 4·996874 | 4·997313 | 4·997719 | 4·998092 | 4·998431 | 4·998737 | 44 | 56 2 |
| 1 8 | 17 | 995902 | 996409 | 996881 | 997320 | 997726 | 998098 | 998437 | 998742 | 43 | 52 2 |
| 1 12 | 18 | 995911 | 996417 | 996889 | 997327 | 997732 | 998104 | 998442 | 998747 | 42 | 48 2 |
| 1 16 | 19 | 995920 | 996425 | 996896 | 997334 | 997739 | 998110 | 998448 | 998752 | 41 | 44 2 |
| 1 20 | 20 | 4·995928 | 4·996433 | 4·996904 | 4·997341 | 4·997745 | 4·998116 | 4·998453 | 4·998757 | 40 | 40 2 |
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| 1 36 | 24 | 4·995963 | 4·996465 | 4·996934 | 4·997369 | 4·997771 | 4·998139 | 4·998474 | 4·998776 | 36 | 24 2 |
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| 1 52 | 28 | 4·995998 | 4·996498 | 4·996964 | 4·997397 | 4·997797 | 4·998163 | 4·998495 | 4·998795 | 32 | 8 2 |
| 1 56 | 29 | 996006 | 996506 | 996972 | 997404 | 997803 | 998168 | 998501 | 998799 | 31 | 4 2 |
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| 2 8 | 32 | 4·996032 | 4·996530 | 4·996994 | 4·997425 | 4·997822 | 4·998186 | 4·998516 | 4·998813 | 28 | 52 1 |
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| 2 16 | 34 | 996049 | 996546 | 997009 | 997439 | 997835 | 998197 | 998527 | 998823 | 26 | 44 1 |
| 2 20 | 35 | 996058 | 996554 | 997016 | 997445 | 997841 | 998203 | 998532 | 998827 | 25 | 40 1 |
| 2 24 | 36 | 4·996066 | 4·996562 | 4·997024 | 4·997452 | 4·997847 | 4·998209 | 4·998537 | 4·998832 | 24 | 36 1 |
| 2 28 | 37 | 996075 | 996570 | 997031 | 997459 | 997854 | 998215 | 998542 | 998837 | 23 | 32 1 |
| 2 32 | 38 | 996083 | 996578 | 997039 | 997466 | 997860 | 998220 | 998547 | 998841 | 22 | 28 1 |
| 2 36 | 39 | 996092 | 996586 | 997046 | 997473 | 997866 | 998226 | 998553 | 998846 | 21 | 24 1 |
| 2 40 | 40 | 4·996100 | 4·996594 | 4·947053 | 4·997480 | 4·997872 | 4·998232 | 4·998558 | 4·998851 | 20 | 20 1 |
| 2 44 | 41 | 996109 | 996602 | 997061 | 997486 | 997879 | 998238 | 998563 | 998855 | 19 | 16 1 |
| 2 48 | 42 | 996117 | 996610 | 997068 | 997493 | 997885 | 998243 | 998568 | 998860 | 18 | 12 1 |
| 2 52 | 43 | 996126 | 996617 | 997076 | 997500 | 997891 | 998249 | 998573 | 998864 | 17 | 8 1 |
| 2 56 | 44 | 4·996134 | 4·996625 | 4·997083 | 4·997507 | 4·997897 | 4·998255 | 4·998578 | 4·998869 | 16 | 4 1 |
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| 3 4 | 46 | 996151 | 996641 | 997098 | 997520 | 997910 | 998266 | 998589 | 998878 | 14 | 56 0 |
| 3 8 | 47 | 996160 | 996649 | 997105 | 997527 | 997916 | 998272 | 998594 | 998883 | 13 | 52 0 |
| 3 12 | 48 | 4·996168 | 4·996657 | 4·997112 | 4·997534 | 4·997922 | 4·998277 | 4·998599 | 4·998887 | 12 | 48 0 |
| 3 16 | 49 | 996176 | 996665 | 997120 | 997541 | 997928 | 998283 | 998604 | 998892 | 11 | 44 0 |
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| 3 24 | 51 | 996193 | 996680 | 997134 | 997554 | 997941 | 998294 | 998614 | 998901 | 9 | 36 0 |
| 3 28 | 52 | 4·996202 | 4·996688 | 4·997141 | 4·997561 | 4·997947 | 4·998300 | 4·998619 | 4·998905 | 8 | 32 0 |
| 3 32 | 53 | 996210 | 996696 | 997149 | 997568 | 997953 | 998305 | 998624 | 998910 | 7 | 28 0 |
| 3 36 | 54 | 996218 | 996704 | 997156 | 997574 | 997959 | 998311 | 998629 | 998914 | 6 | 24 0 |
| 3 40 | 55 | 996227 | 996712 | 997163 | 997581 | 997965 | 998316 | 998634 | 998919 | 5 | 20 0 |
| 3 44 | 56 | 4·996235 | 4·996720 | 4·997170 | 4·997588 | 4·997972 | 4·998322 | 4·998639 | 4·998923 | 4 | 16 0 |
| 3 48 | 57 | 996244 | 996727 | 997178 | 997594 | 997978 | 998328 | 998644 | 998927 | 3 | 12 0 |
| 3 52 | 58 | 996252 | 996735 | 997185 | 997601 | 997984 | 998333 | 998649 | 998932 | 2 | 8 0 |
| 3 56 | 59 | 996260 | 996743 | 997192 | 997608 | 997990 | 998339 | 998654 | 998936 | 1 | 4 0 |
| 4 0 | 60 | 4·996269 | 4·996751 | 4·997199 | 4·997614 | 4·997996 | 4·998344 | 4·998659 | 4·998941 | 0 | 0 0 |
| Time m s | Arc. | 195° | 194° | 193° | 192° | 191° | 190° | 189° | 188° | Arc. | s m Time |
| | | 0m 13h | 56m 12h | 52m | 48m | 44m | 40m | 36m | 32m | | |

| Time m s | Arc. ′ | 28m 172° | 32m 173° | 36m 174° | 40m 175° | 44m 176° | 48m 177° | 52m 178° | 56m 179° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4·998941 | 4·999189 | 4·999404 | 4·999586 | 4·999735 | 4·999851 | 4·999934 | 4·999983 | 60 | 0 4 |
| 0 4 | 1 | 998945 | 999193 | 999408 | 999589 | 999738 | 999853 | 999935 | 999984 | 59 | 56 3 |
| 0 8 | 2 | 998950 | 999197 | 999411 | 999592 | 999740 | 999854 | 999936 | 999984 | 58 | 52 3 |
| 0 12 | 3 | 998954 | 999201 | 999414 | 999595 | 999742 | 999856 | 999937 | 999985 | 57 | 48 3 |
| 0 16 | 4 | 4·998958 | 4·999205 | 4·999418 | 4·999597 | 4·999744 | 4·999858 | 4·999938 | 4·999986 | 56 | 44 3 |
| 0 20 | 5 | 998963 | 999208 | 999421 | 999600 | 999746 | 999859 | 999939 | 999986 | 55 | 40 3 |
| 0 24 | 6 | 998967 | 999212 | 999424 | 999603 | 999748 | 999861 | 999940 | 999987 | 54 | 36 3 |
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| 0 52 | 13 | 998997 | 999239 | 999447 | 999621 | 999763 | 999872 | 999947 | 999990 | 47 | 8 3 |
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| 1 0 | 15 | 999006 | 999246 | 999453 | 999627 | 999767 | 999875 | 999949 | 999991 | 45 | 0 3 |
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| 1 12 | 18 | 999019 | 999257 | 999462 | 999635 | 999774 | 999879 | 999952 | 999992 | 42 | 48 2 |
| 1 16 | 19 | 999023 | 999261 | 999466 | 999637 | 999776 | 999881 | 999953 | 999992 | 41 | 44 2 |
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| 1 28 | 22 | 999036 | 999272 | 999475 | 999645 | 999782 | 999885 | 999956 | 999993 | 38 | 32 2 |
| 1 32 | 23 | 999040 | 999276 | 999478 | 999647 | 999784 | 999887 | 999957 | 999994 | 37 | 28 2 |
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| 2 8 | 32 | 4·999077 | 4·999308 | 4·999506 | 4·999670 | 4·999801 | 4·999899 | 4·999964 | 4·999996 | 28 | 52 1 |
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| 2 40 | 40 | 4·999110 | 4·999336 | 4·999530 | 4·999689 | 4·999816 | 4·999910 | 4·999971 | 4·999998 | 20 | 20 1 |
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| 3 0 | 45 | 999130 | 999354 | 999544 | 999701 | 999825 | 999916 | 999974 | 999999 | 15 | 0 1 |
| 3 4 | 46 | 999134 | 999357 | 999547 | 999704 | 999827 | 999917 | 999975 | 999999 | 14 | 56 0 |
| 3 8 | 47 | 999138 | 999361 | 999550 | 999706 | 999829 | 999919 | 999975 | 999999 | 13 | 52 0 |
| 3 12 | 48 | 4·999142 | 4·999364 | 4·999553 | 4·999708 | 4·999831 | 4·999920 | 4·999976 | 4·999999 | 12 | 48 0 |
| 3 16 | 49 | 999146 | 999367 | 999556 | 999710 | 999832 | 999921 | 999977 | 5·000000 | 11 | 44 0 |
| 3 20 | 50 | 999150 | 999371 | 999558 | 999713 | 999834 | 999922 | 999977 | 5·000000 | 10 | 40 0 |
| 3 24 | 51 | 999154 | 999374 | 999561 | 999715 | 999836 | 999924 | 999978 | 5·000000 | 9 | 36 0 |
| 3 28 | 52 | 4·999158 | 4·999378 | 4·999564 | 4·999717 | 4·999838 | 4·999925 | 4·999979 | 5·000000 | 8 | 32 0 |
| 3 32 | 53 | 999162 | 999381 | 999567 | 999720 | 999839 | 999926 | 999979 | 5·000000 | 7 | 28 0 |
| 3 36 | 54 | 999166 | 999384 | 999570 | 999722 | 999841 | 999927 | 999980 | 5·000000 | 6 | 24 0 |
| 3 40 | 55 | 999170 | 999388 | 999572 | 999724 | 999843 | 999928 | 999981 | 5·000000 | 5 | 20 0 |
| 3 44 | 56 | 4·999174 | 4·999391 | 4·999575 | 4·999726 | 4·999844 | 4·999929 | 4·999981 | 5·000000 | 4 | 16 0 |
| 3 48 | 57 | 999178 | 999394 | 999578 | 999729 | 999846 | 999930 | 999982 | 5·000000 | 3 | 12 0 |
| 3 52 | 58 | 999181 | 999398 | 999581 | 999731 | 999848 | 999932 | 999982 | 5·000000 | 2 | 8 0 |
| 3 56 | 59 | 999185 | 999401 | 999584 | 999733 | 999849 | 999933 | 999983 | 5·000000 | 1 | 4 0 |
| 4 0 | 60 | 4·999189 | 4·999404 | 4·999586 | 4·999735 | 4·999851 | 4·999934 | 4·999983 | 5·000000 | 0 | 0 0 |
| m s Time | Arc. | 187° | 186° | 185° | 184° | 183° | 182° | 181° | 180° | Arc. | s m Time |
| | | 28m | 24m | 20m | 16m | 12m | 8m | 4m | 0m 12h | | |

# LOG. HAVERSINES.

| sec. | | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 deg. | | | | 1 deg. | | | | 2 deg. | | |
| | ′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 | 0.000000 | 4.677574 | 5.279632 | 5.631811 | 5.881684 | 6.075498 | 6.233852 | 6.367737 | 6.483711 | 6.586004 | 60 |
| 1 | 15 | 1.121274 | 691931 | 286840 | 636623 | 885295 | 078388 | 236262 | 369802 | 485518 | 587611 | 59 |
| 2 | 30 | 1.723332 | 706055 | 293989 | 641409 | 888892 | 081269 | 238664 | 371863 | 487322 | 589215 | 58 |
| 3 | 45 | 2.075516 | 719952 | 301079 | 646168 | 892473 | 084140 | 241060 | 373919 | 489122 | 590815 | 57 |
| | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 | 2.325392 | 4.733631 | 5.308113 | 5.650901 | 5.896041 | 6.087002 | 6.243450 | 6.375970 | 6.490918 | 6.592413 | 56 |
| 5 | 15 | 519212 | 747098 | 315089 | 655609 | 899593 | 089854 | 245832 | 378016 | 492711 | 594008 | 55 |
| 6 | 30 | 677575 | 760359 | 322010 | 660292 | 903131 | 092697 | 248209 | 380057 | 494500 | 595600 | 54 |
| 7 | 45 | 811470 | 773421 | 328876 | 664949 | 906654 | 095531 | 250579 | 382093 | 496285 | 597190 | 53 |
| | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 | 2.927452 | 4.786289 | 5.335689 | 5.669581 | 5.910164 | 6.098356 | 6.252942 | 6.384125 | 6.498066 | 6.598776 | 52 |
| 9 | 15 | 3.029759 | 798969 | 342448 | 674189 | 913659 | 101171 | 255299 | 386152 | 499844 | 600359 | |
| 10 | 30 | 121272 | 811467 | 349156 | 678773 | 917140 | 103977 | 257650 | 388174 | 501618 | 601940 | 50 |
| 11 | 45 | 204057 | 823788 | 355811 | 683332 | 920608 | 106774 | 259994 | 390191 | 503389 | 603517 | 49 |
| | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 | 3.279635 | 4.835936 | 5.362417 | 5.687868 | 5.924061 | 6.109563 | 6.262332 | 6.392204 | 6.505156 | 6.605092 | 48 |
| 13 | 15 | 349159 | 847917 | 368972 | 692380 | 927501 | 112342 | 264663 | 394212 | 506920 | 606664 | 47 |
| 14 | 30 | 413528 | 859735 | 375478 | 696869 | 930927 | 115113 | 266989 | 396216 | 508679 | 608235 | 46 |
| 15 | 45 | 473454 | 871393 | 381936 | 701334 | 934340 | 117874 | 269308 | 398215 | 510436 | 609799 | 45 |
| | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 | 3.529512 | 4.882898 | 5.388347 | 5.705777 | 5.937740 | 6.120627 | 6.271621 | 6.400209 | 6.512189 | 6.611363 | |
| 17 | 15 | 582170 | 894252 | 394710 | 710197 | 941126 | 123371 | 273923 | 402198 | 513938 | 612923 | 43 |
| 18 | 30 | 631817 | 905460 | 401027 | 714595 | 944499 | 126107 | 276229 | 404184 | 515683 | 614481 | 42 |
| 19 | 45 | 678780 | 916525 | 407298 | 718971 | 947859 | 128834 | 278523 | 406164 | 517426 | 616036 | 41 |
| | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 | 3.728332 | 4.927451 | 5.413525 | 5.723325 | 5.951206 | 6.131553 | 6.280812 | 6.408141 | 6.519164 | 6.617588 | 40 |
| 21 | 15 | 765711 | 938241 | 419707 | 727657 | 954540 | 134263 | 283094 | 410112 | 520900 | 619138 | 39 |
| 22 | 30 | 806118 | 948899 | 425845 | 731967 | 957862 | 136964 | 285371 | 412079 | 522631 | 620684 | 38 |
| 23 | 45 | 844728 | 959427 | 431940 | 736256 | 961170 | 139657 | 287642 | 414042 | 524360 | 622228 | 37 |
| | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 | 3.881695 | 4.969829 | 5.437993 | 5.740525 | 5.964467 | 6.142342 | 6.289906 | 6.416000 | 6.526085 | 6.623770 | 36 |
| 25 | 15 | 917152 | 980108 | 444004 | 744772 | 967750 | 145019 | 292165 | 417954 | 527806 | 625309 | 35 |
| 26 | 30 | 951419 | 990268 | 449974 | 748999 | 971022 | 147687 | 294418 | 419904 | 529524 | 626844 | 34 |
| 27 | 45 | 984000 | 5.000309 | 455903 | 753205 | 974281 | 150347 | 296665 | 421849 | 531239 | 628377 | 33 |
| | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 | 4.015588 | 5.010236 | 5.461791 | 5.757391 | 5.977528 | 6.152999 | 6.298907 | 6.423790 | 6.532950 | 6.629907 | 32 |
| 29 | 15 | 046068 | 020050 | 467640 | 761556 | 980763 | 155643 | 301142 | 425726 | 534658 | 631435 | 31 |
| 30 | 30 | 075515 | 029756 | 473450 | 765702 | 983986 | 158279 | 303372 | 427659 | 536363 | 632960 | 30 |
| 31 | 45 | 103996 | 039353 | 479222 | 769829 | 987197 | 160907 | 305596 | 429586 | 538064 | 634482 | 29 |
| | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 | 4.131572 | 5.048846 | 5.484955 | 5.773935 | 5.990396 | 6.163527 | 6.307815 | 6.431510 | 6.539762 | 6.636002 | 28 |
| 33 | 15 | 158300 | 058236 | 490650 | 778023 | 993583 | 166139 | 310028 | 433429 | 541457 | 637519 | 27 |
| 34 | 30 | 184230 | 067526 | 496309 | 782091 | 996759 | 168744 | 312235 | 435345 | 543148 | 639033 | 26 |
| 35 | 45 | 209408 | 076717 | 501931 | 786140 | 999923 | 171340 | 314437 | 437255 | 544836 | 640545 | 25 |
| | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 | 4.233877 | 5.085813 | 5.507517 | 5.790171 | 6.003076 | 6.173929 | 6.316633 | 6.439162 | 6.546521 | 6.642054 | 24 |
| 37 | 15 | 257675 | 094814 | 513067 | 794183 | 006247 | 176510 | 318823 | 441065 | 548202 | 643560 | 23 |
| 38 | 30 | 280839 | 103723 | 518582 | 798176 | 009347 | 179084 | 321008 | 442963 | 549880 | 645064 | 22 |
| 39 | 45 | 303401 | 112540 | 524062 | 802151 | 012466 | 181650 | 323187 | 444857 | 551555 | 646565 | 21 |
| | | 10′ | 25′ | 40′ | 56′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 | 4.325392 | 5.121270 | 5.529507 | 5.806108 | 6.015573 | 6.184208 | 6.325362 | 6.446747 | 6.553227 | 6.648064 | 20 |
| 41 | 15 | 846840 | 129913 | 534919 | 810047 | 018670 | 186759 | 327530 | 448633 | 554896 | 649560 | 19 |
| 42 | 30 | 367771 | 138471 | 540297 | 813969 | 021755 | 189302 | 329693 | 450515 | 556561 | 651053 | 18 |
| 43 | 45 | 388209 | 146944 | 545642 | 817872 | 024830 | 191838 | 331851 | 452393 | 558223 | 652544 | 17 |
| | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 | 4.408177 | 5.155337 | 5.550955 | 5.821759 | 6.027894 | 6.194366 | 6.334004 | 6.454267 | 6.559882 | 6.654033 | 16 |
| 45 | 15 | 427697 | 163648 | 556235 | 825628 | 030946 | 196888 | 336151 | 456137 | 561538 | 655519 | 15 |
| 46 | 30 | 446788 | 171882 | 561483 | 829479 | 033989 | 199402 | 338293 | 458003 | 563191 | 657002 | 14 |
| 47 | 45 | 465467 | 180037 | 566700 | 833314 | 037020 | 201908 | 340429 | 459864 | 564840 | 658482 | 13 |
| | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 | 4.483754 | 5.188118 | 5.571885 | 5.837132 | 6.040041 | 6.204408 | 6.342561 | 6.461722 | 6.566487 | 6.65996 | 12 |
| 49 | 15 | 501664 | 196123 | 577040 | 840933 | 043052 | 206900 | 344687 | 463576 | 568130 | 661436 | |
| 50 | 30 | 519212 | 204055 | 582165 | 844718 | 046052 | 209385 | 346808 | 465426 | 569770 | 662910 | 10 |
| 51 | 45 | 536412 | 211916 | 587259 | 848486 | 049042 | 211863 | 348923 | 467272 | 571407 | 664380 | 9 |
| | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 | 4.553278 | 5.219706 | 5.592323 | 5.852238 | 6.052022 | 6.214334 | 6.351034 | 6.469114 | 6.573041 | 6.665849 | 8 |
| 53 | 15 | 569823 | 227427 | 597359 | 855974 | 054991 | 216798 | 353140 | 470952 | 574672 | 667314 | 7 |
| 54 | 30 | 586059 | 235079 | 602366 | 859693 | 057950 | 219255 | 355240 | 472786 | 576300 | 668778 | 6 |
| 55 | 45 | 601997 | 242665 | 607342 | 863397 | 060900 | 221705 | 357335 | 474616 | 577925 | 670235 | 5 |
| | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 | 4.617648 | 5.250186 | 5.612292 | 5.867086 | 6.063839 | 6.224148 | 6.359426 | 6.476443 | 6.579547 | 6.671697 | 4 |
| 57 | 15 | 633021 | 257641 | 617213 | 870758 | 066768 | 226584 | 361511 | 478265 | 581166 | 673153 | 3 |
| 58 | 30 | 648128 | 265034 | 622106 | 874415 | 069688 | 229014 | 363591 | 480084 | 582781 | 674604 | 2 |
| 59 | 45 | 662975 | 272363 | 626972 | 878057 | 072597 | 231436 | 365667 | 481899 | 584394 | 676057 | 1 |
| 60 | 60 | 4.677574 | 5.279632 | 5.631811 | 5.881684 | 6.075498 | 6.233852 | 6.367737 | 6.483711 | 6.586004 | 6.677506 | 0 |
| sec. | | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

| Time m s | Arc. ′ | 20m 140° | 24m 141° | 28m 142° | 32m 143° | 36m 144° | 40m 145° | 44m 146° | 48m 147° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4·972986 | 4·974347 | 4·975670 | 4·976957 | 4·978206 | 4·979419 | 4·980596 | 4·981737 | 60 | 0 4 |
| 0 4 | 1 | 973009 | 974369 | 975692 | 976978 | 978227 | 979439 | 980616 | 981756 | 59 | 56 3 |
| 0 8 | 2 | 973032 | 974391 | 975713 | 976999 | 978247 | 979459 | 980635 | 981774 | 58 | 52 3 |
| 0 12 | 3 | 973055 | 974414 | 975735 | 977020 | 978268 | 979479 | 980654 | 981793 | 57 | 48 3 |
| 0 16 | 4 | 4·973078 | 4·974436 | 4·975757 | 4·977041 | 4·978288 | 4·979499 | 4·980673 | 4·981812 | 56 | 44 3 |
| 0 20 | 5 | 973101 | 974458 | 975779 | 977062 | 978309 | 979519 | 980693 | 981830 | 55 | 40 3 |
| 0 24 | 6 | 973124 | 974481 | 975800 | 977083 | 978329 | 979539 | 980712 | 981849 | 54 | 36 3 |
| 0 28 | 7 | 973146 | 974503 | 975822 | 977104 | 978350 | 979559 | 980731 | 981868 | 53 | 32 3 |
| 0 32 | 8 | 4·973169 | 4·974525 | 4·975844 | 4·977125 | 4·978370 | 4·979578 | 4·980750 | 4·981886 | 52 | 28 3 |
| 0 36 | 9 | 973192 | 974547 | 975865 | 977146 | 978391 | 979598 | 980770 | 981905 | 51 | 24 3 |
| 0 40 | 10 | 973215 | 974570 | 975887 | 977167 | 978411 | 979618 | 980789 | 981924 | 50 | 20 3 |
| 0 44 | 11 | 973238 | 974592 | 975909 | 977188 | 978431 | 979638 | 980808 | 981942 | 49 | 16 3 |
| 0 48 | 12 | 4·973261 | 4·974614 | 4·975930 | 4·977209 | 4·978452 | 4·979658 | 4·980827 | 4·981961 | 48 | 12 3 |
| 0 52 | 13 | 973284 | 974636 | 975952 | 977230 | 978472 | 979678 | 980846 | 981979 | 47 | 8 3 |
| 0 56 | 14 | 973307 | 974659 | 975974 | 977251 | 978493 | 979697 | 980866 | 981998 | 46 | 4 3 |
| 1 0 | 15 | 973329 | 974681 | 975995 | 977272 | 978513 | 979717 | 980885 | 982016 | 45 | 0 3 |
| 1 4 | 16 | 4·973352 | 4·974703 | 4·976017 | 4·977293 | 4·978533 | 4·979737 | 4·980904 | 4·982035 | 44 | 56 2 |
| 1 8 | 17 | 973375 | 974725 | 976038 | 977314 | 978554 | 979757 | 980923 | 982054 | 43 | 52 2 |
| 1 12 | 18 | 973398 | 974747 | 976060 | 977335 | 978574 | 979776 | 980942 | 982072 | 42 | 48 2 |
| 1 16 | 19 | 973421 | 974770 | 976081 | 977356 | 978594 | 979796 | 980961 | 982091 | 41 | 44 2 |
| 1 20 | 20 | 4·973443 | 4·974792 | 4·976103 | 4·977377 | 4·978615 | 4·979816 | 4·980980 | 4·982109 | 40 | 40 2 |
| 1 24 | 21 | 973466 | 974814 | 976124 | 977398 | 978635 | 979835 | 981000 | 982128 | 39 | 36 2 |
| 1 28 | 22 | 973489 | 974836 | 976146 | 977419 | 978655 | 979855 | 981019 | 982146 | 38 | 32 2 |
| 1 32 | 23 | 973512 | 974858 | 976168 | 977440 | 978676 | 979875 | 981038 | 982165 | 37 | 28 2 |
| 1 36 | 24 | 4·973535 | 4·974880 | 4·976189 | 4·977461 | 4·978696 | 4·979895 | 4·981057 | 4·982183 | 36 | 24 2 |
| 1 40 | 25 | 973557 | 974902 | 976211 | 977482 | 978716 | 979914 | 981076 | 982202 | 35 | 20 2 |
| 1 44 | 26 | 973580 | 974925 | 976232 | 977503 | 978736 | 979934 | 981095 | 982220 | 34 | 16 2 |
| 1 48 | 27 | 973603 | 974947 | 976254 | 977523 | 978757 | 979954 | 981114 | 982238 | 33 | 12 2 |
| 1 52 | 28 | 4·973625 | 4·974969 | 4·976275 | 4·977544 | 4·978777 | 4·979973 | 4·981133 | 4·982257 | 32 | 8 2 |
| 1 56 | 29 | 973648 | 974991 | 976296 | 977565 | 978797 | 979993 | 981152 | 982275 | 31 | 4 2 |
| 2 0 | 30 | 973671 | 975013 | 976318 | 977586 | 978817 | 980012 | 981171 | 982294 | 30 | 0 2 |
| 2 4 | 31 | 973693 | 975035 | 976339 | 977607 | 978838 | 980032 | 981190 | 982312 | 29 | 56 1 |
| 2 8 | 32 | 4·973716 | 4·975057 | 4·976361 | 4·977628 | 4·978858 | 4·980052 | 4·981209 | 4·982331 | 28 | 52 1 |
| 2 12 | 33 | 973739 | 975079 | 976382 | 977648 | 978878 | 980071 | 981228 | 982349 | 27 | 48 1 |
| 2 16 | 34 | 973761 | 975101 | 976404 | 977669 | 978898 | 980091 | 981247 | 982367 | 26 | 44 1 |
| 2 20 | 35 | 973784 | 975123 | 976425 | 977690 | 978918 | 980110 | 981266 | 982386 | 25 | 40 1 |
| 2 24 | 36 | 4·973807 | 4·975145 | 4·976446 | 4·977711 | 4·978939 | 4·980130 | 4·981285 | 4·982404 | 24 | 36 1 |
| 2 28 | 37 | 973829 | 975167 | 976468 | 977732 | 978959 | 980149 | 981304 | 982422 | 23 | 32 1 |
| 2 32 | 38 | 973852 | 975189 | 976489 | 977752 | 978979 | 980169 | 981323 | 982441 | 22 | 28 1 |
| 2 36 | 39 | 973874 | 975211 | 976510 | 977773 | 978999 | 980189 | 981342 | 982459 | 21 | 24 1 |
| 2 40 | 40 | 4·973897 | 4·975233 | 4·976532 | 4·977794 | 4·979019 | 4·980208 | 4·981361 | 4·982477 | 20 | 20 1 |
| 2 44 | 41 | 973920 | 975255 | 976553 | 977814 | 979039 | 980228 | 981380 | 982496 | 19 | 16 1 |
| 2 48 | 42 | 973942 | 975277 | 976574 | 977835 | 979059 | 980247 | 981399 | 982514 | 18 | 12 1 |
| 2 52 | 43 | 973965 | 975299 | 976596 | 977856 | 979079 | 980267 | 981417 | 982532 | 17 | 8 1 |
| 2 56 | 44 | 4·973987 | 4·975321 | 4·976617 | 4·977877 | 4·979100 | 4·980286 | 4·981436 | 4·982551 | 16 | 4 1 |
| 3 0 | 45 | 974010 | 975343 | 976638 | 977897 | 979120 | 980305 | 981455 | 982569 | 15 | 0 1 |
| 3 4 | 46 | 974032 | 975365 | 976660 | 977918 | 979140 | 980325 | 981474 | 982587 | 14 | 56 0 |
| 3 8 | 47 | 974055 | 975386 | 976681 | 977939 | 979160 | 980344 | 981493 | 982605 | 13 | 52 0 |
| 3 12 | 48 | 4·974077 | 4·975408 | 4·976702 | 4·977959 | 4·979180 | 4·980364 | 4·981512 | 4·982624 | 12 | 48 0 |
| 3 16 | 49 | 974100 | 975430 | 976723 | 977980 | 979200 | 980383 | 981530 | 982642 | 11 | 44 0 |
| 3 20 | 50 | 974122 | 975452 | 976745 | 978001 | 979220 | 980403 | 981549 | 982660 | 10 | 40 0 |
| 3 24 | 51 | 974145 | 975474 | 976766 | 978021 | 979240 | 980422 | 981568 | 982678 | 9 | 36 0 |
| 3 28 | 52 | 4·974167 | 4·975496 | 4·976787 | 4·978042 | 4·979260 | 4·980441 | 4·981587 | 4·982696 | 8 | 32 0 |
| 3 32 | 53 | 974190 | 975518 | 976808 | 978062 | 979280 | 980461 | 981606 | 982715 | 7 | 28 0 |
| 3 36 | 54 | 974212 | 975539 | 976830 | 978083 | 979300 | 980480 | 981624 | 982733 | 6 | 24 0 |
| 3 40 | 55 | 974235 | 975561 | 976851 | 978104 | 979320 | 980500 | 981643 | 982751 | 5 | 20 0 |
| 3 44 | 56 | 4·974257 | 4·975583 | 4·976872 | 4·978124 | 4·979340 | 4·980519 | 4·981662 | 4·982769 | 4 | 16 0 |
| 3 48 | 57 | 974279 | 975605 | 976893 | 978145 | 979360 | 980538 | 981681 | 982787 | 3 | 12 0 |
| 3 52 | 58 | 974302 | 975626 | 976914 | 978165 | 979380 | 980558 | 981699 | 982805 | 2 | 8 0 |
| 3 56 | 59 | 974324 | 975648 | 976935 | 978186 | 979400 | 980577 | 981718 | 982823 | 1 | 4 0 |
| 4 0 | 60 | 4·974347 | 4·975670 | 4·976957 | 4·978206 | 4·979419 | 4·980596 | 4·981737 | 4·982842 | 0 | 0 0 |
| m s Time | Arc. | 219° | 218° | 217° | 16° | 215° | 214° | 213° | 212° | Arc. | s m Time |
| | | 36m | 32m | 28m | 24m | 20m | 16m | 12m | 8m | | |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 deg. | | | | 6 deg. | | | | 7 deg. | | |
| | ′ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 7.279359 | 7.321709 | 7.362087 | 7.400666 | 7.437600 | 7.473024 | 7.507056 | 7.539800 | 7.571351 | 7.601791 | 60 |
| 1 | 15 280082 | 322398 | 362744 | 401294 | 438203 | 473602 | 507612 | 540335 | 571867 | 602290 | 59 |
| 2 | 30 280805 | 323086 | 363401 | 401923 | 438805 | 474180 | 508167 | 540870 | 572383 | 602788 | 58 |
| 3 | 45 281526 | 323774 | 364057 | 402550 | 439406 | 474758 | 508723 | 541405 | 572898 | 603285 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 7.282248 | 7.324461 | 7.364713 | 7.403178 | 7.440008 | 7.475335 | 7.509278 | 7.541939 | 7.573414 | 7.603783 | 56 |
| 5 | 15 282968 | 325147 | 365368 | 403805 | 440608 | 475912 | 509832 | 542474 | 573929 | 604280 | 55 |
| 6 | 30 283688 | 325833 | 366023 | 404431 | 441209 | 476488 | 510386 | 543007 | 574443 | 604777 | 54 |
| 7 | 45 284408 | 326518 | 366677 | 405057 | 441809 | 477064 | 510940 | 543541 | 574958 | 605274 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 7.285127 | 7.327203 | 7.367331 | 7.405682 | 7.442408 | 7.477640 | 7.511494 | 7.544074 | 7.575472 | 7.605770 | 52 |
| 9 | 15 285845 | 327887 | 367984 | 406307 | 443007 | 478215 | 512047 | 544606 | 575985 | 606266 | 51 |
| 10 | 30 286563 | 328571 | 368637 | 406932 | 443606 | 478790 | 512600 | 545139 | 576499 | 606762 | 50 |
| 11 | 45 287280 | 329254 | 369289 | 407556 | 444204 | 479364 | 513152 | 545671 | 577012 | 607258 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 7.287996 | 7.329937 | 7.369941 | 7.408180 | 7.444802 | 7.479938 | 7.513704 | 7.546203 | 7.577525 | 7.607753 | 48 |
| 13 | 15 288712 | 330619 | 370592 | 408803 | 445399 | 480512 | 514246 | 546734 | 578037 | 608248 | 47 |
| 14 | 30 289428 | 331300 | 371243 | 409426 | 445996 | 481085 | 514807 | 547265 | 578550 | 608743 | 46 |
| 15 | 45 290142 | 331981 | 371894 | 410048 | 446593 | 481658 | 515358 | 547796 | 579062 | 609237 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 7.290856 | 7.332662 | 7.372544 | 7.410670 | 7.447189 | 7.482231 | 7.515909 | 7.548327 | 7.579573 | 7.609731 | 44 |
| 17 | 15 291570 | 333342 | 373193 | 411291 | 447785 | 482803 | 516460 | 548857 | 580085 | 610225 | 43 |
| 18 | 30 292283 | 334021 | 373842 | 411913 | 448380 | 483375 | 517010 | 549386 | 580596 | 610718 | 42 |
| 19 | 45 292995 | 334700 | 374490 | 412533 | 448975 | 483946 | 517559 | 549916 | 581106 | 611212 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 7.293707 | 7.335379 | 7.375138 | 7.413153 | 7.449570 | 7.484517 | 7.518109 | 7.550445 | 7.581617 | 7.611705 | 40 |
| 21 | 15 294418 | 336056 | 375786 | 413773 | 450164 | 485088 | 518658 | 550974 | 582127 | 612197 | 39 |
| 22 | 30 295129 | 336734 | 376433 | 414392 | 450758 | 485658 | 519206 | 551502 | 582637 | 612690 | 38 |
| 23 | 45 295839 | 337410 | 377079 | 415011 | 451351 | 486228 | 519754 | 552031 | 583146 | 613182 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 7.296548 | 7.338087 | 7.377725 | 7.415629 | 7.451944 | 7.486798 | 7.520302 | 7.552559 | 7.583656 | 7.613674 | 36 |
| 25 | 15 297257 | 338762 | 378371 | 416247 | 452537 | 487367 | 520850 | 553086 | 584164 | 614165 | 35 |
| 26 | 30 297965 | 339438 | 379016 | 416865 | 453129 | 487936 | 521397 | 553613 | 584673 | 614657 | 34 |
| 27 | 45 298673 | 340112 | 379660 | 417481 | 453721 | 488504 | 521944 | 554140 | 585181 | 615148 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 7.299380 | 7.340786 | 7.380304 | 7.418098 | 7.454312 | 7.489072 | 7.522491 | 7.554667 | 7.585690 | 7.615638 | 32 |
| 29 | 15 300087 | 341460 | 380948 | 418714 | 454903 | 489640 | 523037 | 555193 | 586197 | 616129 | 31 |
| 30 | 30 300793 | 342133 | 381591 | 419330 | 455493 | 490207 | 523583 | 555719 | 586705 | 616619 | 30 |
| 31 | 45 301498 | 342806 | 382234 | 419945 | 456083 | 490774 | 524128 | 556245 | 587212 | 617109 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 7.302203 | 7.343478 | 7.382876 | 7.420560 | 7.456673 | 7.491341 | 7.524673 | 7.556770 | 7.587719 | 7.617599 | 28 |
| 33 | 15 302907 | 344149 | 383517 | 421174 | 457262 | 491907 | 525218 | 557295 | 588225 | 618088 | 27 |
| 34 | 30 303611 | 344820 | 384159 | 421788 | 457851 | 492473 | 525763 | 557820 | 588732 | 618577 | 26 |
| 35 | 45 304314 | 345491 | 384799 | 422402 | 458440 | 493038 | 526307 | 558344 | 589237 | 619066 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 7.305017 | 7.346161 | 7.385440 | 7.423015 | 7.459028 | 7.493603 | 7.526850 | 7.558868 | 7.589743 | 7.619554 | 24 |
| 37 | 15 305719 | 346830 | 386079 | 423628 | 459616 | 494168 | 527394 | 559392 | 590248 | 620043 | 23 |
| 38 | 30 306420 | 347499 | 386719 | 424240 | 460203 | 494732 | 527937 | 559915 | 590754 | 620531 | 22 |
| 39 | 45 307121 | 348168 | 387358 | 424852 | 460790 | 495296 | 528480 | 560438 | 591258 | 621019 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 7.307821 | 7.348835 | 7.387996 | 7.425463 | 7.461376 | 7.495860 | 7.529022 | 7.560961 | 7.591763 | 7.621506 | 20 |
| 41 | 15 308521 | 349503 | 388634 | 426074 | 461962 | 496423 | 529564 | 561483 | 592267 | 621993 | 19 |
| 42 | 30 309220 | 350170 | 389271 | 426684 | 462548 | 496986 | 530106 | 562006 | 592771 | 622480 | 18 |
| 43 | 45 309919 | 350836 | 389908 | 427294 | 463134 | 497548 | 530647 | 562527 | 593274 | 622966 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 7.310617 | 7.351502 | 7.390545 | 7.427904 | 7.463719 | 7.498111 | 7.531189 | 7.563049 | 7.593778 | 7.623453 | 16 |
| 45 | 15 311314 | 352167 | 391181 | 428513 | 464303 | 498672 | 531729 | 563570 | 594281 | 623939 | 15 |
| 46 | 30 312011 | 352832 | 391816 | 429122 | 464887 | 499234 | 532270 | 564091 | 594784 | 624425 | 14 |
| 47 | 45 312708 | 353496 | 392452 | 429730 | 465471 | 499795 | 532810 | 564611 | 595286 | 624910 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 7.313403 | 7.354160 | 7.393086 | 7.430338 | 7.466054 | 7.500355 | 7.533349 | 7.565132 | 7.595788 | 7.625395 | 12 |
| 49 | 15 314098 | 354824 | 393720 | 430946 | 466637 | 500916 | 533889 | 565652 | 596290 | 625880 | 11 |
| 50 | 30 314793 | 355486 | 394354 | 431553 | 467220 | 501476 | 534428 | 566171 | 596792 | 626365 | 10 |
| 51 | 45 315487 | 356149 | 394987 | 432160 | 467802 | 502035 | 534966 | 566691 | 597293 | 626849 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 7.316181 | 7.356810 | 7.395620 | 7.432766 | 7.468384 | 7.502595 | 7.535505 | 7.567210 | 7.597794 | 7.627334 | 8 |
| 53 | 15 316874 | 357472 | 396252 | 433372 | 468965 | 503153 | 536043 | 567728 | 598294 | 627817 | 7 |
| 54 | 30 317566 | 358133 | 396884 | 433977 | 469546 | 503712 | 536581 | 568247 | 598795 | 628301 | 6 |
| 55 | 45 318258 | 358793 | 397516 | 434582 | 470127 | 504270 | 537118 | 568765 | 599295 | 628784 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 7.318950 | 7.359453 | 7.398147 | 7.435186 | 7.470707 | 7.504828 | 7.537655 | 7.569283 | 7.599795 | 7.629267 | 4 |
| 57 | 15 319640 | 360112 | 398777 | 435790 | 471287 | 505385 | 538192 | 569800 | 600294 | 629750 | 3 |
| 58 | 30 320331 | 360771 | 399407 | 436394 | 471866 | 505943 | 538728 | 570317 | 600794 | 630233 | 2 |
| 59 | 45 321020 | 361429 | 400037 | 436997 | 472445 | 506499 | 539264 | 570834 | 601292 | 630715 | 1 |
| 60 | 60 7.321709 | 7.362087 | 7.400666 | 7.437600 | 7.473024 | 7.507056 | 7.539800 | 7.571351 | 7.601791 | 7.631197 | 0 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 deg. | | 8 deg. | | | | 9 deg. | | | | |
| sec. | ″ 30′ | 48′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | sec. |
| 0 | 0 7.631197 | 7.659636 | 7.687169 | 7.713852 | 7.739736 | 7.764867 | 7.789287 | 7.813035 | 7.836147 | 7.858656 | 60 |
| 1 | 15 631679 | 660102 | 687620 | 714290 | 740161 | 765279 | 789688 | 813425 | 836527 | 859026 | 59 |
| 2 | 30 632160 | 660568 | 688072 | 714728 | 740586 | 765692 | 790089 | 813815 | 836907 | 859396 | 58 |
| 3 | 45 632641 | 661034 | 688523 | 715165 | 741010 | 766104 | 790490 | 814205 | 837286 | 859766 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 7.633122 | 7.661499 | 7.688974 | 7.715602 | 7.741434 | 7.766516 | 7.790890 | 7.814595 | 7.837666 | 7.860136 | 56 |
| 5 | 15 633603 | 661964 | 689424 | 716039 | 741858 | 766928 | 791291 | 814985 | 838045 | 860505 | 55 |
| 6 | 30 634083 | 662429 | 689875 | 716476 | 742282 | 767340 | 791691 | 815374 | 838424 | 860875 | 54 |
| 7 | 45 634564 | 662894 | 690325 | 716912 | 742706 | 767751 | 792091 | 815763 | 838803 | 861244 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 7.635043 | 7.663358 | 7.690775 | 7.717348 | 7.743129 | 7.768163 | 7.792491 | 7.816152 | 7.839182 | 7.861613 | 52 |
| 9 | 15 635523 | 663822 | 691224 | 717784 | 743552 | 768574 | 792891 | 816541 | 839561 | 861982 | 51 |
| 10 | 30 636002 | 664286 | 691674 | 718220 | 743975 | 768985 | 793290 | 816930 | 839939 | 862351 | 50 |
| 11 | 45 636481 | 664750 | 692123 | 718656 | 744398 | 769396 | 793690 | 817318 | 840318 | 862719 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 7.636960 | 7.665213 | 7.692572 | 7.719091 | 7.744821 | 7.769806 | 7.794089 | 7.817707 | 7.840696 | 7.863088 | 48 |
| 13 | 15 637439 | 665676 | 693021 | 719526 | 745243 | 770216 | 794488 | 818095 | 841074 | 863456 | 47 |
| 14 | 30 637917 | 666139 | 693469 | 719961 | 745666 | 770627 | 794887 | 818483 | 841452 | 863824 | 46 |
| 15 | 45 638395 | 666602 | 693917 | 720396 | 746087 | 771037 | 795285 | 818871 | 841829 | 864192 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 7.638873 | 7.667064 | 7.694365 | 7.720831 | 7.746509 | 7.771446 | 7.795684 | 7.819259 | 7.842207 | 7.864560 | 44 |
| 17 | 15 639350 | 667526 | 694813 | 721265 | 746931 | 771856 | 796082 | 819646 | 842584 | 864928 | 43 |
| 18 | 30 639827 | 667988 | 695261 | 721699 | 747352 | 772265 | 796480 | 820034 | 842961 | 865295 | 42 |
| 19 | 45 640304 | 668450 | 695708 | 722133 | 747773 | 772675 | 796878 | 820421 | 843338 | 865663 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 7.640781 | 7.668911 | 7.696155 | 7.722567 | 7.748194 | 7.773084 | 7.797275 | 7.820808 | 7.843715 | 7.866030 | 40 |
| 21 | 15 641257 | 669372 | 696602 | 723000 | 748615 | 773492 | 797673 | 821195 | 844092 | 866397 | 39 |
| 22 | 30 641734 | 669833 | 697049 | 723433 | 749036 | 773901 | 798070 | 821581 | 844468 | 866764 | 38 |
| 23 | 45 642209 | 670294 | 697495 | 723866 | 749456 | 774309 | 798467 | 821968 | 844845 | 867131 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 7.642685 | 7.670755 | 7.697941 | 7.724299 | 7.749876 | 7.774718 | 7.798864 | 7.822354 | 7.845221 | 7.867497 | 36 |
| 25 | 15 643160 | 671215 | 698387 | 724731 | 750296 | 775126 | 799261 | 822740 | 845597 | 867864 | 35 |
| 26 | 30 643636 | 671675 | 698833 | 725164 | 750716 | 775534 | 799658 | 823126 | 845973 | 868230 | 34 |
| 27 | 45 644110 | 672134 | 699278 | 725596 | 751135 | 775941 | 800054 | 823512 | 846349 | 868596 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 7.644585 | 7.672594 | 7.699724 | 7.726028 | 7.751555 | 7.776349 | 7.800450 | 7.823897 | 7.846724 | 7.868962 | 32 |
| 29 | 15 645059 | 673053 | 700169 | 726459 | 751974 | 776756 | 800846 | 824283 | 847099 | 869328 | 31 |
| 30 | 30 645533 | 673512 | 700614 | 726891 | 752393 | 777163 | 801242 | 824668 | 847475 | 869694 | 30 |
| 31 | 45 646007 | 673971 | 701058 | 727322 | 752811 | 777570 | 801638 | 825053 | 847850 | 870059 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 7.646481 | 7.674429 | 7.701502 | 7.727753 | 7.753230 | 7.777977 | 7.802034 | 7.825438 | 7.848225 | 7.870424 | 28 |
| 33 | 15 646954 | 674887 | 701947 | 728184 | 753648 | 778383 | 802429 | 825823 | 848599 | 870790 | 27 |
| 34 | 30 647427 | 675346 | 702390 | 728615 | 754066 | 778789 | 802824 | 826207 | 848974 | 871155 | 26 |
| 35 | 45 647900 | 675803 | 702834 | 729045 | 754484 | 779195 | 803219 | 826592 | 849348 | 871520 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 7.648372 | 7.676261 | 7.703278 | 7.729475 | 7.754902 | 7.779601 | 7.803614 | 7.826976 | 7.849723 | 7.871884 | 24 |
| 37 | 15 648845 | 676718 | 703721 | 729905 | 755319 | 780007 | 804008 | 827360 | 850097 | 872249 | 23 |
| 38 | 30 649317 | 677175 | 704164 | 730335 | 755737 | 780413 | 804403 | 827744 | 850470 | 872613 | 22 |
| 39 | 45 649788 | 677632 | 704606 | 730765 | 756154 | 780818 | 804797 | 828128 | 850844 | 872978 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 7.650260 | 7.678088 | 7.705049 | 7.731194 | 7.756571 | 7.781223 | 7.805191 | 7.828511 | 7.851218 | 7.873342 | 20 |
| 41 | 15 650731 | 678545 | 705491 | 731623 | 756987 | 781628 | 805585 | 828895 | 851591 | 873706 | 19 |
| 42 | 30 651202 | 679001 | 705933 | 732052 | 757404 | 782033 | 805979 | 829278 | 851964 | 874070 | 18 |
| 43 | 45 651673 | 679457 | 706375 | 732481 | 757820 | 782437 | 806372 | 829661 | 852338 | 874433 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 7.652143 | 7.679912 | 7.706817 | 7.732909 | 7.758236 | 7.782842 | 7.806766 | 7.830044 | 7.852711 | 7.874797 | 16 |
| 45 | 15 652613 | 680367 | 707258 | 733337 | 758652 | 783246 | 807159 | 830426 | 853083 | 875160 | 15 |
| 46 | 30 653083 | 680823 | 707699 | 733765 | 759068 | 783650 | 807552 | 830809 | 853456 | 875523 | 14 |
| 47 | 45 653553 | 681277 | 708140 | 734193 | 759483 | 784054 | 807944 | 831191 | 853828 | 875886 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 7.654022 | 7.681732 | 7.708581 | 7.734621 | 7.759899 | 7.784458 | 7.808337 | 7.831574 | 7.854201 | 7.876249 | 12 |
| 49 | 15 654492 | 682186 | 709021 | 735048 | 760314 | 784861 | 808729 | 831956 | 854573 | 876612 | 11 |
| 50 | 30 654961 | 682641 | 709462 | 735475 | 760729 | 785264 | 809122 | 832338 | 854945 | 876975 | 10 |
| 51 | 45 655429 | 683095 | 709902 | 735902 | 761143 | 785667 | 809514 | 832719 | 855317 | 877337 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 7.655898 | 7.683548 | 7.710342 | 7.736329 | 7.761558 | 7.786070 | 7.809906 | 7.833101 | 7.855688 | 7.877699 | 8 |
| 53 | 15 656366 | 684002 | 710781 | 736756 | 761972 | 786473 | 810297 | 833482 | 856060 | 878061 | 7 |
| 54 | 30 656834 | 684455 | 711221 | 737182 | 762386 | 786875 | 810689 | 833863 | 856431 | 878423 | 6 |
| 55 | 45 657301 | 684908 | 711660 | 737608 | 762800 | 787278 | 811080 | 834244 | 856802 | 878785 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 7.657769 | 7.685361 | 7.712099 | 7.738034 | 7.763214 | 7.787680 | 7.811472 | 7.834625 | 7.857173 | 7.879147 | 4 |
| 57 | 15 658236 | 685813 | 712537 | 738460 | 763627 | 788082 | 811863 | 835006 | 857544 | 879505 | 3 |
| 58 | 30 658703 | 686265 | 712976 | 738886 | 764041 | 788484 | 812254 | 835386 | 857915 | 879870 | 2 |
| 59 | 45 659169 | 686717 | 713414 | 739311 | 764454 | 788885 | 812644 | 835767 | 858285 | 880231 | 1 |
| 60 | 60 7.659636 | 7.687169 | 7.713852 | 7.739736 | 7.764867 | 7.789287 | 7.813035 | 7.836147 | 7.858656 | 7.880592 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 10 deg. | | | | 11 deg. | | | | 12 deg. | |
| sec. | ′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 | 7.880592 | 7.901984 | 7.922858 | 7.943237 | 7.963146 | 7.982604 | 8.001632 | 8.020248 | 8.038469 | 8.056312 |
| 1 | 15 | 880953 | 902336 | 923201 | 943573 | 963474 | 982925 | 001945 | 020555 | 038770 | 056606 |
| 2 | 30 | 881314 | 902688 | 923545 | 943908 | 963801 | 983245 | 002259 | 020862 | 039070 | 056900 |
| 3 | 45 | 881674 | 903040 | 923888 | 944244 | 964129 | 983565 | 002572 | 021168 | 039370 | 057194 |
| | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 21′ | 46′ | 1′ | 16′ |
| 4 | 0 | 7.882035 | 7.903391 | 7.924231 | 7.944579 | 7.964457 | 7.983886 | 8.002886 | 8.021475 | 8.039670 | 8.057488 |
| 5 | 15 | 882395 | 903743 | 924574 | 944914 | 964784 | 984206 | 003199 | 021781 | 039970 | 057783 |
| 6 | 30 | 882755 | 904094 | 924917 | 945249 | 965111 | 984526 | 003512 | 022087 | 040270 | 058076 |
| 7 | 45 | 883115 | 904445 | 925260 | 945584 | 965439 | 984846 | 003825 | 022394 | 040570 | 058370 |
| | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ |
| 8 | 0 | 7.883475 | 7.904796 | 7.925603 | 7.945918 | 7.965766 | 7.985166 | 8.004137 | 8.022700 | 8.040870 | 8.058663 |
| 9 | 15 | 883835 | 905147 | 925945 | 946253 | 966093 | 985485 | 004450 | 023006 | 041169 | 058957 |
| 10 | 30 | 884194 | 905498 | 926288 | 946587 | 966420 | 985805 | 004763 | 023312 | 041469 | 059250 |
| 11 | 45 | 884554 | 905849 | 926630 | 946922 | 966746 | 986124 | 005075 | 023617 | 041768 | 059543 |
| | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 | 7.884913 | 7.906199 | 7.926972 | 7.947256 | 7.967073 | 7.986443 | 8.005388 | 8.023923 | 8.042067 | 8.059836 |
| 13 | 15 | 885272 | 906550 | 927314 | 947590 | 967399 | 986763 | 005700 | 024229 | 042367 | 060129 |
| 14 | 30 | 885631 | 906900 | 927656 | 947924 | 967726 | 987082 | 006012 | 024534 | 042666 | 060422 |
| 15 | 45 | 885990 | 907250 | 927998 | 948258 | 968052 | 987401 | 006324 | 024839 | 042965 | 060715 |
| | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 | 7.886349 | 7.907600 | 7.928339 | 7.948591 | 7.968378 | 7.987719 | 8.006636 | 8.025145 | 8.043264 | 8.061008 |
| 17 | 15 | 886707 | 907950 | 928681 | 948925 | 968704 | 988038 | 006947 | 025450 | 043562 | 061301 |
| 18 | 30 | 887066 | 908299 | 929022 | 949258 | 969030 | 988357 | 007259 | 025755 | 043861 | 061593 |
| 19 | 45 | 887424 | 908649 | 929363 | 949592 | 969355 | 988675 | 007571 | 026060 | 044160 | 061886 |
| | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 | 7.887782 | 7.908998 | 7.929705 | 7.949925 | 7.969681 | 7.988994 | 8.007892 | 8.026365 | 8.044458 | 8.062178 |
| 21 | 15 | 888140 | 909347 | 930045 | 950258 | 970006 | 989312 | 008193 | 026669 | 044756 | 062470 |
| 22 | 30 | 888497 | 909696 | 930386 | 950591 | 970332 | 989630 | 008505 | 026974 | 045055 | 062763 |
| 23 | 45 | 888855 | 910045 | 930727 | 950923 | 970657 | 989948 | 008816 | 027278 | 045353 | 063056 |
| | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 | 7.889213 | 7.910394 | 7.931067 | 7.951256 | 7.970982 | 7.990266 | 8.009127 | 8.027583 | 8.045651 | 8.063347 |
| 25 | 15 | 889570 | 910743 | 931408 | 951588 | 971307 | 990584 | 009438 | 027887 | 045949 | 063639 |
| 26 | 30 | 889927 | 911091 | 931748 | 951921 | 971632 | 990901 | 009748 | 028191 | 046247 | 063930 |
| 27 | 45 | 890284 | 911440 | 932088 | 952253 | 971956 | 991219 | 010059 | 028495 | 046544 | 064222 |
| | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 | 7.890641 | 7.911788 | 7.932428 | 7.952585 | 7.972281 | 7.991536 | 8.010370 | 8.028799 | 8.046842 | 8.064513 |
| 29 | 15 | 890998 | 912136 | 932768 | 952917 | 972606 | 991853 | 010680 | 029103 | 047139 | 064805 |
| 30 | 30 | 891354 | 912484 | 933108 | 953249 | 972930 | 992171 | 010990 | 029407 | 047437 | 065096 |
| 31 | 45 | 891711 | 912832 | 933447 | 953581 | 973254 | 992488 | 011300 | 029710 | 047734 | 065387 |
| | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 | 7.892067 | 7.913179 | 7.933787 | 7.953912 | 7.973578 | 7.992805 | 8.011611 | 8.030014 | 8.048031 | 8.065678 |
| 33 | 15 | 892423 | 913527 | 934126 | 954244 | 973902 | 993122 | 011920 | 030317 | 048329 | 065970 |
| 34 | 30 | 892779 | 913874 | 934465 | 954575 | 974226 | 993438 | 012230 | 030621 | 048626 | 066261 |
| 35 | 45 | 893135 | 914222 | 934804 | 954906 | 974550 | 993755 | 012540 | 030924 | 048922 | 066552 |
| | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ |
| 36 | 0 | 7.893491 | 7.914569 | 7.935143 | 7.955238 | 7.974873 | 7.994071 | 8.012850 | 8.031227 | 8.049219 | 8.066842 |
| 37 | 15 | 893846 | 914916 | 935482 | 955568 | 975197 | 994388 | 013159 | 031530 | 049516 | 067133 |
| 38 | 30 | 894202 | 915262 | 935821 | 955899 | 975520 | 994704 | 013469 | 031833 | 049813 | 067424 |
| 39 | 45 | 894557 | 915609 | 936159 | 956230 | 975844 | 995020 | 013778 | 032136 | 050109 | 067714 |
| | | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ |
| 40 | 0 | 7.894912 | 7.915956 | 7.936497 | 7.956561 | 7.976167 | 7.995336 | 8.014087 | 8.032438 | 8.050405 | 8.068004 |
| 41 | 15 | 895267 | 916302 | 936836 | 956891 | 976490 | 995652 | 014396 | 032741 | 050702 | 068293 |
| 42 | 30 | 895622 | 916648 | 937174 | 957221 | 976813 | 995968 | 014705 | 033043 | 050998 | 068585 |
| 43 | 45 | 895977 | 916994 | 937512 | 957552 | 977135 | 996283 | 015014 | 033346 | 051294 | 068875 |
| | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 | 7.896331 | 7.917341 | 7.937850 | 7.957882 | 7.977458 | 7.996599 | 8.015323 | 8.033648 | 8.051590 | 8.069165 |
| 45 | 15 | 896685 | 917686 | 938187 | 958212 | 977780 | 996914 | 015632 | 033950 | 051886 | 069455 |
| 46 | 30 | 897040 | 918032 | 938525 | 958541 | 978103 | 997230 | 015940 | 034252 | 052182 | 069743 |
| 47 | 45 | 897394 | 918378 | 938862 | 958871 | 978425 | 997545 | 016248 | 034554 | 052477 | 070034 |
| | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 | 7.897748 | 7.918723 | 7.939200 | 7.959201 | 7.978747 | 7.997860 | 8.016557 | 8.034856 | 8.052773 | 8.070324 |
| 49 | 15 | 898102 | 919068 | 939537 | 959530 | 979069 | 998175 | 016865 | 035157 | 053068 | 070613 |
| 50 | 30 | 898455 | 919414 | 939874 | 959859 | 979391 | 998490 | 017173 | 035459 | 053364 | 070903 |
| 51 | 45 | 898809 | 919759 | 940211 | 960189 | 979713 | 998804 | 017481 | 035760 | 053659 | 071193 |
| | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 | 7.899162 | 7.920103 | 7.940548 | 7.960518 | 7.980035 | 7.999119 | 8.017789 | 8.036062 | 8.053954 | 8.071451 |
| 53 | 15 | 899515 | 920448 | 940884 | 960847 | 980356 | 999434 | 018097 | 036363 | 054249 | 071770 |
| 54 | 30 | 899868 | 920793 | 941221 | 961175 | 980678 | 999748 | 018404 | 036664 | 054544 | 072059 |
| 55 | 45 | 900221 | 921137 | 941557 | 961504 | 980999 | 8.000062 | 018712 | 036965 | 054839 | 072348 |
| | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 | 7.900574 | 7.921482 | 7.941894 | 7.961833 | 7.981320 | 8.000376 | 8.019019 | 8.037266 | 8.055134 | 8.072637 |
| 57 | 15 | 900927 | 921826 | 942230 | 962161 | 981642 | 000690 | 019327 | 037567 | 055428 | 072926 |
| 58 | 30 | 901279 | 922170 | 942566 | 962489 | 981962 | 001004 | 019634 | 037868 | 055723 | 073215 |
| 59 | 45 | 901632 | 922514 | 942902 | 962818 | 982283 | 001318 | 019941 | 038169 | 056018 | 073503 |
| 60 | 60 | 7.901984 | 7.922858 | 7.943237 | 7.963146 | 7.982604 | 8.001632 | 8.020248 | 8.038469 | 8.056312 | 8.073792 |
| sec. | | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m |

| Time m s | Arc. ′ | 28m 172° | 32m 173° | 36m 174° | 40m 175° | 44m 176° | 48m 177° | 52m 178° | 56m 179° | Arc. ′ | Time s m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 0 | 0 | 4·998941 | 4·999189 | 4·999404 | 4·999586 | 4·999735 | 4·999851 | 4·999934 | 4·999983 | 60 | 0 4 |
| 0 4 | 1 | 998945 | 999193 | 999408 | 999589 | 999738 | 999853 | 999935 | 999984 | 59 | 56 3 |
| 0 8 | 2 | 998950 | 999197 | 999411 | 999592 | 999740 | 999854 | 999936 | 999984 | 58 | 52 3 |
| 0 12 | 3 | 998954 | 999201 | 999414 | 999595 | 999742 | 999856 | 999937 | 999985 | 57 | 48 3 |
| 0 16 | 4 | 4·998958 | 4·999205 | 4·999418 | 4·999597 | 4·999744 | 4·999858 | 4·999938 | 4·999986 | 56 | 44 3 |
| 0 20 | 5 | 998963 | 999208 | 999421 | 999600 | 999746 | 999859 | 999939 | 999986 | 55 | 40 3 |
| 0 24 | 6 | 998967 | 999212 | 999424 | 999603 | 999748 | 999861 | 999940 | 999987 | 54 | 36 3 |
| 0 28 | 7 | 998971 | 999216 | 999427 | 999605 | 999751 | 999862 | 999941 | 999987 | 53 | 32 3 |
| 0 32 | 8 | 4·998976 | 4·999220 | 4·999431 | 4·999608 | 4·999753 | 4·999864 | 4·999942 | 4·999988 | 52 | 28 3 |
| 0 36 | 9 | 998980 | 999224 | 999434 | 999611 | 999755 | 999866 | 999943 | 999988 | 51 | 24 3 |
| 0 40 | 10 | 998984 | 999227 | 999437 | 999614 | 999757 | 999867 | 999944 | 999988 | 50 | 20 3 |
| 0 44 | 11 | 998989 | 999231 | 999440 | 999616 | 999759 | 999869 | 999945 | 999989 | 49 | 16 3 |
| 0 48 | 12 | 4·998993 | 4·999235 | 4·999443 | 4·999619 | 4·999761 | 4·999870 | 4·999946 | 4·999989 | 48 | 12 3 |
| 0 52 | 13 | 998997 | 999239 | 999447 | 999621 | 999763 | 999872 | 999947 | 999990 | 47 | 8 3 |
| 0 56 | 14 | 999002 | 999242 | 999450 | 999624 | 999765 | 999873 | 999948 | 999990 | 46 | 4 3 |
| 1 0 | 15 | 999006 | 999246 | 999453 | 999627 | 999767 | 999875 | 999949 | 999991 | 45 | 0 3 |
| 1 4 | 16 | 4·999010 | 4·999250 | 4·999456 | 4·999629 | 4·999769 | 4·999876 | 4·999950 | 4·999991 | 44 | 56 2 |
| 1 8 | 17 | 999014 | 999253 | 999459 | 999632 | 999771 | 999878 | 999951 | 999991 | 43 | 52 2 |
| 1 12 | 18 | 999019 | 999257 | 999462 | 999635 | 999774 | 999879 | 999952 | 999992 | 42 | 48 2 |
| 1 16 | 19 | 999023 | 999261 | 999466 | 999637 | 999776 | 999881 | 999953 | 999992 | 41 | 44 2 |
| 1 20 | 20 | 4·999027 | 4·999265 | 4·999469 | 4·999640 | 4·999778 | 4·999882 | 4·999954 | 4·999993 | 40 | 40 2 |
| 1 24 | 21 | 999031 | 999268 | 999472 | 999642 | 999780 | 999884 | 999955 | 999993 | 39 | 36 2 |
| 1 28 | 22 | 999036 | 999272 | 999475 | 999645 | 999782 | 999885 | 999956 | 999993 | 38 | 32 2 |
| 1 32 | 23 | 999040 | 999276 | 999478 | 999647 | 999784 | 999887 | 999957 | 999994 | 37 | 28 2 |
| 1 36 | 24 | 4·999044 | 4·999279 | 4·999481 | 4·999650 | 4·999786 | 4·999888 | 4·999958 | 4·999994 | 36 | 24 2 |
| 1 40 | 25 | 999048 | 999283 | 999484 | 999652 | 999788 | 999890 | 999958 | 999994 | 35 | 20 2 |
| 1 44 | 26 | 999052 | 999286 | 999487 | 999655 | 999790 | 999891 | 999959 | 999995 | 34 | 16 2 |
| 1 48 | 27 | 999057 | 999290 | 999490 | 999658 | 999792 | 999892 | 999960 | 999995 | 33 | 12 2 |
| 1 52 | 28 | 4·999061 | 4·999294 | 4·999493 | 4·999660 | 4·999793 | 4·999894 | 4·999961 | 4·999995 | 32 | 8 2 |
| 1 56 | 29 | 999065 | 999297 | 999496 | 999663 | 999795 | 999895 | 999962 | 999996 | 31 | 4 2 |
| 2 0 | 30 | 999069 | 999301 | 999500 | 999665 | 999797 | 999897 | 999963 | 999996 | 30 | 0 2 |
| 2 4 | 31 | 999073 | 999304 | 999503 | 999667 | 999799 | 999898 | 999964 | 999996 | 29 | 56 1 |
| 2 8 | 32 | 4·999077 | 4·999308 | 4·999506 | 4·999670 | 4·999801 | 4·999899 | 4·999964 | 4·999996 | 28 | 52 1 |
| 2 12 | 33 | 999081 | 999312 | 999509 | 999672 | 999803 | 999901 | 999965 | 999996 | 27 | 48 1 |
| 2 16 | 34 | 999086 | 999315 | 999512 | 999675 | 999805 | 999902 | 999966 | 999996 | 26 | 44 1 |
| 2 20 | 35 | 999090 | 999319 | 999515 | 999677 | 999807 | 999903 | 999967 | 999996 | 25 | 40 1 |
| 2 24 | 36 | 4·999094 | 4·999322 | 4·999518 | 4·999680 | 4·999809 | 4·999905 | 4·999968 | 4·999997 | 24 | 36 1 |
| 2 28 | 37 | 999098 | 999326 | 999521 | 999682 | 999811 | 999906 | 999968 | 999997 | 23 | 32 1 |
| 2 32 | 38 | 999102 | 999329 | 999524 | 999685 | 999812 | 999907 | 999969 | 999997 | 22 | 28 1 |
| 2 36 | 39 | 999106 | 999333 | 999526 | 999687 | 999814 | 999909 | 999970 | 999998 | 21 | 24 1 |
| 2 40 | 40 | 4·999110 | 4·999336 | 4·999530 | 4·999689 | 4·999816 | 4·999910 | 4·999971 | 4·999998 | 20 | 20 1 |
| 2 44 | 41 | 999114 | 999340 | 999532 | 999692 | 999818 | 999911 | 999971 | 999998 | 19 | 16 1 |
| 2 48 | 42 | 999118 | 999343 | 999535 | 999694 | 999820 | 999912 | 999972 | 999998 | 18 | 12 1 |
| 2 52 | 43 | 999122 | 999347 | 999538 | 999696 | 999822 | 999914 | 999973 | 999999 | 17 | 8 1 |
| 2 56 | 44 | 4·999126 | 4·999350 | 4·999541 | 4·999699 | 4·999823 | 4·999915 | 4·999973 | 4·999999 | 16 | 4 1 |
| 3 0 | 45 | 999130 | 999354 | 999544 | 999701 | 999825 | 999916 | 999974 | 999999 | 15 | 0 1 |
| 3 4 | 46 | 999134 | 999357 | 999547 | 999704 | 999827 | 999917 | 999975 | 999999 | 14 | 56 0 |
| 3 8 | 47 | 999138 | 999361 | 999550 | 999706 | 999829 | 999919 | 999975 | 999999 | 13 | 52 0 |
| 3 12 | 48 | 4·999142 | 4·999364 | 4·999553 | 4·999708 | 4·999831 | 4·999920 | 4·999976 | 4·999999 | 12 | 48 0 |
| 3 16 | 49 | 999146 | 999367 | 999556 | 999710 | 999832 | 999921 | 999977 | 5·000000 | 11 | 44 0 |
| 3 20 | 50 | 999150 | 999371 | 999558 | 999713 | 999834 | 999922 | 999977 | 5·000000 | 10 | 40 0 |
| 3 24 | 51 | 999154 | 999374 | 999561 | 999715 | 999836 | 999924 | 999978 | 5·000000 | 9 | 36 0 |
| 3 28 | 52 | 4·999158 | 4·999378 | 4·999564 | 4·999717 | 4·999838 | 4·999925 | 4·999979 | 5·000000 | 8 | 32 0 |
| 3 32 | 53 | 999162 | 999381 | 999567 | 999720 | 999839 | 999926 | 999979 | 5·000000 | 7 | 28 0 |
| 3 36 | 54 | 999166 | 999384 | 999570 | 999722 | 999841 | 999927 | 999980 | 5·000000 | 6 | 24 0 |
| 3 40 | 55 | 999170 | 999388 | 999572 | 999724 | 999843 | 999928 | 999981 | 5·000000 | 5 | 20 0 |
| 3 44 | 56 | 4·999174 | 4·999391 | 4·999575 | 4·999726 | 4·999844 | 4·999929 | 4·999981 | 5·000000 | 4 | 16 0 |
| 3 48 | 57 | 999178 | 999394 | 999578 | 999729 | 999846 | 999930 | 999982 | 5·000000 | 3 | 12 0 |
| 3 52 | 58 | 999181 | 999398 | 999581 | 999731 | 999848 | 999932 | 999982 | 5·000000 | 2 | 8 0 |
| 3 56 | 59 | 999185 | 999401 | 999584 | 999733 | 999849 | 999933 | 999983 | 5·000000 | 1 | 4 0 |
| 4 0 | 60 | 4·999189 | 4·999404 | 4·999586 | 4·999735 | 4·999851 | 4·999934 | 4·999983 | 5·000000 | 0 | 0 0 |
| m s Time | Arc. | 187° | 186° | 185° | 184° | 183° | 182° | 181° | 180° | Arc. | s m Time |
| | | 28m | 24m | 20m | 16m | 12m | 8m | 4m | 0m 12h | | |

| sec. | | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 15 deg. | | | | 16 deg. | | | | 17 deg. | | |
| | " | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 | 8.231395 | 8.245669 | 8.259708 | 8.273519 | 8.287111 | 8.300488 | 8.313659 | 8.326629 | 8.339404 | 8.351990 | |
| 1 | 15 | 231635 | 245905 | 259940 | 273748 | 287335 | 300710 | 313877 | 326844 | 339615 | 352198 | |
| 2 | 30 | 231875 | 246141 | 260172 | 273976 | 287560 | 300931 | 314095 | 327058 | 339827 | 352406 | |
| 3 | 45 | 232115 | 246376 | 260404 | 274204 | 287784 | 301152 | 314312 | 327272 | 340038 | 352614 | |
| | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 | 8.232354 | 8.246612 | 8.260636 | 8.274432 | 8.288009 | 8.301373 | 8.314530 | 8.327487 | 8.340249 | 8.352822 | |
| 5 | 15 | 232594 | 246848 | 260867 | 274660 | 288233 | 301594 | 314747 | 327701 | 340460 | 353031 | |
| 6 | 30 | 232833 | 247083 | 261099 | 274888 | 288458 | 301815 | 314965 | 327915 | 340671 | 353238 | |
| 7 | 45 | 233073 | 247319 | 261331 | 275116 | 288682 | 302035 | 315182 | 328129 | 340882 | 353446 | |
| | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 | 8.233312 | 8.247554 | 8.261562 | 8.275344 | 8.288906 | 8.302256 | 8.315400 | 8.328344 | 8.341093 | 8.353654 | |
| 9 | 15 | 233552 | 247790 | 261794 | 275572 | 289131 | 302477 | 315617 | 328558 | 341304 | 353862 | |
| 10 | 30 | 233791 | 248025 | 262025 | 275800 | 289355 | 302698 | 315835 | 328772 | 341515 | 354070 | |
| 11 | 45 | 234030 | 248260 | 262257 | 276027 | 289579 | 302918 | 316052 | 328986 | 341726 | 354277 | |
| | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 | 8.234269 | 8.248495 | 8.262488 | 8.276255 | 8.289803 | 8.303139 | 8.316269 | 8.329200 | 8.341936 | 8.354485 | |
| 13 | 15 | 234508 | 248730 | 262719 | 276483 | 290027 | 303359 | 316486 | 329413 | 342147 | 354694 | |
| 14 | 30 | 234747 | 248965 | 262951 | 276710 | 290251 | 303580 | 316703 | 329627 | 342358 | 354900 | |
| 15 | 45 | 234986 | 249200 | 263182 | 276938 | 290475 | 303800 | 316920 | 329841 | 342568 | 355107 | |
| | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 | 8.235225 | 8.249435 | 8.263413 | 8.277165 | 8.290699 | 8.304021 | 8.317137 | 8.330055 | 8.342779 | 8.355315 | |
| 17 | 15 | 235464 | 249670 | 263644 | 277392 | 290922 | 304241 | 317354 | 330268 | 342989 | 355522 | |
| 18 | 30 | 235703 | 249905 | 263875 | 277620 | 291146 | 304461 | 317571 | 330482 | 343200 | 355730 | |
| 19 | 45 | 235941 | 250140 | 264106 | 277847 | 291370 | 304681 | 317788 | 330695 | 343410 | 355937 | |
| | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 | 8.236180 | 8.250374 | 8.264337 | 8.278074 | 8.291593 | 8.304901 | 8.318004 | 8.330909 | 8.343620 | 8.356144 | |
| 21 | 15 | 236418 | 250609 | 264567 | 278301 | 291817 | 305121 | 318221 | 331122 | 343830 | 356351 | |
| 22 | 30 | 236657 | 250843 | 264798 | 278528 | 292040 | 305341 | 318438 | 331336 | 344041 | 356558 | |
| 23 | 45 | 236895 | 251078 | 265029 | 278755 | 292264 | 305561 | 318654 | 331549 | 344251 | 356766 | |
| | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 | 8.237133 | 8.251312 | 8.265259 | 8.278982 | 8.292487 | 8.305781 | 8.318871 | 8.331762 | 8.344461 | 8.356973 | |
| 25 | 15 | 237372 | 251547 | 265490 | 279209 | 292716 | 306001 | 319087 | 331975 | 344671 | 357180 | |
| 26 | 30 | 237610 | 251781 | 265720 | 279436 | 292933 | 306221 | 319304 | 332189 | 344881 | 357386 | |
| 27 | 45 | 237848 | 252015 | 265951 | 279662 | 293157 | 306440 | 319520 | 332402 | 345091 | 357593 | |
| | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 | 8.238086 | 8.252249 | 8.266181 | 8.279889 | 8.293380 | 8.306660 | 8.319736 | 8.332615 | 8.345301 | 8.357800 | |
| 29 | 15 | 238324 | 252483 | 266411 | 280115 | 293603 | 306880 | 319953 | 332828 | 345511 | 358007 | |
| 30 | 30 | 238562 | 252717 | 266642 | 280342 | 293826 | 307099 | 320169 | 333041 | 345720 | 358214 | |
| 31 | 45 | 238800 | 252951 | 266872 | 280568 | 294049 | 307319 | 320385 | 333254 | 345930 | 358420 | |
| | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 | 8.239038 | 8.253185 | 8.267102 | 8.280795 | 8.294272 | 8.307538 | 8.320601 | 8.333466 | 8.346140 | 8.358627 | |
| 33 | 15 | 239275 | 253419 | 267332 | 281021 | 294494 | 307757 | 320817 | 333679 | 346349 | 358833 | |
| 34 | 30 | 239513 | 253653 | 267562 | 281248 | 294717 | 307977 | 321033 | 333892 | 346559 | 359040 | |
| 35 | 45 | 239751 | 253886 | 267792 | 281474 | 294940 | 308196 | 321249 | 334105 | 346769 | 359246 | |
| | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 | 8.239988 | 8.254120 | 8.268022 | 8.281700 | 8.295162 | 8.308415 | 8.321465 | 8.334317 | 8.346978 | 8.359453 | |
| 37 | 15 | 240226 | 254354 | 268251 | 281926 | 295385 | 308634 | 321681 | 334530 | 347187 | 359659 | |
| 38 | 30 | 240463 | 254587 | 268481 | 282152 | 295608 | 308853 | 321896 | 334742 | 347397 | 359866 | |
| 39 | 45 | 240700 | 254820 | 268711 | 282378 | 295830 | 309073 | 322112 | 334955 | 347606 | 360072 | |
| | | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 | 8.240938 | 8.255054 | 8.268940 | 8.282604 | 8.296052 | 8.309291 | 8.322328 | 8.335167 | 8.347815 | 8.360278 | |
| 41 | 15 | 241175 | 255287 | 269170 | 282830 | 296275 | 309510 | 322543 | 335379 | 348025 | 360484 | |
| 42 | 30 | 241412 | 255520 | 269399 | 283056 | 296497 | 309729 | 322759 | 335592 | 348234 | 360690 | |
| 43 | 45 | 241649 | 255754 | 269629 | 283282 | 296719 | 309948 | 322974 | 335804 | 348443 | 360896 | |
| | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 | 8.241886 | 8.255987 | 8.269858 | 8.283507 | 8.296941 | 8.310167 | 8.323190 | 8.336016 | 8.348652 | 8.361102 | |
| 45 | 15 | 242123 | 256220 | 270087 | 283733 | 297164 | 310385 | 323405 | 336228 | 348861 | 361308 | |
| 46 | 30 | 242360 | 256453 | 270317 | 283959 | 297386 | 310604 | 323620 | 336440 | 349070 | 361514 | |
| 47 | 45 | 242597 | 256686 | 270546 | 284184 | 297608 | 310823 | 323836 | 336652 | 349279 | 361720 | |
| | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 | 8.242833 | 8.256919 | 8.270775 | 8.284416 | 8.297830 | 8.311041 | 8.324051 | 8.336864 | 8.349488 | 8.361926 | |
| 49 | 15 | 243070 | 257151 | 271004 | 284635 | 298051 | 311260 | 324266 | 337076 | 349696 | 362132 | |
| 50 | 30 | 243307 | 257384 | 271233 | 284860 | 298273 | 311478 | 324481 | 337288 | 349905 | 362338 | |
| 51 | 45 | 243543 | 257617 | 271462 | 285086 | 298495 | 311696 | 324696 | 337500 | 350114 | 362543 | |
| | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 | 8.243780 | 8.257849 | 8.271691 | 8.285311 | 8.298717 | 8.311915 | 8.324911 | 8.337712 | 8.350323 | 8.362749 | |
| 53 | 15 | 244016 | 258082 | 271919 | 285536 | 298938 | 312133 | 325126 | 337924 | 350531 | 362954 | |
| 54 | 30 | 244252 | 258314 | 272148 | 285761 | 299160 | 312351 | 325341 | 338135 | 350740 | 363160 | |
| 55 | 45 | 244489 | 258547 | 272377 | 285986 | 299382 | 312569 | 325556 | 338347 | 350948 | 363365 | |
| | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 | 8.244725 | 8.258779 | 8.272606 | 8.286211 | 8.299603 | 8.312787 | 8.325771 | 8.338558 | 8.351157 | 8.363571 | |
| 57 | 15 | 244961 | 259011 | 272834 | 286436 | 299824 | 313005 | 325985 | 338770 | 351365 | 363776 | |
| 58 | 30 | 245197 | 259244 | 273063 | 286661 | 300046 | 313223 | 326200 | 338981 | 351573 | 363981 | |
| 59 | 45 | 245433 | 259476 | 273291 | 286886 | 300267 | 313441 | 326414 | 339193 | 351782 | 364187 | |
| 60 | 60 | 8.245669 | 8.259708 | 8.273519 | 8.287111 | 8.300488 | 8.313659 | 8.326629 | 8.339404 | 8.351990 | 8.364392 | |
| sec. | | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

# LOG. HAVERSINES.

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 deg. | | | | 1 deg. | | | | 2 deg. | | |
| " | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 0.000000 | 4.677574 | 5.279632 | 5.631811 | 5.881684 | 6.075498 | 6.233852 | 6.367737 | 6.483711 | 6.586004 | 60 |
| 1 | 15 1.121274 | 691931 | 286840 | 636623 | 885295 | 078388 | 236262 | 369802 | 485518 | 587611 | 59 |
| 2 | 30 1.723332 | 706055 | 293989 | 641409 | 888892 | 081269 | 238664 | 371863 | 487322 | 589215 | 58 |
| 3 | 45 2.075516 | 719952 | 301079 | 646168 | 892473 | 084140 | 241060 | 373919 | 489122 | 590815 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 2.325392 | 4.733631 | 5.308113 | 5.650901 | 5.896041 | 6.087002 | 6.243450 | 6.375970 | 6.490918 | 6.592413 | 56 |
| 5 | 15 519212 | 747098 | 315089 | 655609 | 899593 | 089854 | 245832 | 378016 | 492711 | 594008 | 55 |
| 6 | 30 677575 | 760359 | 322010 | 660292 | 903131 | 092697 | 248209 | 380057 | 494500 | 595600 | 54 |
| 7 | 45 811470 | 773421 | 328876 | 664949 | 906654 | 095531 | 250579 | 382093 | 496285 | 597190 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 2.927452 | 4.786289 | 5.335689 | 5.669581 | 5.910164 | 6.098356 | 6.252942 | 6.384125 | 6.498066 | 6.598776 | 52 |
| 9 | 15 3.029759 | 798969 | 342448 | 674189 | 913659 | 101171 | 255299 | 386152 | 499844 | 600359 | 51 |
| 10 | 30 121272 | 811467 | 349156 | 678773 | 917140 | 103977 | 257650 | 388174 | 501618 | 601940 | 50 |
| 11 | 45 204057 | 823788 | 355811 | 683332 | 920608 | 106774 | 259994 | 390191 | 503389 | 603517 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 3.279635 | 4.835936 | 5.362417 | 5.687868 | 5.924061 | 6.109563 | 6.262332 | 6.392204 | 6.505156 | 6.605092 | 48 |
| 13 | 15 349159 | 847917 | 368972 | 692880 | 927501 | 112342 | 264663 | 394212 | 506920 | 606664 | 47 |
| 14 | 30 413528 | 859735 | 375478 | 696869 | 930927 | 115113 | 266989 | 396216 | 508679 | 608233 | 46 |
| 15 | 45 473454 | 871393 | 381936 | 701834 | 934340 | 117874 | 269308 | 398215 | 510436 | 609799 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 3.529512 | 4.882898 | 5.388347 | 5.705777 | 5.937740 | 6.120627 | 6.271621 | 6.400209 | 6.512189 | 6.611363 | 44 |
| 17 | 15 582170 | 894252 | 394710 | 710197 | 941126 | 123371 | 273928 | 402198 | 513938 | 612923 | 43 |
| 18 | 30 631817 | 905460 | 401027 | 714595 | 944499 | 126107 | 276229 | 404184 | 515683 | 614481 | 42 |
| 19 | 45 678780 | 916525 | 407298 | 718971 | 947859 | 128834 | 278523 | 406164 | 517426 | 616036 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 3.723332 | 4.927451 | 5.413525 | 5.723325 | 5.951206 | 6.131553 | 6.280812 | 6.408141 | 6.519164 | 6.617588 | 40 |
| 21 | 15 765711 | 938241 | 419707 | 727657 | 954540 | 134263 | 283094 | 410112 | 520900 | 619138 | 39 |
| 22 | 30 806118 | 948899 | 425845 | 731967 | 957862 | 136964 | 285371 | 412079 | 522631 | 620684 | 38 |
| 23 | 45 844728 | 959427 | 431940 | 736256 | 961170 | 139657 | 287642 | 414042 | 524360 | 622228 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 3.881695 | 4.969829 | 5.437993 | 5.740525 | 5.964467 | 6.142342 | 6.289906 | 6.416000 | 6.526085 | 6.623770 | 36 |
| 25 | 15 917152 | 980108 | 444004 | 744772 | 967750 | 145019 | 292165 | 417954 | 527806 | 625308 | 35 |
| 26 | 30 951419 | 990268 | 449974 | 748999 | 971022 | 147687 | 294418 | 419904 | 529524 | 626844 | 34 |
| 27 | 45 984000 | 5.000309 | 455903 | 753205 | 974281 | 150347 | 296665 | 421849 | 531239 | 628377 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 4.015588 | 5.010236 | 5.461791 | 5.757391 | 5.977528 | 6.152999 | 6.298907 | 6.423790 | 6.532950 | 6.629907 | 32 |
| 29 | 15 046068 | 020050 | 467640 | 761556 | 980763 | 155643 | 301142 | 425726 | 534658 | 631435 | 31 |
| 30 | 30 075515 | 029756 | 473450 | 765702 | 983986 | 158279 | 303372 | 427659 | 536363 | 632960 | 30 |
| 31 | 45 103996 | 039353 | 479222 | 769829 | 987197 | 160907 | 305596 | 429586 | 538064 | 634482 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 4.131572 | 5.048846 | 5.484955 | 5.773935 | 5.990396 | 6.163527 | 6.307815 | 6.431510 | 6.539762 | 6.636002 | 28 |
| 33 | 15 158300 | 058236 | 490650 | 778023 | 993583 | 166139 | 310028 | 433429 | 541457 | 637519 | 27 |
| 34 | 30 184230 | 067526 | 496309 | 782091 | 996759 | 168744 | 312235 | 435345 | 543148 | 639033 | 26 |
| 35 | 45 209408 | 076717 | 501931 | 786140 | 999923 | 171340 | 314437 | 437255 | 544836 | 640545 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 4.233877 | 5.085813 | 5.507517 | 5.790171 | 6.003076 | 6.173929 | 6.316633 | 6.439162 | 6.546521 | 6.642054 | 24 |
| 37 | 15 257675 | 094814 | 513067 | 794183 | 006217 | 176510 | 318823 | 441065 | 548202 | 643560 | 23 |
| 38 | 30 280839 | 103723 | 518582 | 798176 | 009347 | 179084 | 321008 | 442963 | 549880 | 645064 | 22 |
| 39 | 45 303401 | 112540 | 524062 | 802151 | 012466 | 181650 | 323187 | 444857 | 551555 | 646565 | 21 |
| | 10′ | 25′ | 40′ | 56′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 4.325392 | 5.121270 | 5.529507 | 5.806108 | 6.015573 | 6.184208 | 6.325362 | 6.446747 | 6.553227 | 6.648064 | 20 |
| 41 | 15 346840 | 129913 | 534919 | 810047 | 018670 | 186759 | 327530 | 448633 | 554896 | 649560 | 19 |
| 42 | 30 367771 | 138471 | 540297 | 813969 | 021755 | 189302 | 329693 | 450515 | 556561 | 651053 | 18 |
| 43 | 45 388209 | 146944 | 545642 | 817872 | 024830 | 191838 | 331851 | 452393 | 558223 | 652544 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 4.408177 | 5.155337 | 5.550955 | 5.821759 | 6.027894 | 6.194366 | 6.334004 | 6.454267 | 6.559882 | 6.654033 | 16 |
| 45 | 15 427697 | 163648 | 556235 | 825628 | 030946 | 196888 | 336151 | 456137 | 561538 | 655518 | 15 |
| 46 | 30 446788 | 171882 | 561483 | 829479 | 033989 | 199402 | 338293 | 458003 | 563191 | 657002 | 14 |
| 47 | 45 465467 | 180037 | 566700 | 833314 | 037020 | 201908 | 340429 | 459864 | 564840 | 658482 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 4.483754 | 5.188118 | 5.571885 | 5.837132 | 6.040041 | 6.204408 | 6.342561 | 6.461722 | 6.566487 | 6.659961 | 12 |
| 49 | 15 501664 | 196123 | 577040 | 840933 | 043052 | 206900 | 344687 | 463576 | 568130 | 661436 | 11 |
| 50 | 30 519212 | 204055 | 582165 | 844718 | 046052 | 209385 | 346808 | 465426 | 569770 | 662910 | 10 |
| 51 | 45 536412 | 211916 | 587259 | 848486 | 049042 | 211863 | 348923 | 467272 | 571407 | 664380 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 4.553278 | 5.219706 | 5.592323 | 5.852238 | 6.052022 | 6.214334 | 6.351034 | 6.469114 | 6.573041 | 6.665849 | 8 |
| 53 | 15 569823 | 227427 | 597359 | 855974 | 054991 | 216798 | 353140 | 470952 | 574672 | 667314 | 7 |
| 54 | 30 586059 | 235079 | 602365 | 859693 | 057950 | 219255 | 355240 | 472786 | 576300 | 668778 | 6 |
| 55 | 45 601997 | 242665 | 607342 | 863397 | 060900 | 221705 | 357335 | 474616 | 577925 | 670238 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 4.617648 | 5.250186 | 5.612292 | 5.867086 | 6.063839 | 6.224148 | 6.359426 | 6.476443 | 6.579547 | 6.671697 | 4 |
| 57 | 15 633021 | 257641 | 617213 | 870758 | 066768 | 226584 | 361511 | 478265 | 581166 | 673153 | 3 |
| 58 | 30 648128 | 265034 | 622106 | 874415 | 069688 | 229014 | 363591 | 480084 | 582781 | 674606 | 2 |
| 59 | 45 662975 | 272363 | 626972 | 878057 | 072597 | 231436 | 365667 | 481899 | 584394 | 676057 | 1 |
| 60 | 60 4.677574 | 5.279632 | 5.631811 | 5.881684 | 6.075498 | 6.233852 | 6.367737 | 6.483711 | 6.586004 | 6.677506 | 0 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

| | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 deg. | | 23 deg. | | | | 24 deg. | | | | |
| sec. | ′ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | sec. |
| 0 | 0 8.580471 | 8.589944 | 8.599311 | 8.608573 | 8.617734 | 8.626795 | 8.635758 | 8.644625 | 8.653399 | 8.662081 | 60 |
| 1 | 15 580630 | 590101 | 599466 | 608727 | 617885 | 626945 | 635906 | 644772 | 653545 | 662225 | 59 |
| 2 | 30 580789 | 590258 | 599621 | 608880 | 618037 | 627095 | 636055 | 644919 | 653690 | 662369 | 58 |
| 3 | 45 580948 | 590415 | 599776 | 609033 | 618189 | 627245 | 636203 | 645066 | 653836 | 662513 | 57 |
| | 31′ 46′ | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 8.581106 | 8.590572 | 8.599931 | 8.609187 | 8.618341 | 8.627395 | 8.636352 | 8.645213 | 8.653981 | 8.662657 | 56 |
| 5 | 15 581265 | 590729 | 600086 | 609340 | 618492 | 627545 | 636500 | 645360 | 654126 | 662801 | 55 |
| 6 | 30 581424 | 590886 | 600242 | 609494 | 618644 | 627695 | 636649 | 645507 | 654272 | 662945 | 54 |
| 7 | 45 581582 | 591042 | 600396 | 609647 | 618796 | 627845 | 636797 | 645654 | 654417 | 663088 | 53 |
| | 32′ 47′ | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 8.581741 | 8.591199 | 8.600552 | 8.609800 | 8.618947 | 8.627993 | 8.636946 | 8.645801 | 8.654562 | 8.663232 | 52 |
| 9 | 15 581899 | 591356 | 600706 | 609954 | 619099 | 628145 | 637094 | 645947 | 654707 | 663376 | 51 |
| 10 | 30 582058 | 591513 | 600862 | 610107 | 619251 | 628295 | 637242 | 646094 | 654853 | 663520 | 50 |
| 11 | 45 582216 | 591669 | 601016 | 610260 | 619402 | 628445 | 637391 | 646241 | 654998 | 663663 | 49 |
| | 33′ 48′ | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 8.582375 | 8.591826 | 8.601171 | 8.610413 | 8.619554 | 8.628595 | 8.637539 | 8.646388 | 8.655143 | 8.663807 | 48 |
| 13 | 15 582533 | 591982 | 601326 | 610566 | 619705 | 628745 | 637687 | 646534 | 655288 | 663951 | 47 |
| 14 | 30 582691 | 592139 | 601481 | 610720 | 619857 | 628895 | 637835 | 646681 | 655433 | 664094 | 46 |
| 15 | 45 582850 | 592296 | 601636 | 610873 | 620008 | 629044 | 637984 | 646828 | 655578 | 664238 | 45 |
| | 34′ 49′ | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 8.583008 | 8.592452 | 8.601791 | 8.611026 | 8.620160 | 8.629194 | 8.638132 | 8.646974 | 8.655723 | 8.664381 | 44 |
| 17 | 15 583166 | 592609 | 601945 | 611179 | 620311 | 629344 | 638280 | 647121 | 655868 | 664525 | 43 |
| 18 | 30 583325 | 592765 | 602100 | 611332 | 620462 | 629494 | 638428 | 647267 | 656014 | 664668 | 42 |
| 19 | 45 583483 | 592922 | 602255 | 611485 | 620614 | 629643 | 638576 | 647414 | 656158 | 664812 | 41 |
| | 35′ 50′ | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 8.583641 | 8.593078 | 8.602410 | 8.611638 | 8.620765 | 8.629793 | 8.638724 | 8.647560 | 8.656304 | 8.664955 | 40 |
| 21 | 15 583799 | 593234 | 602564 | 611791 | 620916 | 629943 | 638872 | 647707 | 656448 | 665099 | 39 |
| 22 | 30 583957 | 593391 | 602719 | 611944 | 621067 | 630092 | 639020 | 647853 | 656593 | 665242 | 38 |
| 23 | 45 584115 | 593547 | 602873 | 612097 | 621219 | 630242 | 639168 | 648000 | 656738 | 665386 | 37 |
| | 36′ 51′ | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 8.584273 | 8.593703 | 8.603028 | 8.612249 | 8.621370 | 8.630391 | 8.639316 | 8.648146 | 8.656883 | 8.665529 | 36 |
| 25 | 15 584431 | 593860 | 603182 | 612402 | 621521 | 630541 | 639464 | 648292 | 657028 | 665672 | 35 |
| 26 | 30 584589 | 594016 | 603337 | 612555 | 621672 | 630691 | 639612 | 648439 | 657173 | 665816 | 34 |
| 27 | 45 584747 | 594172 | 603491 | 612708 | 621823 | 630840 | 639760 | 648585 | 657317 | 665959 | 33 |
| | 37′ 52′ | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 8.584905 | 8.594328 | 8.603646 | 8.612861 | 8.621974 | 8.630989 | 8.639908 | 8.648731 | 8.657462 | 8.666102 | 32 |
| 29 | 15 585063 | 594484 | 603800 | 613013 | 622125 | 631139 | 640056 | 648878 | 657607 | 666245 | 31 |
| 30 | 30 585221 | 594641 | 603955 | 613166 | 622276 | 631288 | 640203 | 649024 | 657752 | 666389 | 30 |
| 31 | 45 585379 | 594797 | 604109 | 613319 | 622427 | 631438 | 640351 | 649170 | 657896 | 666532 | 29 |
| | 38′ 53′ | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 8.585537 | 8.594953 | 8.604263 | 8.613471 | 8.622578 | 8.631587 | 8.640499 | 8.649316 | 8.658041 | 8.666675 | 28 |
| 33 | 15 585695 | 595109 | 604418 | 613624 | 622729 | 631736 | 640647 | 649463 | 658186 | 666818 | 27 |
| 34 | 30 585853 | 595265 | 604572 | 613776 | 622880 | 631886 | 640794 | 649609 | 658330 | 666961 | 26 |
| 35 | 45 586010 | 595421 | 604726 | 613929 | 623031 | 632035 | 640942 | 649755 | 658475 | 667104 | 25 |
| | 39′ 54′ | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 8.586168 | 8.595577 | 8.604880 | 8.614081 | 8.623182 | 8.632184 | 8.641090 | 8.649901 | 8.658620 | 8.667247 | 24 |
| 37 | 15 586326 | 595733 | 605035 | 614234 | 623333 | 632333 | 641237 | 650047 | 658764 | 667390 | 23 |
| 38 | 30 586483 | 595888 | 605189 | 614386 | 623484 | 632482 | 641385 | 650193 | 658909 | 667533 | 22 |
| 39 | 45 586641 | 596044 | 605343 | 614539 | 623634 | 632632 | 641532 | 650339 | 659053 | 667676 | 21 |
| | 40′ 55′ | | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 8.586799 | 8.596200 | 8.605497 | 8.614691 | 8.623785 | 8.632781 | 8.641680 | 8.650485 | 8.659198 | 8.667819 | 20 |
| 41 | 15 586956 | 596356 | 605651 | 614844 | 623936 | 632930 | 641828 | 650631 | 659342 | 667962 | 19 |
| 42 | 30 587114 | 596512 | 605805 | 614996 | 624087 | 633079 | 641975 | 650777 | 659486 | 668105 | 18 |
| 43 | 45 587271 | 596667 | 605959 | 615148 | 624237 | 633228 | 642123 | 650923 | 659631 | 668248 | 17 |
| | 41′ 56′ | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 8.587429 | 8.596823 | 8.606113 | 8.615301 | 8.624388 | 8.633377 | 8.642270 | 8.651069 | 8.659775 | 8.668391 | 16 |
| 45 | 15 587586 | 596979 | 606267 | 615453 | 624539 | 633526 | 642417 | 651214 | 659919 | 668534 | 15 |
| 46 | 30 587743 | 597135 | 606421 | 615605 | 624689 | 633675 | 642565 | 651360 | 660064 | 668677 | 14 |
| 47 | 45 587901 | 597290 | 606575 | 615757 | 624840 | 633824 | 642712 | 651506 | 660208 | 668819 | 13 |
| | 42′ 57′ | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 8.588058 | 8.597446 | 8.606729 | 8.615910 | 8.624990 | 8.633973 | 8.642859 | 8.651652 | 8.660352 | 8.668962 | 12 |
| 49 | 15 588215 | 597601 | 606883 | 616062 | 625141 | 634122 | 643007 | 651798 | 660497 | 669105 | 11 |
| 50 | 30 588373 | 597757 | 607036 | 616214 | 625291 | 634271 | 643154 | 651943 | 660641 | 669246 | 10 |
| 51 | 45 588530 | 597912 | 607190 | 616366 | 625442 | 634419 | 643301 | 652089 | 660785 | 669390 | 9 |
| | 43′ 58′ | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 8.588687 | 8.598068 | 8.607344 | 8.616518 | 8.625592 | 8.634568 | 8.643449 | 8.652235 | 8.660929 | 8.669533 | 8 |
| 53 | 15 588844 | 598223 | 607498 | 616670 | 625742 | 634717 | 643596 | 652380 | 661073 | 669676 | 7 |
| 54 | 30 589002 | 598375 | 607651 | 616822 | 625893 | 634866 | 643743 | 652526 | 661217 | 669818 | 6 |
| 55 | 45 589159 | 598534 | 607805 | 616974 | 626043 | 635014 | 643890 | 652672 | 661361 | 669961 | 5 |
| | 44′ 59′ | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 8.589316 | 8.598689 | 8.607959 | 8.617126 | 8.626194 | 8.635163 | 8.644037 | 8.652817 | 8.661505 | 8.670103 | 4 |
| 57 | 15 589473 | 598845 | 608112 | 617278 | 626344 | 635312 | 644184 | 652963 | 661649 | 670246 | 3 |
| 58 | 30 589630 | 599000 | 608266 | 617430 | 626494 | 635461 | 644331 | 653108 | 661793 | 670389 | 2 |
| 59 | 45 589787 | 599155 | 608419 | 617582 | 626644 | 635609 | 644478 | 653254 | 661937 | 670531 | 1 |
| 60 | 60 8.589944 | 8.599311 | 8.608573 | 8.617734 | 8.626795 | 8.635758 | 8.644625 | 8.653399 | 8.662081 | 8.670674 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| sec. | | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 25 deg. | | | | 26 deg. | | | | 27 deg. | | |
| | ′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 | 8.670674 | 8.679177 | 8.687595 | 8.695927 | 8.704176 | 8.712343 | 8.720431 | 8.728439 | 8.736371 | 8.744226 | 60 |
| 1 | 15 | 670816 | 679318 | 687734 | 696065 | 704313 | 712479 | 720565 | 728572 | 736502 | 744356 | 59 |
| 2 | 30 | 670958 | 679459 | 687874 | 696203 | 704450 | 712614 | 720699 | 728705 | 736634 | 744486 | 58 |
| 3 | 45 | 671101 | 679600 | 688013 | 696341 | 704586 | 712750 | 720833 | 728838 | 736765 | 744617 | 57 |
| | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 | 8.671243 | 8.679741 | 8.688153 | 8.696479 | 8.704723 | 8.712885 | 8.720967 | 8.728970 | 8.736897 | 8.744747 | 56 |
| 5 | 15 | 671385 | 679882 | 688292 | 696618 | 704860 | 713020 | 721101 | 729103 | 737028 | 744877 | 55 |
| 6 | 30 | 671528 | 680023 | 688432 | 696756 | 704996 | 713156 | 721235 | 729236 | 737159 | 745007 | 54 |
| 7 | 45 | 671670 | 680164 | 688571 | 696894 | 705133 | 713291 | 721369 | 729368 | 737291 | 745137 | 53 |
| | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 | 8.671812 | 8.680305 | 8.688710 | 8.697032 | 8.705270 | 8.713426 | 8.721503 | 8.729501 | 8.737422 | 8.745268 | 52 |
| 9 | 15 | 671955 | 680445 | 688850 | 697170 | 705406 | 713562 | 721637 | 729634 | 737554 | 745398 | 51 |
| 10 | 30 | 672097 | 680586 | 688989 | 697308 | 705543 | 713697 | 721771 | 729766 | 737685 | 745528 | 50 |
| 11 | 45 | 672239 | 680727 | 689128 | 697445 | 705679 | 713832 | 721905 | 729899 | 737816 | 745658 | 49 |
| | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 | 8.672381 | 8.680868 | 8.689268 | 8.697583 | 8.705816 | 8.713967 | 8.722039 | 8.730032 | 8.737948 | 8.745788 | 48 |
| 13 | 15 | 672523 | 681008 | 689407 | 697721 | 705952 | 714102 | 722172 | 730164 | 738079 | 745918 | 47 |
| 14 | 30 | 672666 | 681149 | 689546 | 697859 | 706089 | 714238 | 722306 | 730297 | 738210 | 746048 | 46 |
| 15 | 45 | 672808 | 681290 | 689685 | 697997 | 706225 | 714373 | 722440 | 730429 | 738341 | 746178 | 45 |
| | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 | 8.672950 | 8.681430 | 8.689825 | 8.698135 | 8.706362 | 8.714508 | 8.722574 | 8.730562 | 8.738473 | 8.746308 | 44 |
| 17 | 15 | 673092 | 681571 | 689964 | 698273 | 706498 | 714643 | 722708 | 730694 | 738604 | 746438 | 43 |
| 18 | 30 | 673234 | 681711 | 690103 | 698410 | 706635 | 714778 | 722841 | 730827 | 738735 | 746568 | 42 |
| 19 | 45 | 673376 | 681852 | 690242 | 698548 | 706771 | 714913 | 722975 | 730959 | 738866 | 746698 | 41 |
| | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 | 8.673518 | 8.681993 | 8.690381 | 8.698686 | 8.706908 | 8.715048 | 8.723109 | 8.731092 | 8.738997 | 8.746829 | 40 |
| 21 | 15 | 673660 | 682133 | 690520 | 698824 | 707044 | 715183 | 723242 | 731224 | 739128 | 746959 | 39 |
| 22 | 30 | 673802 | 682274 | 690660 | 698961 | 707180 | 715318 | 723376 | 731356 | 739260 | 747087 | 38 |
| 23 | 45 | 673944 | 682414 | 690799 | 699099 | 707316 | 715453 | 723510 | 731489 | 739391 | 747217 | 37 |
| | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 | 8.674086 | 8.682555 | 8.690938 | 8.699237 | 8.707453 | 8.715588 | 8.723643 | 8.731621 | 8.739522 | 8.747347 | 36 |
| 25 | 15 | 674227 | 682695 | 691077 | 699374 | 707589 | 715723 | 723777 | 731753 | 739653 | 747477 | 35 |
| 26 | 30 | 674369 | 682835 | 691216 | 699512 | 707725 | 715858 | 723911 | 731886 | 739784 | 747607 | 34 |
| 27 | 45 | 674511 | 682976 | 691354 | 699649 | 707861 | 715993 | 724044 | 732018 | 739915 | 747736 | 33 |
| | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 | 8.674653 | 8.683116 | 8.691493 | 8.699787 | 8.707998 | 8.716127 | 8.724178 | 8.732150 | 8.740046 | 8.747866 | 32 |
| 29 | 15 | 674795 | 683256 | 691632 | 699924 | 708134 | 716262 | 724311 | 732282 | 740177 | 747996 | 31 |
| 30 | 30 | 674936 | 683397 | 691771 | 700062 | 708270 | 716397 | 724445 | 732414 | 740308 | 748126 | 30 |
| 31 | 45 | 675078 | 683537 | 691910 | 700199 | 708406 | 716532 | 724578 | 732547 | 740438 | 748255 | 29 |
| | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 | 8.675220 | 8.683677 | 8.692049 | 8.700337 | 8.708542 | 8.716667 | 8.724712 | 8.732679 | 8.740569 | 8.748385 | 28 |
| 33 | 15 | 675361 | 683817 | 692188 | 700474 | 708678 | 716801 | 724845 | 732811 | 740700 | 748514 | 27 |
| 34 | 30 | 675503 | 683958 | 692327 | 700612 | 708814 | 716936 | 724978 | 732943 | 740831 | 748644 | 26 |
| 35 | 45 | 675645 | 684098 | 692465 | 700749 | 708950 | 717071 | 725112 | 733075 | 740962 | 748774 | 25 |
| | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 | 8.675786 | 8.684238 | 8.692604 | 8.700886 | 8.709086 | 8.717205 | 8.725245 | 8.733207 | 8.741093 | 8.748903 | 24 |
| 37 | 15 | 675928 | 684378 | 692743 | 701024 | 709222 | 717340 | 725378 | 733339 | 741223 | 749033 | 23 |
| 38 | 30 | 676069 | 684518 | 692881 | 701161 | 709358 | 717475 | 725512 | 733471 | 741354 | 749162 | 22 |
| 39 | 45 | 676211 | 684658 | 693020 | 701298 | 709494 | 717609 | 725645 | 733603 | 741485 | 749292 | 21 |
| | | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 | 8.676352 | 8.684798 | 8.693159 | 8.701436 | 8.709630 | 8.717744 | 8.725778 | 8.733735 | 8.741616 | 8.749421 | 20 |
| 41 | 15 | 676494 | 684938 | 693297 | 701573 | 709766 | 717878 | 725912 | 733867 | 741746 | 749551 | 19 |
| 42 | 30 | 676635 | 685078 | 693436 | 701710 | 709902 | 718013 | 726045 | 733999 | 741877 | 749680 | 18 |
| 43 | 45 | 676777 | 685218 | 693575 | 701847 | 710038 | 718147 | 726178 | 734131 | 742008 | 749810 | 17 |
| | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 | 8.676918 | 8.685358 | 8.693713 | 8.701984 | 8.710173 | 8.718282 | 8.726311 | 8.734263 | 8.742138 | 8.749939 | 16 |
| 45 | 15 | 677060 | 685498 | 693852 | 702121 | 710309 | 718416 | 726444 | 734395 | 742269 | 750068 | 15 |
| 46 | 30 | 677201 | 685638 | 693990 | 702259 | 710445 | 718551 | 726578 | 734527 | 742400 | 750198 | 14 |
| 47 | 45 | 677342 | 685778 | 694129 | 702396 | 710581 | 718685 | 726711 | 734659 | 742530 | 750327 | 13 |
| | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 | 8.677484 | 8.685918 | 8.694267 | 8.702533 | 8.710716 | 8.718820 | 8.726844 | 8.734790 | 8.742661 | 8.750457 | 12 |
| 49 | 15 | 677625 | 686058 | 694406 | 702670 | 710852 | 718954 | 726977 | 734922 | 742791 | 750586 | 11 |
| 50 | 30 | 677766 | 686198 | 694544 | 702807 | 710988 | 719088 | 727110 | 735054 | 742922 | 750715 | 10 |
| 51 | 45 | 677907 | 686337 | 694682 | 702944 | 711123 | 719223 | 727243 | 735186 | 743052 | 750844 | 9 |
| | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 | 8.678049 | 8.686477 | 8.694821 | 8.703081 | 8.711259 | 8.719357 | 8.727376 | 8.735317 | 8.743183 | 8.750974 | 8 |
| 53 | 15 | 678190 | 686617 | 694959 | 703218 | 711395 | 719491 | 727509 | 735449 | 743313 | 751103 | 7 |
| 54 | 30 | 678331 | 686757 | 695097 | 703355 | 711530 | 719626 | 727642 | 735581 | 743444 | 751232 | 6 |
| 55 | 45 | 678472 | 686896 | 695236 | 703492 | 711666 | 719760 | 727775 | 735712 | 743574 | 751361 | 5 |
| | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 | 8.678613 | 8.687036 | 8.695374 | 8.703629 | 8.711801 | 8.719894 | 8.727908 | 8.735844 | 8.743705 | 8.751490 | 4 |
| 57 | 15 | 678754 | 687176 | 695512 | 703765 | 711937 | 720028 | 728041 | 735976 | 743835 | 751620 | 3 |
| 58 | 30 | 678895 | 687315 | 695651 | 703902 | 712073 | 720162 | 728174 | 736107 | 743965 | 751749 | 2 |
| 59 | 45 | 679036 | 687455 | 695789 | 704039 | 712208 | 720297 | 728306 | 736239 | 744096 | 751878 | 1 |
| 60 | 60 | 8.679177 | 8.687595 | 8.695927 | 8.704176 | 8.712343 | 8.720431 | 8.728439 | 8.736371 | 8.744226 | 8.752007 | 0 |
| sec | | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m | sec. |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 deg. | | 8 deg. | | | | 9 deg. | | | | |
| | ″ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 7.631197 | 7.659636 | 7.687169 | 7.713852 | 7.739736 | 7.764867 | 7.789287 | 7.813035 | 7 836147 | 7.858656 | 60 |
| 1 | 15 631679 | 660102 | 687620 | 714290 | 740161 | 765279 | 789688 | 813425 | 836527 | 859026 | 59 |
| 2 | 30 632160 | 660568 | 688072 | 714728 | 740586 | 765692 | 790089 | 813815 | 836907 | 859396 | 58 |
| 3 | 45 632641 | 661034 | 688523 | 715165 | 741010 | 766104 | 790490 | 814205 | 837286 | 859766 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 7.633122 | 7.661499 | 7.688974 | 7.715602 | 7.741434 | 7.766516 | 7.790890 | 7.814595 | 7.837666 | 7.860136 | 56 |
| 5 | 15 633603 | 661964 | 689424 | 716039 | 741858 | 766928 | 791291 | 814985 | 838045 | 860505 | 55 |
| 6 | 30 634083 | 662429 | 689875 | 716476 | 742282 | 767340 | 791691 | 815374 | 838424 | 860875 | 54 |
| 7 | 45 634564 | 662894 | 690325 | 716912 | 742706 | 767751 | 792091 | 815763 | 838803 | 861244 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 7.635043 | 7.663358 | 7.690775 | 7.717348 | 7.743129 | 7.768163 | 7.792491 | 7.816152 | 7.839182 | 7.861613 | 52 |
| 9 | 15 635523 | 663822 | 691224 | 717784 | 743552 | 768574 | 792891 | 816541 | 839561 | 861982 | 51 |
| 10 | 30 636002 | 664286 | 691674 | 718220 | 743975 | 768985 | 793290 | 816930 | 839939 | 862351 | 50 |
| 11 | 45 636481 | 664750 | 692123 | 718656 | 744398 | 769396 | 793690 | 817318 | 840318 | 862719 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 7.636960 | 7.665213 | 7.692572 | 7.719091 | 7.744821 | 7.769806 | 7.794089 | 7.817707 | 7.840696 | 7.863088 | 48 |
| 13 | 15 637439 | 665676 | 693021 | 719526 | 745243 | 770216 | 794488 | 818095 | 841074 | 863456 | 47 |
| 14 | 30 637917 | 666139 | 693469 | 719961 | 745666 | 770627 | 794887 | 818483 | 841452 | 863824 | 46 |
| 15 | 45 638395 | 666602 | 693917 | 720396 | 746087 | 771037 | 795285 | 818871 | 841829 | 864192 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 7.638873 | 7.667064 | 7.694365 | 7.720831 | 7.746509 | 7.771446 | 7.795684 | 7.819259 | 7.842207 | 7.864560 | 44 |
| 17 | 15 639350 | 667526 | 694813 | 721265 | 746931 | 771856 | 796082 | 819646 | 842584 | 864928 | 43 |
| 18 | 30 639827 | 667988 | 695261 | 721699 | 747352 | 772265 | 796480 | 820034 | 842961 | 865295 | 42 |
| 19 | 45 640304 | 668450 | 695708 | 722133 | 747773 | 772675 | 796878 | 820421 | 843338 | 865663 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 7.640781 | 7.668911 | 7.696155 | 7.722567 | 7.748194 | 7.773084 | 7.797275 | 7.820808 | 7.843715 | 7.866030 | 40 |
| 21 | 15 641257 | 669372 | 696602 | 723000 | 748615 | 773492 | 797673 | 821195 | 844092 | 866397 | 39 |
| 22 | 30 641734 | 669833 | 697049 | 723433 | 749036 | 773901 | 798070 | 821581 | 844468 | 866764 | 38 |
| 23 | 45 642209 | 670294 | 697495 | 723866 | 749456 | 774309 | 798467 | 821968 | 844845 | 867131 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 7.642685 | 7.670755 | 7.697941 | 7.724299 | 7.749876 | 7.774718 | 7.798864 | 7.822354 | 7.845221 | 7.867497 | 36 |
| 25 | 15 643160 | 671215 | 698387 | 724731 | 750296 | 775126 | 799261 | 822740 | 845597 | 867864 | 35 |
| 26 | 30 643636 | 671675 | 698833 | 725164 | 750716 | 775534 | 799658 | 823126 | 845973 | 868230 | 34 |
| 27 | 45 644110 | 672134 | 699278 | 725596 | 751135 | 775941 | 800054 | 823512 | 846349 | 868596 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 7.644585 | 7.672594 | 7.699724 | 7.726028 | 7.751555 | 7.776349 | 7.800450 | 7.823897 | 7.846724 | 7.868962 | 32 |
| 29 | 15 645059 | 673053 | 700169 | 726459 | 751974 | 776756 | 800846 | 824283 | 847099 | 869328 | 31 |
| 30 | 30 645533 | 673512 | 700614 | 726891 | 752393 | 777163 | 801242 | 824668 | 847475 | 869694 | 30 |
| 31 | 45 646007 | 673971 | 701058 | 727322 | 752811 | 777570 | 801638 | 825053 | 847850 | 870059 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 7.646481 | 7.674429 | 7.701502 | 7.727753 | 7.753230 | 7.777977 | 7.802034 | 7.825438 | 7.848225 | 7.870424 | 28 |
| 33 | 15 646954 | 674887 | 701947 | 728184 | 753648 | 778383 | 802429 | 825823 | 848599 | 870790 | 27 |
| 34 | 30 647427 | 675346 | 702390 | 728615 | 754066 | 778789 | 802824 | 826207 | 848974 | 871155 | 26 |
| 35 | 45 647900 | 675803 | 702834 | 729045 | 754484 | 779195 | 803219 | 826592 | 849348 | 871520 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 7.648372 | 7.676261 | 7.703278 | 7.729475 | 7.754902 | 7.779601 | 7.803614 | 7.826976 | 7.849723 | 7.871884 | 24 |
| 37 | 15 648845 | 676718 | 703721 | 729905 | 755319 | 780007 | 804008 | 827360 | 850097 | 872249 | 23 |
| 38 | 30 649317 | 677175 | 704164 | 730335 | 755737 | 780413 | 804403 | 827744 | 850470 | 872613 | 22 |
| 39 | 45 649788 | 677632 | 704606 | 730765 | 756154 | 780818 | 804797 | 828128 | 850844 | 872978 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 7.650260 | 7.678088 | 7.705049 | 7.731194 | 7.756571 | 7.781223 | 7.805191 | 7.828511 | 7.851218 | 7.873342 | 20 |
| 41 | 15 650731 | 678545 | 705491 | 731623 | 756987 | 781628 | 805585 | 828895 | 851591 | 873706 | 19 |
| 42 | 30 651202 | 679001 | 705933 | 732052 | 757404 | 782033 | 805979 | 829278 | 851964 | 874070 | 18 |
| 43 | 45 651673 | 679457 | 706375 | 732481 | 757820 | 782437 | 806372 | 829661 | 852338 | 874433 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 7.652143 | 7.679912 | 7.706817 | 7.732909 | 7.758236 | 7.782842 | 7.806766 | 7.830044 | 7.852711 | 7.874797 | 16 |
| 45 | 15 652613 | 680367 | 707258 | 733337 | 758652 | 783246 | 807159 | 830426 | 853083 | 875160 | 15 |
| 46 | 30 653083 | 680823 | 707699 | 733765 | 759068 | 783650 | 807552 | 830809 | 853456 | 875523 | 14 |
| 47 | 45 653553 | 681277 | 708140 | 734193 | 759483 | 784054 | 807944 | 831191 | 853828 | 875886 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 7.654022 | 7.681732 | 7.708581 | 7.734621 | 7.759899 | 7.784458 | 7.808337 | 7.831574 | 7.854201 | 7.876249 | 12 |
| 49 | 15 654492 | 682186 | 709021 | 735048 | 760314 | 784861 | 808729 | 831956 | 854573 | 876612 | 11 |
| 50 | 30 654961 | 682641 | 709462 | 735475 | 760729 | 785264 | 809122 | 832338 | 854945 | 876975 | 10 |
| 51 | 45 655429 | 683095 | 709902 | 735902 | 761143 | 785667 | 809514 | 832719 | 855317 | 877337 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 7.655898 | 7.683548 | 7.710342 | 7.736329 | 7.761558 | 7.786070 | 7.809906 | 7.833101 | 7.855688 | 7.877699 | 8 |
| 53 | 15 656366 | 684002 | 710781 | 736756 | 761972 | 786473 | 810297 | 833482 | 856060 | 878061 | 7 |
| 54 | 30 656834 | 684455 | 711221 | 737182 | 762386 | 786875 | 810689 | 833863 | 856431 | 878423 | 6 |
| 55 | 45 657301 | 684908 | 711660 | 737608 | 762800 | 787278 | 811080 | 834244 | 856802 | 878785 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 7.657769 | 7.685361 | 7.712099 | 7.738034 | 7.763214 | 7.787680 | 7.811472 | 7.834625 | 7.857173 | 7.879147 | 4 |
| 57 | 15 658236 | 685813 | 712537 | 738460 | 763627 | 788082 | 811863 | 835006 | 857544 | 879508 | 3 |
| 58 | 30 658703 | 686265 | 712976 | 738886 | 764041 | 788484 | 812254 | 835386 | 857915 | 879870 | 2 |
| 59 | 45 659169 | 686717 | 713414 | 739311 | 764454 | 788885 | 812644 | 835767 | 858285 | 880231 | 1 |
| 60 | 60 7.659636 | 7.687169 | 7.713852 | 7.739736 | 7.764867 | 7.789287 | 7.813035 | 7.836147 | 7.858656 | 7.880592 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 deg | | | | 31 deg. | | | | 32 deg. | | |
| | ° 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 8.825992 | 8.833034 | 8.840015 | 8.846936 | 8.853798 | 8.860602 | 8.867349 | 8.874040 | 8.880676 | 8.887258 | 60 |
| 1 | 15 826110 | 833151 | 840130 | 847050 | 853912 | 860715 | 867461 | 874151 | 880786 | 887367 | 59 |
| 2 | 30 826228 | 833268 | 840246 | 847165 | 854025 | 860828 | 867573 | 874262 | 880896 | 887476 | 58 |
| 3 | 45 826346 | 833384 | 840362 | 847280 | 854139 | 860941 | 867685 | 874373 | 881006 | 887585 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 8.826464 | 8.833501 | 8.840478 | 8.847395 | 8.854253 | 8.861053 | 8.867797 | 8.874484 | 8.881117 | 8.887694 | 56 |
| 5 | 15 826582 | 833618 | 840594 | 847510 | 854367 | 861166 | 867909 | 874595 | 881227 | 887804 | 55 |
| 6 | 30 826699 | 833735 | 840709 | 847624 | 854481 | 861279 | 868021 | 874706 | 881337 | 887913 | 54 |
| 7 | 45 826817 | 833851 | 840825 | 847739 | 854594 | 861392 | 868133 | 874817 | 881447 | 888022 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 8.826935 | 8.833968 | 8.840941 | 8.847854 | 8.854708 | 8.861505 | 8.868245 | 8.874928 | 8.881557 | 8.888131 | 52 |
| 9 | 15 827053 | 834085 | 841056 | 847969 | 854822 | 861618 | 868356 | 875039 | 881667 | 888240 | 51 |
| 10 | 30 827170 | 834202 | 841172 | 848083 | 854936 | 861730 | 868468 | 875150 | 881777 | 888349 | 50 |
| 11 | 45 827288 | 834318 | 841289 | 848198 | 855049 | 861843 | 868580 | 875261 | 881887 | 888458 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 8.827406 | 8.834435 | 8.841404 | 8.848313 | 8.855163 | 8.861956 | 8.868692 | 8.875372 | 8.881997 | 8.888567 | 48 |
| 13 | 15 827523 | 834551 | 841519 | 848427 | 855277 | 862069 | 868804 | 875483 | 882107 | 888676 | 47 |
| 14 | 30 827641 | 834668 | 841635 | 848542 | 855390 | 862181 | 868915 | 875594 | 882217 | 888785 | 46 |
| 15 | 45 827759 | 834785 | 841750 | 848656 | 855504 | 862294 | 869027 | 875704 | 882327 | 888895 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 8.827876 | 8.834901 | 8 841866 | 8.848771 | 8.855618 | 8.862407 | 8.869139 | 8.875815 | 8.882436 | 8.889004 | 44 |
| 17 | 15 827994 | 835018 | 841981 | 848886 | 855731 | 862519 | 869251 | 875926 | 882546 | 889113 | 43 |
| 18 | 30 828111 | 835134 | 842097 | 849000 | 855845 | 862632 | 869362 | 876037 | 882656 | 889222 | 42 |
| 19 | 45 828229 | 835251 | 842213 | 849115 | 855959 | 862745 | 869474 | 876148 | 882766 | 889330 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 8.828346 | 8.835367 | 8.842328 | 8.849229 | 8.856072 | 8.862857 | 8.869586 | 8.876258 | 8.882876 | 8.889439 | 40 |
| 21 | 15 828464 | 835484 | 842444 | 849344 | 856186 | 862970 | 869697 | 876369 | 882986 | 889548 | 39 |
| 22 | 30 828581 | 835600 | 842559 | 849458 | 856299 | 863082 | 869809 | 876480 | 883096 | 889657 | 38 |
| 23 | 45 828699 | 835717 | 842675 | 849573 | 856413 | 863195 | 869921 | 876590 | 883205 | 889766 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 8.828816 | 8.835833 | 8.842790 | 8.849687 | 8.856526 | 8.863308 | 8.870032 | 8.876701 | 8.883315 | 8.889875 | 36 |
| 25 | 15 828934 | 835950 | 842905 | 849802 | 856640 | 863420 | 870144 | 876812 | 883425 | 889984 | 35 |
| 26 | 30 829051 | 836066 | 843021 | 849916 | 856753 | 863533 | 870255 | 876923 | 883535 | 890093 | 34 |
| 27 | 45 829169 | 836183 | 843136 | 850031 | 856867 | 863645 | 870367 | 877033 | 883644 | 890202 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 8.829286 | 8.836299 | 8.843252 | 8.850145 | 8.856980 | 8.863758 | 8.870479 | 8.877144 | 8.883754 | 8.890311 | 32 |
| 29 | 15 829403 | 836415 | 843367 | 850259 | 857093 | 863870 | 870590 | 877254 | 883864 | 890419 | 31 |
| 30 | 30 829521 | 836532 | 843482 | 850374 | 857207 | 863983 | 870702 | 877365 | 883974 | 890528 | 30 |
| 31 | 45 829638 | 836648 | 843598 | 850488 | 857320 | 864095 | 870813 | 877476 | 884083 | 890637 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 8.829756 | 8.836764 | 8.843713 | 8.850603 | 8.857434 | 8.864207 | 8.870925 | 8.877586 | 8.884193 | 8.890746 | 28 |
| 33 | 15 829873 | 836881 | 843828 | 850717 | 857547 | 864320 | 871036 | 877697 | 884303 | 890854 | 27 |
| 34 | 30 829990 | 836997 | 843944 | 850831 | 857660 | 864432 | 871148 | 877807 | 884412 | 890963 | 26 |
| 35 | 45 830107 | 837113 | 844059 | 850945 | 857774 | 864545 | 871259 | 877918 | 884522 | 891072 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 8.830225 | 8.837230 | 8.844174 | 8.851060 | 8.857887 | 8.864657 | 8.871370 | 8.878028 | 8.884632 | 8.891181 | 24 |
| 37 | 15 830342 | 837346 | 844289 | 851174 | 858000 | 864769 | 871482 | 878139 | 884741 | 891289 | 23 |
| 38 | 30 830459 | 837462 | 844405 | 851288 | 858114 | 864882 | 871593 | 878249 | 884851 | 891398 | 22 |
| 39 | 45 830576 | 837578 | 844520 | 851403 | 858227 | 864994 | 871705 | 878360 | 884960 | 891507 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 8.830694 | 8.837694 | 8.844635 | 8.851517 | 8.858340 | 8.865106 | 8.871816 | 8.878470 | 8.885070 | 8.891615 | 20 |
| 41 | 15 830811 | 837810 | 844750 | 851631 | 858453 | 865219 | 871927 | 878581 | 885179 | 891724 | 19 |
| 42 | 30 830928 | 837927 | 844865 | 851745 | 858567 | 865331 | 872039 | 878691 | 885289 | 891833 | 18 |
| 43 | 45 831045 | 838043 | 844981 | 851859 | 858680 | 865443 | 872150 | 878802 | 885398 | 891941 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 8.831162 | 8.838159 | 8.845096 | 8.851973 | 8.858793 | 8.865555 | 8.872261 | 8.878912 | 8.885508 | 8.892050 | 16 |
| 45 | 15 831279 | 838275 | 845211 | 852088 | 858906 | 865668 | 872373 | 879022 | 885617 | 892158 | 15 |
| 46 | 30 831396 | 838391 | 845326 | 852202 | 859019 | 865780 | 872484 | 879133 | 885727 | 892267 | 14 |
| 47 | 45 831513 | 838507 | 845441 | 852316 | 859132 | 865892 | 872595 | 879243 | 885836 | 892376 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 8.831630 | 8.838623 | 8.845556 | 8.852430 | 8.859246 | 8.866004 | 8.872706 | 8.879353 | 8.885946 | 8.892484 | 12 |
| 49 | 15 831748 | 838739 | 845671 | 852544 | 859359 | 866116 | 872818 | 879464 | 886055 | 892593 | 11 |
| 50 | 30 831865 | 838855 | 845786 | 852658 | 859472 | 866229 | 872929 | 879574 | 886164 | 892701 | 10 |
| 51 | 45 831982 | 838971 | 845901 | 852772 | 859585 | 866341 | 873040 | 879684 | 886274 | 892810 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 8.832099 | 8.839087 | 8.846016 | 8.852886 | 8.859698 | 8.866453 | 8.873151 | 8.879795 | 8.886383 | 8.892918 | 8 |
| 53 | 15 832216 | 839203 | 846131 | 853000 | 859811 | 866565 | 873262 | 879905 | 886492 | 893027 | 7 |
| 54 | 30 832332 | 839319 | 846246 | 853114 | 859924 | 866677 | 873374 | 880015 | 886602 | 893135 | 6 |
| 55 | 45 832449 | 839435 | 846361 | 853228 | 860037 | 866789 | 873485 | 880125 | 886711 | 893243 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 8.832566 | 8.839551 | 8.846476 | 8.853342 | 8.860150 | 8.866901 | 8.873596 | 8.880235 | 8.886821 | 8.893352 | 4 |
| 57 | 15 832683 | 839667 | 846591 | 853456 | 860263 | 867013 | 873707 | 880346 | 886930 | 893460 | 3 |
| 58 | 30 832800 | 839783 | 846706 | 853570 | 860376 | 867125 | 873818 | 880456 | 887039 | 893569 | 2 |
| 59 | 45 832917 | 839899 | 846821 | 853684 | 860489 | 867237 | 873929 | 880566 | 887148 | 893677 | 1 |
| 60 | 60 8.833034 | 8.840015 | 8.846936 | 8.853798 | 8.860602 | 8.867349 | 8.874040 | 8.880676 | 8.887258 | 8.893785 | 0 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 deg. | | 13 deg. | | | | 14 deg. | | | | |
| | ″ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 8.073792 | 8.090922 | 8.107718 | 8.124190 | 8.140352 | 8.156215 | 8.171789 | 8.187085 | 8.202112 | 8.216879 | 60 |
| 1 | 15 074080 | 091205 | 107995 | 124462 | 140619 | 156477 | 172046 | 187337 | 202360 | 217123 | 59 |
| 2 | 30 074368 | 091487 | 108272 | 124734 | 140886 | 156739 | 172303 | 187590 | 202608 | 217367 | 58 |
| 3 | 45 074656 | 091770 | 108549 | 125005 | 141152 | 157000 | 172560 | 187842 | 202856 | 217611 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 8.074944 | 8.092052 | 8.108826 | 8.125277 | 8.141419 | 8.157262 | 8.172817 | 8.188095 | 8.203104 | 8.217854 | 56 |
| 5 | 15 075232 | 092334 | 109102 | 125549 | 141685 | 157524 | 173074 | 188347 | 203352 | 218098 | 55 |
| 6 | 30 075520 | 092617 | 109379 | 125820 | 141952 | 157785 | 173331 | 188599 | 203600 | 218342 | 54 |
| 7 | 45 075808 | 092899 | 109656 | 126091 | 142218 | 158046 | 173588 | 188851 | 203848 | 218585 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 33′ | 47′ | |
| 8 | 0 8.076095 | 8.093181 | 8.109932 | 8.126363 | 8.142484 | 8.158308 | 8.173844 | 8.189104 | 8.204095 | 8.218829 | 52 |
| 9 | 15 076383 | 093463 | 110209 | 126634 | 142750 | 158569 | 174101 | 189356 | 204343 | 219072 | 51 |
| 10 | 30 076670 | 093744 | 110485 | 126905 | 143016 | 158830 | 174357 | 189608 | 204591 | 219316 | 50 |
| 11 | 45 076958 | 094026 | 110761 | 127176 | 143282 | 159091 | 174614 | 189859 | 204838 | 219559 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 8.077245 | 8.094308 | 8.111037 | 8.127447 | 8.143548 | 8.159352 | 8.174870 | 8.190111 | 8.205086 | 8.219802 | 48 |
| 13 | 15 077532 | 094589 | 111314 | 127718 | 143814 | 159613 | 175126 | 190363 | 205333 | 220045 | 47 |
| 14 | 30 077819 | 094871 | 111590 | 127989 | 144080 | 159874 | 175382 | 190615 | 205580 | 220288 | 46 |
| 15 | 45 078106 | 095152 | 111865 | 128259 | 144345 | 160135 | 175639 | 190866 | 205827 | 220531 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 8.078393 | 8.095433 | 8.112141 | 8.128530 | 8.144611 | 8.160396 | 8.175895 | 8.191118 | 8.206075 | 8.220774 | 44 |
| 17 | 15 078680 | 095714 | 112417 | 128800 | 144876 | 160656 | 176151 | 191369 | 206322 | 221017 | 43 |
| 18 | 30 078967 | 095995 | 112693 | 129071 | 145142 | 160917 | 176406 | 191621 | 206569 | 221260 | 42 |
| 19 | 45 079253 | 096276 | 112968 | 129341 | 145407 | 161177 | 176662 | 191872 | 206816 | 221503 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 8.079540 | 8.096557 | 8.113244 | 8.129611 | 8.145672 | 8.161438 | 8.176918 | 8.192123 | 8.207062 | 8.221745 | 40 |
| 21 | 15 079826 | 096838 | 113519 | 129882 | 145937 | 161698 | 177174 | 192374 | 207309 | 221988 | 39 |
| 22 | 30 080113 | 097119 | 113794 | 130152 | 146203 | 161958 | 177429 | 192625 | 207556 | 222230 | 38 |
| 23 | 45 080399 | 097399 | 114069 | 130422 | 146468 | 162218 | 177685 | 192876 | 207803 | 222473 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 8.080685 | 8.097680 | 8.114345 | 8.130692 | 8.146733 | 8.162479 | 8.177940 | 8.193127 | 8.208049 | 8.222715 | 36 |
| 25 | 15 080971 | 097960 | 114620 | 130961 | 146997 | 162738 | 178195 | 193378 | 208296 | 222957 | 35 |
| 26 | 30 081257 | 098241 | 114895 | 131231 | 147262 | 162998 | 178451 | 193629 | 208542 | 223200 | 34 |
| 27 | 45 081543 | 098521 | 115169 | 131501 | 147527 | 163258 | 178706 | 193879 | 208788 | 223442 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 8.081828 | 8.098801 | 8.115444 | 8.131770 | 8.147791 | 8.163518 | 8.178961 | 8.194130 | 8.209035 | 8.223684 | 32 |
| 29 | 15 082114 | 099081 | 115719 | 132040 | 148056 | 163778 | 179216 | 194381 | 209281 | 223926 | 31 |
| 30 | 30 082400 | 099361 | 115993 | 132309 | 148320 | 164037 | 179471 | 194631 | 209527 | 224168 | 30 |
| 31 | 45 082685 | 099641 | 116268 | 132579 | 148585 | 164297 | 179726 | 194881 | 209773 | 224410 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 8.082970 | 8.099921 | 8.116542 | 8.132848 | 8.148849 | 8.164556 | 8.179981 | 8.195132 | 8.210019 | 8.224652 | 28 |
| 33 | 15 083256 | 100200 | 116817 | 133117 | 149113 | 164816 | 180235 | 195382 | 210265 | 224893 | 27 |
| 34 | 30 083541 | 100480 | 117091 | 133386 | 149377 | 165075 | 180490 | 195632 | 210511 | 225135 | 26 |
| 35 | 45 083826 | 100759 | 117365 | 133655 | 149641 | 165334 | 180745 | 195882 | 210757 | 225377 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 8.084111 | 8.101039 | 8.117639 | 8.133924 | 8.149905 | 8.165593 | 8.180999 | 8.196132 | 8.211003 | 8.225618 | 24 |
| 37 | 15 084396 | 101318 | 117913 | 134193 | 150169 | 165852 | 181254 | 196382 | 211248 | 225860 | 23 |
| 38 | 30 084681 | 101597 | 118187 | 134461 | 150433 | 166111 | 181508 | 196632 | 211494 | 226101 | 22 |
| 39 | 45 084965 | 101876 | 118461 | 134730 | 150696 | 166370 | 181762 | 196882 | 211739 | 226343 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 8.085250 | 8.102156 | 8.118734 | 8.134999 | 8.150960 | 8.166629 | 8.182016 | 8.197132 | 8.211985 | 8.226584 | 20 |
| 41 | 15 085534 | 102434 | 119008 | 135267 | 151223 | 166888 | 182270 | 197382 | 212230 | 226825 | 19 |
| 42 | 30 085819 | 102713 | 119282 | 135535 | 151487 | 167146 | 182525 | 197631 | 212475 | 227066 | 18 |
| 43 | 45 086103 | 102992 | 119555 | 135804 | 151750 | 167405 | 182778 | 197881 | 212721 | 227307 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 8.086387 | 8.103271 | 8.119828 | 8.136072 | 8.152013 | 8.167663 | 8.183032 | 8.198130 | 8.212966 | 8.227548 | 16 |
| 45 | 15 086671 | 103549 | 120102 | 136340 | 152277 | 167922 | 183286 | 198380 | 213211 | 227789 | 15 |
| 46 | 30 086956 | 103828 | 120375 | 136608 | 152540 | 168180 | 183540 | 198629 | 213456 | 228030 | 14 |
| 47 | 45 087239 | 104106 | 120648 | 136876 | 152803 | 168439 | 183794 | 198878 | 213701 | 228271 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 8.087523 | 8.104385 | 8.120921 | 8.137144 | 8.153066 | 8.168697 | 8.184047 | 8.199127 | 8.213946 | 8.228512 | 12 |
| 49 | 15 087807 | 104663 | 121194 | 137412 | 153328 | 168955 | 184301 | 199376 | 214191 | 228752 | 11 |
| 50 | 30 088091 | 104941 | 121467 | 137680 | 153591 | 169213 | 184554 | 199625 | 214435 | 228993 | 10 |
| 51 | 45 088374 | 105219 | 121739 | 137947 | 153854 | 169471 | 184808 | 199874 | 214680 | 229234 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 8.088658 | 8.105497 | 8.122012 | 8.138215 | 8.154117 | 8.169729 | 8.185061 | 8.200123 | 8.214925 | 8.229474 | 8 |
| 53 | 15 088941 | 105775 | 122285 | 138482 | 154379 | 169986 | 185314 | 200372 | 215169 | 229714 | 7 |
| 54 | 30 089224 | 106053 | 122557 | 138750 | 154642 | 170244 | 185567 | 200621 | 215414 | 229955 | 6 |
| 55 | 45 089508 | 106330 | 122829 | 139017 | 154904 | 170502 | 185820 | 200869 | 215658 | 230195 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 8.089791 | 8.106608 | 8.123102 | 8.139284 | 8.155166 | 8.170759 | 8.186073 | 8.201118 | 8.215902 | 8.230435 | 4 |
| 57 | 15 090074 | 106885 | 123374 | 139551 | 155429 | 171017 | 186326 | 201366 | 216147 | 230675 | 3 |
| 58 | 30 090357 | 107163 | 123646 | 139818 | 155691 | 171274 | 186579 | 201615 | 216391 | 230915 | 2 |
| 59 | 45 090639 | 107440 | 123918 | 140085 | 155953 | 171532 | 186832 | 201863 | 216635 | 231155 | 1 |
| 60 | 0 8 090922 | 8 107718 | 8.124190 | 8 140352 | 8.156215 | 8.171789 | 8.187085 | 8.202112 | 8.216879 | 8.231395 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35 deg. | | | | 36 deg. | | | | 37 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 8.956284 | 8.962271 | 8.968213 | 8.974111 | 8.979965 | 8.985775 | 8.991543 | 8.997269 | 9.002953 | 9.008596 | 60 |
| 1 | 15 956384 | 962370 | 968312 | 974209 | 980062 | 985872 | 991639 | 997364 | 003047 | 008690 | 59 |
| 2 | 30 956484 | 962470 | 968410 | 974307 | 980159 | 985968 | 991735 | 997459 | 003142 | 008783 | 58 |
| 3 | 45 956584 | 962569 | 968509 | 974405 | 980256 | 986065 | 991830 | 997554 | 003236 | 008877 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 8.956684 | 8.962668 | 8.968608 | 8.974502 | 8.980353 | 8.986161 | 8.991926 | 8.997649 | 9.003330 | 9.008971 | 56 |
| 5 | 15 956784 | 962768 | 968706 | 974600 | 980451 | 986258 | 992022 | 997744 | 003425 | 009064 | 55 |
| 6 | 30 956884 | 962867 | 968805 | 974698 | 980548 | 986354 | 992118 | 997839 | 003519 | 009158 | 54 |
| 7 | 45 956984 | 962966 | 968903 | 974796 | 980645 | 986450 | 992213 | 997934 | 003613 | 009252 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 8.957085 | 8.963066 | 8.969002 | 8.974894 | 8.980742 | 8.986547 | 8.992309 | 8.998029 | 9.003708 | 9.009345 | 52 |
| 9 | 15 957185 | 963165 | 969101 | 974992 | 980839 | 986643 | 992405 | 998124 | 003802 | 009439 | 51 |
| 10 | 30 957285 | 963264 | 969199 | 975090 | 980936 | 986740 | 992500 | 998219 | 003896 | 009532 | 50 |
| 11 | 45 957385 | 963364 | 969298 | 975187 | 981033 | 986836 | 992596 | 998314 | 003990 | 009626 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 8.957485 | 8.963463 | 8.969396 | 8.975285 | 8.981130 | 8.986932 | 8.992692 | 8.998409 | 9.004085 | 9.009720 | 48 |
| 13 | 15 957585 | 963562 | 969495 | 975383 | 981227 | 987029 | 992787 | 998504 | 004179 | 009813 | 47 |
| 14 | 30 957685 | 963661 | 969593 | 975481 | 981324 | 987125 | 992883 | 998599 | 004273 | 009907 | 46 |
| 15 | 45 957785 | 963761 | 969692 | 975578 | 981421 | 987221 | 992978 | 998694 | 004367 | 010000 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 8.957885 | 8.963860 | 8.969790 | 8.975676 | 8.981518 | 8.987318 | 8.993074 | 8.998789 | 9.004462 | 9.010094 | 44 |
| 17 | 15 957985 | 963959 | 969889 | 975774 | 981615 | 987414 | 993170 | 998883 | 004556 | 010187 | 43 |
| 18 | 30 958085 | 964058 | 969987 | 975872 | 981712 | 987510 | 993265 | 998978 | 004650 | 010281 | 42 |
| 19 | 45 958184 | 964157 | 970086 | 975969 | 981809 | 987606 | 993361 | 999073 | 004744 | 010374 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 8.958284 | 8.964257 | 8.970184 | 8.976067 | 8.981906 | 8.987703 | 8.993456 | 8.999168 | 9.004838 | 9.010468 | 40 |
| 21 | 15 958384 | 964356 | 970282 | 976165 | 982003 | 987799 | 993552 | 999263 | 004933 | 010561 | 39 |
| 22 | 30 958484 | 964455 | 970381 | 976262 | 982100 | 987895 | 993647 | 999358 | 005027 | 010655 | 38 |
| 23 | 45 958584 | 964554 | 970479 | 976360 | 982197 | 987991 | 993743 | 999453 | 005121 | 010748 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 8.958684 | 8.964653 | 8.970578 | 8.976456 | 8.982294 | 8.988088 | 8.993838 | 8.999547 | 9.005215 | 9.010842 | 36 |
| 25 | 15 958784 | 964752 | 970676 | 976555 | 982391 | 988184 | 993934 | 999642 | 005309 | 010935 | 35 |
| 26 | 30 958884 | 964851 | 970774 | 976653 | 982488 | 988280 | 994029 | 999737 | 005403 | 011029 | 34 |
| 27 | 45 958983 | 964950 | 970873 | 976750 | 982585 | 988376 | 994125 | 999832 | 005497 | 011122 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 8.959083 | 8.965050 | 8.970971 | 8.976848 | 8.982682 | 8.988472 | 8.994220 | 8.999927 | 9.005591 | 9.011215 | 32 |
| 29 | 15 959183 | 965149 | 971069 | 976946 | 982778 | 988568 | 994316 | 9.000021 | 005685 | 011309 | 31 |
| 30 | 30 959283 | 965248 | 971168 | 977043 | 982875 | 988665 | 994411 | 000116 | 005779 | 011402 | 30 |
| 31 | 45 959383 | 965347 | 971266 | 977141 | 982972 | 988761 | 994507 | 000211 | 005873 | 011496 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 8.959482 | 8.965446 | 8.971364 | 8.977238 | 8.983069 | 8.988857 | 8.994602 | 9.000305 | 9.005968 | 9.011589 | 28 |
| 33 | 15 959582 | 965545 | 971462 | 977336 | 983166 | 988953 | 994697 | 000400 | 006062 | 011682 | 27 |
| 34 | 30 959682 | 965644 | 971561 | 977433 | 983263 | 989049 | 994793 | 000495 | 006156 | 011776 | 26 |
| 35 | 45 959782 | 965743 | 971659 | 977531 | 983359 | 989145 | 994888 | 000589 | 006250 | 011869 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 8.959881 | 8.965842 | 8.971757 | 8.977628 | 8.983456 | 8.989241 | 8.994984 | 9.000684 | 9.006344 | 9.011962 | 24 |
| 37 | 15 959981 | 965941 | 971855 | 977726 | 983553 | 989337 | 995079 | 000779 | 006438 | 012055 | 23 |
| 38 | 30 960081 | 966040 | 971953 | 977823 | 983650 | 989433 | 995174 | 000874 | 006532 | 012149 | 22 |
| 39 | 45 960180 | 966138 | 972052 | 977921 | 983746 | 989529 | 995270 | 000968 | 006625 | 012242 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 8.960280 | 8.966237 | 8.972150 | 8.978018 | 8.983843 | 8.989625 | 8.995365 | 9.001063 | 9.006719 | 9.012335 | 20 |
| 41 | 15 960380 | 966336 | 972248 | 978116 | 983940 | 989721 | 995460 | 001157 | 006813 | 012429 | 19 |
| 42 | 30 960479 | 966435 | 972346 | 978213 | 984037 | 989817 | 995555 | 001252 | 006907 | 012522 | 18 |
| 43 | 45 960579 | 966534 | 972444 | 978310 | 984133 | 989913 | 995651 | 001346 | 007001 | 012615 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 8.960679 | 8.966633 | 8.972542 | 8.978408 | 8.984230 | 8.990009 | 8.995746 | 9.001441 | 9.007095 | 9.012709 | 16 |
| 45 | 15 960778 | 966732 | 972641 | 978505 | 984327 | 990105 | 995841 | 001536 | 007189 | 012802 | 15 |
| 46 | 30 960878 | 966831 | 972739 | 978603 | 984423 | 990201 | 995937 | 001630 | 007283 | 012895 | 14 |
| 47 | 45 960977 | 966929 | 972837 | 978700 | 984520 | 990297 | 996032 | 001725 | 007377 | 012988 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 8.961077 | 8.967028 | 8.972935 | 8.978797 | 8.984617 | 8.990393 | 8.996127 | 9.001819 | 9.007471 | 9.013081 | 12 |
| 49 | 15 961177 | 967127 | 973033 | 978895 | 984713 | 990489 | 996222 | 001914 | 007564 | 013174 | 11 |
| 50 | 30 961276 | 967226 | 973131 | 978992 | 984810 | 990585 | 996317 | 002008 | 007658 | 013267 | 10 |
| 51 | 45 961376 | 967325 | 973229 | 979089 | 984906 | 990681 | 996413 | 002103 | 007752 | 013361 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 8.961475 | 8.967423 | 8.973327 | 8.979187 | 8.985003 | 8.990777 | 8.996508 | 9.002197 | 9.007846 | 9.013454 | 8 |
| 53 | 15 961575 | 967522 | 973425 | 979284 | 985100 | 990872 | 996603 | 002292 | 007940 | 013547 | 7 |
| 54 | 30 961674 | 967621 | 973523 | 979381 | 985196 | 990968 | 996698 | 002386 | 008033 | 013640 | 6 |
| 55 | 45 961774 | 967720 | 973621 | 979478 | 985293 | 991064 | 996793 | 002481 | 008127 | 013733 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 8.961873 | 8.967818 | 8.973719 | 8.979576 | 8.985389 | 8.991160 | 8.996888 | 9.002575 | 9.008221 | 9.013826 | 4 |
| 57 | 15 961973 | 967917 | 973817 | 979673 | 985486 | 991256 | 996983 | 002670 | 008315 | 013919 | 3 |
| 58 | 30 962072 | 968016 | 973915 | 979770 | 985582 | 991352 | 997079 | 002764 | 008408 | 014012 | 2 |
| 59 | 45 962171 | 968114 | 974013 | 979867 | 985679 | 991447 | 997174 | 002858 | 008502 | 014105 | 1 |
| 60 | 60 8.962271 | 8.968213 | 8.974111 | 8.979965 | 8.985775 | 8.991543 | 8.997269 | 9.002953 | 9.008596 | 9.014198 | 0 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| sec. | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 17 deg. | | 18 deg. | | | | 19 deg. | | | | |
| | " 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 8.364392 | 8.376615 | 8.388665 | 8.400546 | 8.412262 | 8.423818 | 8.435218 | 8.446467 | 8.457568 | 8.468524 | 60 |
| 1 | 15 364597 | 376817 | 388864 | 400742 | 412456 | 424009 | 435407 | 446653 | 457752 | 468706 | 59 |
| 2 | 30 364802 | 377020 | 389064 | 400939 | 412650 | 424201 | 435596 | 446839 | 457935 | 468887 | 58 |
| 3 | 45 365007 | 377222 | 389263 | 401135 | 412843 | 424392 | 435784 | 447026 | 458119 | 469068 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 8.365212 | 8.377424 | 8.389462 | 8.401332 | 8.413037 | 8.424583 | 8.435973 | 8.447212 | 8.458303 | 8.469250 | 56 |
| 5 | 15 365417 | 377626 | 389661 | 401528 | 413231 | 424774 | 436162 | 447398 | 458486 | 469431 | 55 |
| 6 | 30 365622 | 377828 | 389860 | 401724 | 413425 | 424965 | 436350 | 447584 | 458670 | 469612 | 54 |
| 7 | 45 365827 | 378030 | 390060 | 401921 | 413618 | 425156 | 436539 | 447770 | 458853 | 469793 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 8.366032 | 8.378232 | 8.390259 | 8.402117 | 8.413812 | 8.425347 | 8.436727 | 8.447956 | 8.459037 | 8.469975 | 52 |
| 9 | 15 366237 | 378434 | 390458 | 402313 | 414005 | 425538 | 436915 | 448142 | 459220 | 470156 | 51 |
| 10 | 30 366441 | 378635 | 390657 | 402510 | 414199 | 425729 | 437104 | 448327 | 459404 | 470337 | 50 |
| 11 | 45 366646 | 378837 | 390855 | 402706 | 414392 | 425920 | 437292 | 448513 | 459587 | 470518 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 8.366851 | 8.379039 | 8.391054 | 8.402902 | 8.414586 | 8.426110 | 8.437480 | 8.448699 | 8.459771 | 8.470699 | 48 |
| 13 | 15 367055 | 379241 | 391253 | 403098 | 414779 | 426301 | 437668 | 448885 | 459954 | 470880 | 47 |
| 14 | 30 367260 | 379442 | 391452 | 403294 | 414972 | 426492 | 437857 | 449070 | 460137 | 471061 | 46 |
| 15 | 45 367464 | 379644 | 391651 | 403490 | 415166 | 426682 | 438045 | 449256 | 460320 | 471241 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 8.367669 | 8.379845 | 8.391849 | 8.403686 | 8.415359 | 8.426873 | 8.438233 | 8.449442 | 8.460504 | 8.471422 | 44 |
| 17 | 15 367873 | 380047 | 392048 | 403882 | 415552 | 427064 | 438421 | 449627 | 460687 | 471603 | 43 |
| 18 | 30 368077 | 380248 | 392247 | 404077 | 415745 | 427254 | 438609 | 449813 | 460870 | 471784 | 42 |
| 19 | 45 368282 | 380450 | 392445 | 404273 | 415938 | 427445 | 438797 | 449998 | 461053 | 471965 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 8.368486 | 8.380651 | 8.392644 | 8.404469 | 8.416131 | 8.427635 | 8.438985 | 8.450184 | 8.461236 | 8.472145 | 40 |
| 21 | 15 368690 | 380852 | 392842 | 404665 | 416324 | 427826 | 439172 | 450369 | 461419 | 472326 | 39 |
| 22 | 30 368894 | 381053 | 393040 | 404860 | 416517 | 428016 | 439360 | 450554 | 461602 | 472506 | 38 |
| 23 | 45 369098 | 381255 | 393239 | 405056 | 416710 | 428206 | 439548 | 450740 | 461785 | 472687 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 8.369302 | 8.381456 | 8.393437 | 8.405252 | 8.416903 | 8.428397 | 8.439736 | 8.450925 | 8.461968 | 8.472868 | 36 |
| 25 | 15 369506 | 381657 | 393635 | 405447 | 417096 | 428587 | 439924 | 451110 | 462150 | 473048 | 35 |
| 26 | 30 369710 | 381858 | 393834 | 405643 | 417289 | 428777 | 440111 | 451295 | 462333 | 473228 | 34 |
| 27 | 45 369914 | 382059 | 394032 | 405838 | 417482 | 428967 | 440299 | 451480 | 462516 | 473409 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 8.370118 | 8.382260 | 8.394230 | 8.406033 | 8.417674 | 8.429157 | 8.440486 | 8.451666 | 8.462699 | 8.473589 | 32 |
| 29 | 15 370322 | 382461 | 394428 | 406229 | 417867 | 429347 | 440674 | 451851 | 462881 | 473770 | 31 |
| 30 | 30 370526 | 382661 | 394626 | 406424 | 418060 | 429537 | 440862 | 452036 | 463064 | 473950 | 30 |
| 31 | 45 370729 | 382862 | 394824 | 406619 | 418252 | 429727 | 441049 | 452221 | 463247 | 474130 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 8.370933 | 8.383063 | 8.395022 | 8.406814 | 8.418445 | 8.429917 | 8.441236 | 8.452406 | 8.463429 | 8.474310 | 28 |
| 33 | 15 371137 | 383264 | 395220 | 407010 | 418637 | 430107 | 441424 | 452591 | 463612 | 474490 | 27 |
| 34 | 30 371340 | 383464 | 395418 | 407205 | 418830 | 430297 | 441611 | 452775 | 463794 | 474671 | 26 |
| 35 | 45 371544 | 383665 | 395615 | 407400 | 419022 | 430487 | 441798 | 452960 | 463976 | 474851 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 8.371747 | 8.383866 | 8.395813 | 8.407595 | 8.419214 | 8.430677 | 8.441986 | 8.453145 | 8.464159 | 8.475031 | 24 |
| 37 | 15 371950 | 384066 | 396011 | 407790 | 419407 | 430866 | 442173 | 453330 | 464341 | 475211 | 23 |
| 38 | 30 372154 | 384267 | 396209 | 407985 | 419599 | 431056 | 442360 | 453515 | 464524 | 475391 | 22 |
| 39 | 45 372357 | 384467 | 396406 | 408180 | 419791 | 431246 | 442547 | 453699 | 464706 | 475571 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 8.372560 | 8.384667 | 8.396604 | 8.408374 | 8.419983 | 8.431435 | 8.442734 | 8.453884 | 8.464888 | 8.475751 | 20 |
| 41 | 15 372764 | 384868 | 396801 | 408569 | 420176 | 431625 | 442921 | 454068 | 465070 | 475930 | 19 |
| 42 | 30 372967 | 385068 | 396999 | 408764 | 420368 | 431814 | 443108 | 454253 | 465252 | 476110 | 18 |
| 43 | 45 373170 | 385268 | 397196 | 408959 | 420560 | 432004 | 443295 | 454437 | 465434 | 476290 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 8.373373 | 8.385468 | 8.397394 | 8.409153 | 8.420752 | 8.432193 | 8.443482 | 8.454622 | 8.465617 | 8.476470 | 16 |
| 45 | 15 373576 | 385668 | 397591 | 409348 | 420944 | 432383 | 443669 | 454806 | 465799 | 476649 | 15 |
| 46 | 30 373779 | 385869 | 397788 | 409542 | 421136 | 432572 | 443856 | 454991 | 465981 | 476829 | 14 |
| 47 | 45 373982 | 386069 | 397985 | 409737 | 421328 | 432761 | 444043 | 455175 | 466162 | 477009 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 8.374185 | 8.386269 | 8.398183 | 8.409931 | 8.421519 | 8.432951 | 8.444229 | 8.455359 | 8.466344 | 8.477188 | 12 |
| 49 | 15 374387 | 386469 | 398380 | 410126 | 421711 | 433140 | 444416 | 455544 | 466526 | 477368 | 11 |
| 50 | 30 374590 | 386668 | 398577 | 410320 | 421903 | 433329 | 444603 | 455728 | 466708 | 477547 | 10 |
| 51 | 45 374793 | 386868 | 398774 | 410515 | 422095 | 433518 | 444789 | 455912 | 466890 | 477727 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58 | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 8.374996 | 8.387068 | 8.398971 | 8.410709 | 8.422286 | 8.433707 | 8.444976 | 8.456096 | 8.467072 | 8.477906 | 8 |
| 53 | 15 375198 | 387268 | 399168 | 410903 | 422478 | 433896 | 445162 | 456280 | 467253 | 478086 | 7 |
| 54 | 30 375401 | 387468 | 399365 | 411097 | 422669 | 434085 | 445349 | 456464 | 467435 | 478265 | 6 |
| 55 | 45 375603 | 387667 | 399562 | 411292 | 422861 | 434274 | 445535 | 456648 | 467617 | 478444 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 8.375806 | 8.387867 | 8.399759 | 8.411486 | 8.423053 | 8.434463 | 8.445722 | 8.456832 | 8.467798 | 8.478624 | 4 |
| 57 | 15 376008 | 388066 | 399955 | 411680 | 423244 | 434652 | 445908 | 457016 | 467980 | 478803 | 3 |
| 58 | 30 376211 | 388266 | 400152 | 411874 | 423435 | 434841 | 446095 | 457200 | 468162 | 478982 | 2 |
| 59 | 45 376413 | 388465 | 400349 | 412068 | 423627 | 435030 | 446281 | 457384 | 468343 | 479161 | 1 |
| 60 | 60 8.376615 | 8.388665 | 8.400546 | 8.412262 | 8.423818 | 8.435218 | 8.446467 | 8.457568 | 8.468524 | 8.479340 | 0 |

| | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| sec. | 20 deg. | | | | 21 deg. | | | | 22 deg. | | sec. |
| | ° 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 8.479340 | 8.490019 | 8.500564 | 8.510979 | 8.521266 | 8.531429 | 8.541470 | 8.551392 | 8.561198 | 8.570890 | 60 |
| 1 | 15 479519 | 490196 | 500739 | 511151 | 521436 | 531597 | 541636 | 551556 | 561360 | 571051 | 59 |
| 2 | 30 479699 | 490373 | 500914 | 511324 | 521607 | 531765 | 541802 | 551720 | 561523 | 571211 | 58 |
| 3 | 45 479878 | 490550 | 501088 | 511496 | 521777 | 531934 | 541968 | 551885 | 561685 | 571372 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 8.480057 | 8.490726 | 8.501263 | 8.511669 | 8.521947 | 8.532102 | 8.542135 | 8.552049 | 8.561847 | 8.571532 | 56 |
| 5 | 15 480235 | 490903 | 501437 | 511841 | 522118 | 532270 | 542301 | 552213 | 562010 | 571693 | 55 |
| 6 | 30 480414 | 491080 | 501612 | 512013 | 522288 | 532438 | 542467 | 552378 | 562172 | 571853 | 54 |
| 7 | 45 480593 | 491256 | 501786 | 512186 | 522458 | 532606 | 542633 | 552542 | 562334 | 572014 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 8.480772 | 8.491433 | 8.501961 | 8.512358 | 8.522628 | 8.532774 | 8.542799 | 8.552706 | 8.562497 | 8.572174 | 52 |
| 9 | 15 480951 | 491610 | 502135 | 512530 | 522798 | 532942 | 542965 | 552870 | 562659 | 572334 | 51 |
| 10 | 30 481130 | 491786 | 502309 | 512702 | 522968 | 533111 | 543131 | 553034 | 562821 | 572495 | 50 |
| 11 | 45 481308 | 491963 | 502483 | 512874 | 523138 | 533278 | 543297 | 553198 | 562983 | 572655 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 8.481487 | 8.492139 | 8.502658 | 8.513047 | 8.523308 | 8.533446 | 8.543463 | 8.553362 | 8.563145 | 8.572815 | 48 |
| 13 | 15 481666 | 492315 | 502832 | 513219 | 523478 | 533614 | 543629 | 553526 | 563307 | 572975 | 47 |
| 14 | 30 481844 | 492492 | 503006 | 513391 | 523648 | 533782 | 543795 | 553690 | 563469 | 573136 | 46 |
| 15 | 45 482023 | 492668 | 503180 | 513563 | 523818 | 533950 | 543961 | 553854 | 563631 | 573296 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 8.482201 | 8.492844 | 8.503354 | 8.513735 | 8.523988 | 8.534118 | 8.544127 | 8.554018 | 8.563793 | 8.573456 | 44 |
| 17 | 15 482380 | 493021 | 503528 | 513906 | 524158 | 534286 | 544293 | 554182 | 563955 | 573616 | 43 |
| 18 | 30 482558 | 493197 | 503702 | 514078 | 524328 | 534454 | 544459 | 554346 | 564117 | 573776 | 42 |
| 19 | 45 482737 | 493373 | 503876 | 514250 | 524497 | 534621 | 544624 | 554509 | 564279 | 573936 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 8.482915 | 8.493549 | 8.504050 | 8.514422 | 8.524667 | 8.534789 | 8.544790 | 8.554673 | 8.564441 | 8.574096 | 40 |
| 21 | 15 483093 | 493725 | 504224 | 514594 | 524837 | 534957 | 544956 | 554837 | 564603 | 574256 | 39 |
| 22 | 30 483272 | 493901 | 504398 | 514766 | 525007 | 535124 | 545121 | 555001 | 564765 | 574416 | 38 |
| 23 | 45 483450 | 494077 | 504572 | 514937 | 525176 | 535292 | 545287 | 555164 | 564926 | 574576 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 8.483628 | 8.494253 | 8.504746 | 8.515109 | 8.525346 | 8.535459 | 8.545453 | 8.555328 | 8.565088 | 8.574736 | 36 |
| 25 | 15 483806 | 494429 | 504920 | 515281 | 525515 | 535627 | 545618 | 555491 | 565250 | 574896 | 35 |
| 26 | 30 483985 | 494605 | 505093 | 515452 | 525685 | 535795 | 545784 | 555655 | 565412 | 575056 | 34 |
| 27 | 45 484163 | 494781 | 505267 | 515624 | 525854 | 535962 | 545949 | 555819 | 565573 | 575215 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 8.484341 | 8.494957 | 8.505441 | 8.515795 | 8.526024 | 8.536129 | 8.546115 | 8.555982 | 8.565735 | 8.575375 | 32 |
| 29 | 15 484519 | 495133 | 505614 | 515967 | 526193 | 536297 | 546280 | 556146 | 565896 | 575535 | 31 |
| 30 | 30 484697 | 495308 | 505788 | 516138 | 526363 | 536464 | 546445 | 556309 | 566058 | 575695 | 30 |
| 31 | 45 484875 | 495484 | 505961 | 516310 | 526532 | 536631 | 546611 | 556472 | 566219 | 575854 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 8.485053 | 8.495660 | 8.506135 | 8.516481 | 8.526701 | 8.536799 | 8.546776 | 8.556636 | 8.566381 | 8.576014 | 28 |
| 33 | 15 485231 | 495835 | 506308 | 516652 | 526871 | 536966 | 546941 | 556799 | 566542 | 576173 | 27 |
| 34 | 30 485408 | 496011 | 506482 | 516824 | 527040 | 537133 | 547107 | 556963 | 566704 | 576333 | 26 |
| 35 | 45 485586 | 496187 | 506655 | 516995 | 527209 | 537300 | 547272 | 557126 | 566865 | 576493 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 8.485764 | 8.496362 | 8.506829 | 8.517166 | 8.527378 | 8.537468 | 8.547437 | 8.557289 | 8.567027 | 8.576652 | 24 |
| 37 | 15 485942 | 496538 | 507002 | 517338 | 527547 | 537635 | 547602 | 557452 | 567188 | 576812 | 23 |
| 38 | 30 486119 | 496713 | 507175 | 517509 | 527717 | 537802 | 547767 | 557615 | 567349 | 576971 | 22 |
| 39 | 45 486297 | 496889 | 507349 | 517680 | 527886 | 537969 | 547932 | 557779 | 567510 | 577130 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 8.486475 | 8.497064 | 8.507522 | 8.517851 | 8.528055 | 8.538136 | 8.548097 | 8.557942 | 8.567672 | 8.577290 | 20 |
| 41 | 15 486652 | 497239 | 507695 | 518022 | 528224 | 538302 | 548262 | 558105 | 567833 | 577449 | 19 |
| 42 | 30 486830 | 497415 | 507868 | 518193 | 528393 | 538470 | 548427 | 558268 | 567994 | 577609 | 18 |
| 43 | 45 487007 | 497590 | 508041 | 518364 | 528562 | 538637 | 548592 | 558431 | 568155 | 577768 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 8.487185 | 8.497765 | 8.508214 | 8.518535 | 8.528731 | 8.538804 | 8.548757 | 8.558594 | 8.568316 | 8.577927 | 16 |
| 45 | 15 487362 | 497939 | 508387 | 518706 | 528899 | 538971 | 548922 | 558757 | 568477 | 578086 | 15 |
| 46 | 30 487540 | 498116 | 508560 | 518877 | 529068 | 539137 | 549087 | 558920 | 568639 | 578246 | 14 |
| 47 | 45 487717 | 498291 | 508733 | 519048 | 529237 | 539304 | 549252 | 559083 | 568800 | 578405 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 8.487894 | 8.498466 | 8.508906 | 8.519219 | 8.529406 | 8.539471 | 8.549417 | 8.559246 | 8.568961 | 8.578564 | 12 |
| 49 | 15 488072 | 498644 | 509079 | 519390 | 529575 | 539638 | 549581 | 559408 | 569121 | 578723 | 11 |
| 50 | 30 488249 | 498816 | 509252 | 519560 | 529743 | 539804 | 549746 | 559571 | 569282 | 578882 | 10 |
| 51 | 45 488426 | 498991 | 509425 | 519731 | 529912 | 539971 | 549911 | 559734 | 569443 | 579041 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 8.488603 | 8.499166 | 8.509598 | 8.519902 | 8.530081 | 8.540138 | 8.550076 | 8.559897 | 8.569604 | 8.579200 | 8 |
| 53 | 15 488780 | 499341 | 509771 | 520072 | 530249 | 540304 | 550240 | 560060 | 569765 | 579359 | 7 |
| 54 | 30 488958 | 499516 | 509943 | 520243 | 530418 | 540471 | 550405 | 560222 | 569926 | 579518 | 6 |
| 55 | 45 489135 | 499691 | 510116 | 520414 | 530586 | 540637 | 550569 | 560385 | 570087 | 579677 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 8.489312 | 8.499866 | 8.510289 | 8.520584 | 8.530755 | 8.540804 | 8.550734 | 8.560548 | 8.570247 | 8.579836 | 4 |
| 57 | 15 489489 | 500040 | 510461 | 520755 | 530923 | 540970 | 550898 | 560710 | 570408 | 579995 | 3 |
| 58 | 30 489666 | 500215 | 510634 | 520925 | 531092 | 541137 | 551063 | 560873 | 570569 | 580154 | 2 |
| 59 | 45 489842 | 500390 | 510806 | 521096 | 531260 | 541303 | 551227 | 561035 | 570729 | 580313 | 1 |
| 60 | 60 8.490019 | 8.500564 | 8.510979 | 8.521266 | 8.531429 | 8.541470 | 8.551392 | 8.561198 | 8.570890 | 8.580471 | 0 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22 deg. | | 23 deg. | | | | 24 deg. | | | | |
| | ′ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 8.580471 | 8.589944 | 8.599311 | 8.608573 | 8.617734 | 8.626795 | 8.635758 | 8.644625 | 8.653399 | 8.662081 | 60 |
| 1 | 15 580630 | 590101 | 599466 | 608727 | 617885 | 626945 | 635906 | 644772 | 653545 | 662225 | 59 |
| 2 | 30 580789 | 590258 | 599621 | 608880 | 618037 | 627095 | 636055 | 644919 | 653690 | 662369 | 58 |
| 3 | 45 580948 | 590415 | 599776 | 609033 | 618189 | 627245 | 636203 | 645066 | 653836 | 662513 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 8.581106 | 8.590572 | 8.599931 | 8.609187 | 8.618341 | 8.627395 | 8.636352 | 8.645213 | 8.653981 | 8.662657 | 56 |
| 5 | 15 581265 | 590729 | 600086 | 609340 | 618492 | 627545 | 636500 | 645360 | 654126 | 662801 | 55 |
| 6 | 30 581424 | 590886 | 600242 | 609494 | 618644 | 627695 | 636649 | 645507 | 654272 | 662945 | 54 |
| 7 | 45 581582 | 591042 | 600396 | 609647 | 618796 | 627845 | 636797 | 645654 | 654417 | 663088 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 8.581741 | 8.591199 | 8.600552 | 8.609800 | 8.618947 | 8.627993 | 8.636946 | 8.645801 | 8.654562 | 8.663232 | 52 |
| 9 | 15 581899 | 591356 | 600706 | 609954 | 619099 | 628145 | 637094 | 645947 | 654707 | 663376 | 51 |
| 10 | 30 582058 | 591513 | 600862 | 610107 | 619251 | 628295 | 637242 | 646094 | 654853 | 663520 | 50 |
| 11 | 45 582216 | 591669 | 601016 | 610260 | 619402 | 628445 | 637391 | 646241 | 654998 | 663663 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 8.582375 | 8.591826 | 8.601171 | 8.610413 | 8.619554 | 8.628595 | 8.637539 | 8.646388 | 8.655143 | 8.663807 | 48 |
| 13 | 15 582533 | 591982 | 601326 | 610566 | 619705 | 628745 | 637687 | 646534 | 655288 | 663951 | 47 |
| 14 | 30 582691 | 592139 | 601481 | 610720 | 619857 | 628895 | 637835 | 646681 | 655433 | 664094 | 46 |
| 15 | 45 582850 | 592296 | 601636 | 610873 | 620008 | 629044 | 637984 | 646828 | 655578 | 664238 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 8.583008 | 8.592452 | 8.601791 | 8.611026 | 8.620160 | 8.629194 | 8.638132 | 8.646974 | 8.655723 | 8.664381 | 44 |
| 17 | 15 583166 | 592609 | 601945 | 611179 | 620311 | 629344 | 638280 | 647121 | 655868 | 664525 | 43 |
| 18 | 30 583325 | 592765 | 602100 | 611332 | 620462 | 629494 | 638428 | 647267 | 656014 | 664668 | 42 |
| 19 | 45 583483 | 592922 | 602255 | 611485 | 620614 | 629643 | 638576 | 647414 | 656158 | 664812 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 8.583641 | 8.593078 | 8.602410 | 8.611638 | 8.620765 | 8.629793 | 8.638724 | 8.647560 | 8.656304 | 8.664955 | 40 |
| 21 | 15 583799 | 593234 | 602564 | 611791 | 620916 | 629943 | 638872 | 647707 | 656448 | 665099 | 39 |
| 22 | 30 583957 | 593391 | 602719 | 611944 | 621067 | 630092 | 639020 | 647853 | 656593 | 665242 | 38 |
| 23 | 45 584115 | 593547 | 602873 | 612097 | 621219 | 630242 | 639168 | 648000 | 656738 | 665386 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 8.584273 | 8.593703 | 8.603028 | 8.612249 | 8.621370 | 8.630391 | 8.639316 | 8.648146 | 8.656883 | 8.665529 | 36 |
| 25 | 15 584431 | 593860 | 603182 | 612402 | 621521 | 630541 | 639464 | 648292 | 657028 | 665672 | 35 |
| 26 | 30 584589 | 594016 | 603337 | 612555 | 621672 | 630691 | 639612 | 648439 | 657173 | 665816 | 34 |
| 27 | 45 584747 | 594172 | 603491 | 612708 | 621823 | 630840 | 639760 | 648585 | 657317 | 665959 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 8.584905 | 8.594328 | 8.603646 | 8.612861 | 8.621974 | 8.630989 | 8.639908 | 8.648731 | 8.657462 | 8.666102 | 32 |
| 29 | 15 585063 | 594484 | 603800 | 613013 | 622125 | 631139 | 640056 | 648878 | 657607 | 666245 | 31 |
| 30 | 30 585221 | 594641 | 603955 | 613166 | 622276 | 631288 | 640203 | 649024 | 657752 | 666389 | 30 |
| 31 | 45 585379 | 594797 | 604109 | 613319 | 622427 | 631438 | 640351 | 649170 | 657896 | 666532 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 8.585537 | 8.594953 | 8.604263 | 8.613471 | 8.622578 | 8.631587 | 8.640499 | 8.649316 | 8.658041 | 8.666675 | 28 |
| 33 | 15 585695 | 595109 | 604418 | 613624 | 622729 | 631736 | 640647 | 649463 | 658186 | 666818 | 27 |
| 34 | 30 585853 | 595265 | 604572 | 613776 | 622880 | 631886 | 640794 | 649609 | 658330 | 666961 | 26 |
| 35 | 45 586010 | 595421 | 604726 | 613929 | 623031 | 632035 | 640942 | 649755 | 658475 | 667104 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 8.586168 | 8.595577 | 8.604880 | 8.614081 | 8.623182 | 8.632184 | 8.641090 | 8.649901 | 8.658620 | 8.667247 | 24 |
| 37 | 15 586326 | 595733 | 605035 | 614234 | 623333 | 632333 | 641237 | 650047 | 658764 | 667390 | 23 |
| 38 | 30 586483 | 595888 | 605189 | 614386 | 623484 | 632482 | 641385 | 650193 | 658909 | 667533 | 22 |
| 39 | 45 586641 | 596044 | 605343 | 614539 | 623634 | 632632 | 641532 | 650339 | 659053 | 667676 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 8.586799 | 8.596200 | 8.605497 | 8.614691 | 8.623785 | 8.632781 | 8.641680 | 8.650485 | 8.659198 | 8.667819 | 20 |
| 41 | 15 586956 | 596356 | 605651 | 614844 | 623936 | 632930 | 641828 | 650631 | 659342 | 667962 | 19 |
| 42 | 30 587114 | 596512 | 605805 | 614996 | 624087 | 633079 | 641975 | 650777 | 659486 | 668105 | 18 |
| 43 | 45 587271 | 596667 | 605959 | 615148 | 624237 | 633228 | 642123 | 650923 | 659631 | 668248 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 8.587429 | 8.596823 | 8.606113 | 8.615301 | 8.624388 | 8.633377 | 8.642270 | 8.651069 | 8.659775 | 8.668391 | 16 |
| 45 | 15 587586 | 596979 | 606267 | 615453 | 624539 | 633526 | 642417 | 651214 | 659919 | 668534 | 15 |
| 46 | 30 587743 | 597135 | 606421 | 615605 | 624689 | 633675 | 642565 | 651360 | 660064 | 668677 | 14 |
| 47 | 45 587901 | 597290 | 606575 | 615757 | 624840 | 633824 | 642712 | 651506 | 660208 | 668819 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 8.588058 | 8.597446 | 8.606729 | 8.615910 | 8.624990 | 8.633973 | 8.642859 | 8.651652 | 8.660352 | 8.668962 | 12 |
| 49 | 15 588215 | 597601 | 606883 | 616062 | 625141 | 634122 | 643007 | 651798 | 660497 | 669105 | 11 |
| 50 | 30 588373 | 597757 | 607036 | 616214 | 625291 | 634271 | 643154 | 651943 | 660641 | 669248 | 10 |
| 51 | 45 588530 | 597912 | 607190 | 616366 | 625442 | 634419 | 643301 | 652089 | 660785 | 669390 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 8.588687 | 8.598068 | 8.607344 | 8.616518 | 8.625592 | 8.634568 | 8.643449 | 8.652235 | 8.660929 | 8.669533 | 8 |
| 53 | 15 588844 | 598223 | 607498 | 616670 | 625742 | 634717 | 643596 | 652380 | 661073 | 669676 | 7 |
| 54 | 30 589002 | 598375 | 607651 | 616822 | 625893 | 634866 | 643743 | 652526 | 661217 | 669818 | 6 |
| 55 | 45 589159 | 598534 | 607805 | 616974 | 626043 | 635014 | 643890 | 652672 | 661361 | 669961 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 8.589316 | 8.598689 | 8.607959 | 8.617126 | 8.626194 | 8.635163 | 8.644037 | 8.652817 | 8.661505 | 8.670103 | 4 |
| 57 | 15 589473 | 598845 | 608112 | 617278 | 626344 | 635312 | 644184 | 652963 | 661649 | 670246 | 3 |
| 58 | 30 589630 | 599000 | 608266 | 617430 | 626494 | 635461 | 644331 | 653108 | 661793 | 670389 | 2 |
| 59 | 45 589787 | 599155 | 608419 | 617582 | 626644 | 635609 | 644478 | 653254 | 661937 | 670531 | 1 |
| 60 | 60 8.589944 | 8.599311 | 8.608573 | 8.617734 | 8.626795 | 8.635758 | 8.644625 | 8.653399 | 8.662081 | 8.670674 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 45 deg. | | | | 46 deg. | | | | 47 deg. | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 9.165679 | 9.170240 | 9.174773 | 9.179278 | 9.183756 | 9.188207 | 9.192631 | 9.197028 | 9.201399 | 9.205745 |
| 1 | 15 165755 | 170316 | 174848 | 179353 | 183830 | 188281 | 192704 | 197101 | 201472 | 205817 |
| 2 | 30 165832 | 170392 | 174924 | 179428 | 183905 | 188355 | 192778 | 197174 | 201545 | 205889 |
| 3 | 45 165908 | 170467 | 174999 | 179503 | 183979 | 188429 | 192851 | 197247 | 201617 | 205961 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ |
| 4 | 0 9.165984 | 9.170543 | 9.175074 | 9.179578 | 9.184054 | 9.188503 | 9.192925 | 9.197320 | 9.201690 | 9.206033 |
| 5 | 15 166060 | 170619 | 175149 | 179652 | 184128 | 188576 | 192998 | 197393 | 201762 | 206105 |
| 6 | 30 166137 | 170695 | 175225 | 179727 | 184202 | 188650 | 193072 | 197466 | 201835 | 206178 |
| 7 | 45 166213 | 170770 | 175300 | 179802 | 184277 | 188724 | 193145 | 197539 | 201908 | 206250 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ |
| 8 | 0 9.166289 | 9.170846 | 9.175375 | 9.179877 | 9.184351 | 9.188798 | 9.193219 | 9.197613 | 9.201980 | 9.206322 |
| 9 | 15 166365 | 170922 | 175450 | 179952 | 184425 | 188872 | 193292 | 197685 | 202053 | 206395 |
| 10 | 30 166441 | 170998 | 175526 | 180026 | 184500 | 188946 | 193366 | 197759 | 202125 | 206467 |
| 11 | 45 166517 | 171073 | 175601 | 180101 | 184574 | 189020 | 193439 | 197831 | 202198 | 206539 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 9.166594 | 9.171149 | 9.175676 | 9.180176 | 9.184648 | 9.189094 | 9.193512 | 9.197905 | 9.202270 | 9.206611 |
| 13 | 15 166670 | 171225 | 175751 | 180251 | 184723 | 189168 | 193586 | 197977 | 202343 | 206684 |
| 14 | 30 166746 | 171300 | 175827 | 180325 | 184797 | 189241 | 193659 | 198050 | 202416 | 206755 |
| 15 | 45 166822 | 171376 | 175902 | 180400 | 184871 | 189315 | 193733 | 198123 | 202488 | 206827 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 9.166898 | 9.171452 | 9.175977 | 9.180475 | 9.184946 | 9.189389 | 9.193806 | 9.198196 | 9.202561 | 9.206899 |
| 17 | 15 166974 | 171527 | 176052 | 180550 | 185020 | 189463 | 193879 | 198269 | 202633 | 206971 |
| 18 | 30 167051 | 171603 | 176127 | 180624 | 185094 | 189537 | 193953 | 198342 | 202706 | 207043 |
| 19 | 45 167127 | 171678 | 176203 | 180699 | 185168 | 189611 | 194026 | 198415 | 202778 | 207115 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 9.167203 | 9.171754 | 9.176278 | 9.180774 | 9.185243 | 9.189684 | 9.194100 | 9.198488 | 9.202851 | 9.207187 |
| 21 | 15 167279 | 171830 | 176353 | 180848 | 185317 | 189758 | 194173 | 198561 | 202923 | 207259 |
| 22 | 30 167355 | 171905 | 176428 | 180923 | 185391 | 189832 | 194246 | 198634 | 202996 | 207331 |
| 23 | 45 167431 | 171981 | 176503 | 180998 | 185465 | 189906 | 194319 | 198707 | 203068 | 207403 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 9.167507 | 9.172057 | 9.176578 | 9.181073 | 9.185540 | 9.189980 | 9.194393 | 9.198780 | 9.203141 | 9.207475 |
| 25 | 15 167583 | 172132 | 176653 | 181147 | 185614 | 190053 | 194466 | 198853 | 203213 | 207547 |
| 26 | 30 167659 | 172208 | 176729 | 181222 | 185688 | 190127 | 194540 | 198926 | 203285 | 207619 |
| 27 | 45 167735 | 172283 | 176804 | 181297 | 185762 | 190201 | 194613 | 198998 | 203358 | 207691 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 9.167811 | 9.172359 | 9.176879 | 9.181371 | 9.185836 | 9.190275 | 9.194686 | 9.199071 | 9.203430 | 9.207763 |
| 29 | 15 167887 | 172434 | 176954 | 181446 | 185911 | 190348 | 194759 | 199144 | 203503 | 207835 |
| 30 | 30 167963 | 172510 | 177029 | 181521 | 185985 | 190422 | 194833 | 199217 | 203575 | 207907 |
| 31 | 45 168039 | 172586 | 177104 | 181595 | 186059 | 190496 | 194906 | 199290 | 203648 | 207979 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 9.168115 | 9.172661 | 9.177179 | 9.181670 | 9.186133 | 9.190570 | 9.194979 | 9.199363 | 9.203720 | 9.208051 |
| 33 | 15 168191 | 172737 | 177254 | 181744 | 186207 | 190643 | 195053 | 199436 | 203792 | 208123 |
| 34 | 30 168267 | 172812 | 177329 | 181819 | 186281 | 190717 | 195126 | 199508 | 203865 | 208195 |
| 35 | 45 168343 | 172888 | 177404 | 181894 | 186356 | 190791 | 195199 | 199581 | 203937 | 208267 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ |
| 36 | 0 9.168419 | 9.172963 | 9.177479 | 9.181968 | 9.186430 | 9.190864 | 9.195272 | 9.199654 | 9.204010 | 9.208339 |
| 37 | 15 168495 | 173039 | 177554 | 182043 | 186504 | 190938 | 195346 | 199727 | 204082 | 208411 |
| 38 | 30 168571 | 173114 | 177629 | 182117 | 186578 | 191012 | 195419 | 199800 | 204154 | 208483 |
| 39 | 45 168647 | 173190 | 177704 | 182192 | 186652 | 191085 | 195492 | 199872 | 204227 | 208555 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ |
| 40 | 0 9.168723 | 9.173265 | 9.177779 | 9.182266 | 9.186726 | 9.191159 | 9.195565 | 9.199945 | 9.204299 | 9.208627 |
| 41 | 15 168799 | 173341 | 177854 | 182341 | 186800 | 191233 | 195638 | 200018 | 204371 | 208699 |
| 42 | 30 168875 | 173416 | 177929 | 182416 | 186874 | 191306 | 195712 | 200091 | 204444 | 208771 |
| 43 | 45 168951 | 173491 | 178004 | 182490 | 186948 | 191380 | 195785 | 200163 | 204516 | 208843 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 9.169027 | 9.173567 | 9.178079 | 9.182565 | 9.187023 | 9.191454 | 9.195858 | 9.200236 | 9.204588 | 9.208915 |
| 45 | 15 169102 | 173642 | 178154 | 182639 | 187097 | 191527 | 195931 | 200309 | 204661 | 208988 |
| 46 | 30 169178 | 173718 | 178229 | 182714 | 187171 | 191601 | 196004 | 200382 | 204733 | 209060 |
| 47 | 45 169254 | 173793 | 178304 | 182788 | 187245 | 191674 | 196078 | 200454 | 204805 | 209130 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 9.169330 | 9.173869 | 9.178379 | 9.182863 | 9.187319 | 9.191748 | 9.196151 | 9.200527 | 9.204878 | 9.209202 |
| 49 | 15 169406 | 173944 | 178454 | 182937 | 187393 | 191822 | 196224 | 200600 | 204950 | 209275 |
| 50 | 30 169482 | 174019 | 178529 | 183012 | 187467 | 191895 | 196297 | 200673 | 205022 | 209347 |
| 51 | 45 169558 | 174095 | 178604 | 183086 | 187541 | 191969 | 196370 | 200745 | 205094 | 209418 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 9.169634 | 9.174170 | 9.178679 | 9.183161 | 9.187615 | 9.192042 | 9.196443 | 9.200818 | 9.205167 | 9.209490 |
| 53 | 15 169709 | 174246 | 178754 | 183235 | 187689 | 192116 | 196516 | 200891 | 205239 | 209561 |
| 54 | 30 169785 | 174321 | 178829 | 183309 | 187763 | 192190 | 196590 | 200963 | 205311 | 209633 |
| 55 | 45 169861 | 174396 | 178904 | 183384 | 187837 | 192263 | 196663 | 201036 | 205383 | 209705 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 9.169937 | 9.174472 | 9.178979 | 9.183458 | 9.187911 | 9.192337 | 9.196736 | 9.201109 | 9.205456 | 9.209777 |
| 57 | 15 170013 | 174547 | 179054 | 183533 | 187985 | 192410 | 196809 | 201181 | 205528 | 209849 |
| 58 | 30 170089 | 174622 | 179128 | 183607 | 188059 | 192484 | 196882 | 201254 | 205600 | 209921 |
| 59 | 45 170164 | 174698 | 179203 | 183682 | 188133 | 192557 | 196955 | 201327 | 205672 | 209992 |
| | 9.170240 | 9.174773 | 9.179278 | 9.183756 | 9.188207 | 9.192631 | 9.197028 | 9.201399 | 9.205745 | 9.210064 |
| | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 27 deg. | | 28 deg. | | | | 29 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 8.752007 | 8.759715 | 8.767350 | 8.774916 | 8.782411 | 8.789839 | 8.797199 | 8.804494 | 8.811723 | 8.818889 | 60 |
| 1 | 15 752136 | 759842 | 767477 | 775041 | 782536 | 789962 | 797321 | 804615 | 811843 | 819008 | 59 |
| 2 | 30 752265 | 759970 | 767604 | 775167 | 782660 | 790085 | 797443 | 804736 | 811963 | 819127 | 58 |
| 3 | 45 752394 | 760098 | 767730 | 775292 | 782784 | 790208 | 797566 | 804857 | 812083 | 819246 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 8.752523 | 8.760226 | 8.767857 | 8.775417 | 8.782909 | 8.790332 | 8.797688 | 8.804978 | 8.812203 | 8.819365 | 56 |
| 5 | 15 752652 | 760353 | 767983 | 775543 | 783033 | 790455 | 797810 | 805099 | 812323 | 819484 | 55 |
| 6 | 30 752781 | 760481 | 768110 | 775668 | 783157 | 790578 | 797932 | 805220 | 812443 | 819602 | 54 |
| 7 | 45 752910 | 760609 | 768237 | 775794 | 783281 | 790701 | 798054 | 805341 | 812563 | 819721 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 8.753039 | 8.760737 | 8.768363 | 8.775919 | 8.783406 | 8.790824 | 8.798176 | 8.805461 | 8.812683 | 8.819840 | 52 |
| 9 | 15 753168 | 760864 | 768490 | 776044 | 783530 | 790947 | 798298 | 805582 | 812802 | 819959 | 51 |
| 10 | 30 753296 | 760992 | 768616 | 776170 | 783654 | 791070 | 798420 | 805703 | 812922 | 820078 | 50 |
| 11 | 45 753425 | 761120 | 768745 | 776295 | 783778 | 791193 | 798541 | 805824 | 813042 | 820196 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 8.753554 | 8.761247 | 8.768869 | 8.776420 | 8.783902 | 8.791316 | 8.798663 | 8.805945 | 8.813162 | 8.820315 | 48 |
| 13 | 15 753683 | 761375 | 768995 | 776545 | 784026 | 791439 | 798785 | 806066 | 813281 | 820434 | 47 |
| 14 | 30 753812 | 761503 | 769122 | 776671 | 784150 | 791562 | 798907 | 806186 | 813401 | 820552 | 46 |
| 15 | 45 753941 | 761630 | 769248 | 776796 | 784274 | 791685 | 799029 | 806307 | 813521 | 820671 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 8.754069 | 8.761758 | 8.769375 | 8.776921 | 8.784399 | 8.791808 | 8.799151 | 8.806428 | 8.813641 | 8.820790 | 44 |
| 17 | 15 754198 | 761885 | 769501 | 777046 | 784523 | 791931 | 799273 | 806549 | 813760 | 820908 | 43 |
| 18 | 30 754327 | 762013 | 769627 | 777172 | 784647 | 792054 | 799395 | 806669 | 813880 | 821027 | 42 |
| 19 | 45 754465 | 762140 | 769754 | 777297 | 784771 | 792177 | 799516 | 806790 | 813999 | 821145 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 8.754584 | 8.762268 | 8.769880 | 8.777422 | 8.784895 | 8.792300 | 8.799638 | 8.806911 | 8.814119 | 8.821264 | 40 |
| 21 | 15 754713 | 762395 | 770006 | 777547 | 785019 | 792423 | 799760 | 807031 | 814239 | 821382 | 39 |
| 22 | 30 754841 | 762523 | 770132 | 777672 | 785143 | 792545 | 799882 | 807152 | 814358 | 821501 | 38 |
| 23 | 45 754970 | 762650 | 770259 | 777797 | 785266 | 792668 | 800003 | 807273 | 814478 | 821619 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 8.755099 | 8.762777 | 8.770385 | 8.777922 | 8.785390 | 8.792791 | 8.800125 | 8.807393 | 8.814597 | 8.821738 | 36 |
| 25 | 15 755227 | 762905 | 770511 | 778047 | 785514 | 792914 | 800247 | 807514 | 814717 | 821856 | 35 |
| 26 | 30 755356 | 763032 | 770637 | 778172 | 785638 | 793037 | 800368 | 807635 | 814836 | 821975 | 34 |
| 27 | 45 755484 | 763159 | 770763 | 778297 | 785762 | 793159 | 800490 | 807755 | 814956 | 822093 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 8.755613 | 8.763287 | 8.770889 | 8.778422 | 8.785886 | 8.793282 | 8.800612 | 8.807876 | 8.815075 | 8.822212 | 32 |
| 29 | 15 755741 | 763414 | 771016 | 778547 | 786010 | 793405 | 800733 | 807996 | 815195 | 822330 | 31 |
| 30 | 30 755870 | 763541 | 771142 | 778672 | 786134 | 793527 | 800855 | 808117 | 815314 | 822449 | 30 |
| 31 | 45 755998 | 763669 | 771268 | 778797 | 786257 | 793650 | 800976 | 808237 | 815434 | 822567 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 8.756127 | 8.763796 | 8.771394 | 8.778922 | 8.786381 | 8.793773 | 8.801098 | 8.808358 | 8.815553 | 8.822685 | 28 |
| 33 | 15 756255 | 763923 | 771520 | 779047 | 786505 | 793895 | 801219 | 808478 | 815672 | 822804 | 27 |
| 34 | 30 756383 | 764050 | 771646 | 779172 | 786629 | 794018 | 801341 | 808598 | 815792 | 822922 | 26 |
| 35 | 45 756512 | 764177 | 771772 | 779296 | 786752 | 794140 | 801462 | 808719 | 815911 | 823040 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 8.756640 | 8.764305 | 8.771898 | 8.779421 | 8.786876 | 8.794263 | 8.801584 | 8.808839 | 8.816031 | 8.823159 | 24 |
| 37 | 15 756768 | 764432 | 772024 | 779546 | 787000 | 794386 | 801705 | 808960 | 816150 | 823277 | 23 |
| 38 | 30 756897 | 764559 | 772150 | 779671 | 787123 | 794508 | 801827 | 809080 | 816269 | 823395 | 22 |
| 39 | 45 757025 | 764686 | 772276 | 779796 | 787247 | 794631 | 801948 | 809200 | 816388 | 823513 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 8.757153 | 8.764813 | 8.772402 | 8.779920 | 8.787370 | 8.794753 | 8.802070 | 8.809321 | 8.816508 | 8.823632 | 20 |
| 41 | 15 757282 | 764940 | 772527 | 780045 | 787494 | 794876 | 802191 | 809441 | 816627 | 823750 | 19 |
| 42 | 30 757410 | 765067 | 772653 | 780170 | 787618 | 794998 | 802312 | 809561 | 816746 | 823868 | 18 |
| 43 | 45 757538 | 765194 | 772779 | 780294 | 787741 | 795121 | 802434 | 809682 | 816865 | 823986 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 8.757666 | 8.765321 | 8.772905 | 8.780419 | 8.787865 | 8.795243 | 8.802555 | 8.809802 | 8.816985 | 8.824104 | 16 |
| 45 | 15 757794 | 765448 | 773031 | 780544 | 787988 | 795365 | 802676 | 809922 | 817104 | 824222 | 15 |
| 46 | 30 757923 | 765575 | 773157 | 780668 | 788112 | 795488 | 802798 | 810042 | 817223 | 824341 | 14 |
| 47 | 45 758051 | 765702 | 773282 | 780793 | 788235 | 795610 | 802919 | 810162 | 817342 | 824459 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 8.758179 | 8.765829 | 8.773408 | 8.780918 | 8.788359 | 8.795733 | 8.803040 | 8.810283 | 8.817461 | 8.824577 | 12 |
| 49 | 15 758307 | 765956 | 773534 | 781042 | 788482 | 795855 | 803161 | 810403 | 817580 | 824695 | 11 |
| 50 | 30 758435 | 766083 | 773660 | 781167 | 788606 | 795977 | 803283 | 810523 | 817699 | 824813 | 10 |
| 51 | 45 758563 | 766209 | 773785 | 781291 | 788729 | 796099 | 803404 | 810643 | 817818 | 824931 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 8.758691 | 8.766336 | 8.773911 | 8.781416 | 8.788852 | 8.796222 | 8.803525 | 8.810763 | 8.817938 | 8.825049 | 8 |
| 53 | 15 758819 | 766463 | 774037 | 781540 | 788976 | 796344 | 803646 | 810883 | 818056 | 825167 | 7 |
| 54 | 30 758947 | 766590 | 774162 | 781665 | 789099 | 796466 | 803767 | 811003 | 818176 | 825285 | 6 |
| 55 | 45 759075 | 766717 | 774288 | 781789 | 789222 | 796588 | 803888 | 811123 | 818295 | 825403 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 8.759203 | 8.766844 | 8.774413 | 8.781914 | 8.789346 | 8.796711 | 8.804010 | 8.811243 | 8.818414 | 8.825521 | 4 |
| 57 | 15 759331 | 766970 | 774539 | 782038 | 789469 | 796833 | 804131 | 811363 | 818532 | 825639 | 3 |
| 58 | 30 759459 | 767097 | 774664 | 782163 | 789592 | 796955 | 804252 | 811483 | 818651 | 825757 | 2 |
| 59 | 45 759587 | 767224 | 774790 | 782287 | 789716 | 797077 | 804373 | 811603 | 818770 | 825875 | 1 |
| 60 | 60 8.759715 | 8.767350 | 8.774916 | 8.782411 | 8.789839 | 8.797199 | 8.804494 | 8.811723 | 8.818889 | 8.825992 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 deg. | | | | 51 deg. | | | | 52 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.251897 | 9.255949 | 9.259978 | 9.263985 | 9.267969 | 9.271930 | 9.275870 | 9.279788 | 9.283684 | 9.287558 | 60 |
| 1 | 15 251964 | 256016 | 260045 | 264051 | 268035 | 271996 | 275936 | 279853 | 283749 | 287623 | 59 |
| 2 | 30 252032 | 256083 | 260112 | 264118 | 268101 | 272062 | 276001 | 279918 | 283813 | 287687 | 58 |
| 3 | 45 252100 | 256151 | 260179 | 264184 | 268167 | 272128 | 276066 | 279983 | 283878 | 287752 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.252167 | 9.256218 | 9.260246 | 9.264251 | 9.268234 | 9.272194 | 9.276132 | 9.280048 | 9.283943 | 9.287816 | 56 |
| 5 | 15 252235 | 256285 | 260313 | 264317 | 268300 | 272260 | 276197 | 280113 | 284008 | 287880 | 55 |
| 6 | 30 252303 | 256353 | 260380 | 264384 | 268366 | 272325 | 276263 | 280178 | 284072 | 287945 | 54 |
| 7 | 45 252370 | 256420 | 260447 | 264451 | 268432 | 272391 | 276328 | 280243 | 284137 | 288009 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.252438 | 9.256487 | 9.260514 | 9.264517 | 9.268498 | 9.272457 | 9.276394 | 9.280309 | 9.284202 | 9.288073 | 52 |
| 9 | 15 252506 | 256555 | 260580 | 264584 | 268564 | 272523 | 276459 | 280374 | 284266 | 288138 | 51 |
| 10 | 30 252573 | 256622 | 260647 | 264650 | 268631 | 272589 | 276525 | 280439 | 284331 | 288202 | 50 |
| 11 | 45 252641 | 256689 | 260714 | 264717 | 268697 | 272654 | 276590 | 280504 | 284396 | 288266 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.252709 | 9.256756 | 9.260781 | 9.264783 | 9.268763 | 9.272720 | 9.276655 | 9.280569 | 9.284461 | 9.288331 | 48 |
| 13 | 15 252776 | 256824 | 260848 | 264850 | 268829 | 272786 | 276721 | 280634 | 284525 | 288395 | 47 |
| 14 | 30 252844 | 256891 | 260915 | 264916 | 268895 | 272852 | 276786 | 280699 | 284590 | 288459 | 46 |
| 15 | 45 252912 | 256958 | 260982 | 264983 | 268961 | 272917 | 276852 | 280764 | 284654 | 288524 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.252979 | 9.257025 | 9.261049 | 9.265049 | 9.269027 | 9.272983 | 9.276917 | 9.280829 | 9.284719 | 9.288588 | 44 |
| 17 | 15 253047 | 257093 | 261115 | 265116 | 269093 | 273049 | 276982 | 280891 | 284784 | 288652 | 43 |
| 18 | 30 253115 | 257160 | 261182 | 265182 | 269160 | 273115 | 277048 | 280959 | 284849 | 288717 | 42 |
| 19 | 45 253182 | 257227 | 261249 | 265249 | 269226 | 273180 | 277113 | 281024 | 284913 | 288781 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.253250 | 9.257294 | 9.261316 | 9.265315 | 9.269292 | 9.273246 | 9.277178 | 9.281089 | 9.284978 | 9.288845 | 40 |
| 21 | 15 253317 | 257362 | 261383 | 265382 | 269358 | 273312 | 277244 | 281154 | 285042 | 288909 | 39 |
| 22 | 30 253385 | 257429 | 261450 | 265448 | 269424 | 273378 | 277309 | 281219 | 285107 | 288974 | 38 |
| 23 | 45 253453 | 257496 | 261517 | 265514 | 269490 | 273443 | 277374 | 281284 | 285172 | 289038 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.253520 | 9.257563 | 9.261583 | 9.265581 | 9.269556 | 9.273509 | 9.277440 | 9.281349 | 9.285236 | 9.289102 | 36 |
| 25 | 15 253588 | 257630 | 261650 | 265647 | 269622 | 273575 | 277505 | 281414 | 285301 | 289166 | 35 |
| 26 | 30 253655 | 257698 | 261717 | 265714 | 269688 | 273640 | 277570 | 281479 | 285366 | 289231 | 34 |
| 27 | 45 253723 | 257765 | 261784 | 265780 | 269754 | 273706 | 277636 | 281544 | 285430 | 289295 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.253790 | 9.257832 | 9.261851 | 9.265847 | 9.269820 | 9.273772 | 9.277701 | 9.281609 | 9.285495 | 9.289359 | 32 |
| 29 | 15 253858 | 257899 | 261917 | 265913 | 269886 | 273837 | 277766 | 281674 | 285559 | 289423 | 31 |
| 30 | 30 253926 | 257966 | 261984 | 265979 | 269952 | 273903 | 277832 | 281739 | 285624 | 289488 | 30 |
| 31 | 45 253993 | 258033 | 262051 | 266046 | 270018 | 273969 | 277897 | 281803 | 285688 | 289552 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.254061 | 9.258101 | 9.262118 | 9.266112 | 9.270084 | 9.274034 | 9.277962 | 9.281868 | 9.285753 | 9.289616 | 28 |
| 33 | 15 254128 | 258168 | 262184 | 266179 | 270150 | 274100 | 278028 | 281933 | 285817 | 289680 | 27 |
| 34 | 30 254196 | 258235 | 262251 | 266245 | 270216 | 274166 | 278093 | 281998 | 285882 | 289745 | 26 |
| 35 | 45 254263 | 258302 | 262318 | 266311 | 270282 | 274231 | 278158 | 282063 | 285947 | 289809 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.254331 | 9.258369 | 9.262385 | 9.266378 | 9.270348 | 9.274297 | 9.278223 | 9.282128 | 9.286011 | 9.289873 | 24 |
| 37 | 15 254398 | 258436 | 262451 | 266444 | 270414 | 274362 | 278289 | 282193 | 286076 | 289937 | 23 |
| 38 | 30 254466 | 258503 | 262518 | 266510 | 270480 | 274428 | 278354 | 282258 | 286140 | 290001 | 22 |
| 39 | 45 254533 | 258570 | 262585 | 266577 | 270546 | 274494 | 278419 | 282323 | 286205 | 290065 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.254601 | 9.258637 | 9.262652 | 9.266643 | 9.270612 | 9.274559 | 9.278484 | 9.282388 | 9.286269 | 9.290130 | 20 |
| 41 | 15 254666 | 258705 | 262718 | 266709 | 270678 | 274625 | 278550 | 282452 | 286334 | 290194 | 19 |
| 42 | 30 254735 | 258772 | 262785 | 266776 | 270744 | 274691 | 278615 | 282517 | 286398 | 290258 | 18 |
| 43 | 45 254803 | 258839 | 262852 | 266842 | 270810 | 274756 | 278680 | 282582 | 286463 | 290322 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.254870 | 9.258906 | 9.262918 | 9.266908 | 9.270876 | 9.274822 | 9.278745 | 9.282647 | 9.286527 | 9.290386 | 16 |
| 45 | 15 254938 | 258973 | 262985 | 266975 | 270942 | 274887 | 278810 | 282712 | 286592 | 290450 | 15 |
| 46 | 30 255005 | 259040 | 263052 | 267041 | 271008 | 274953 | 278876 | 282777 | 286656 | 290514 | 14 |
| 47 | 45 255073 | 259107 | 263118 | 267107 | 271074 | 275018 | 278941 | 282842 | 286721 | 290579 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.255140 | 9.259174 | 9.263185 | 9.267174 | 9.271140 | 9.275084 | 9.279006 | 9.282906 | 9.286785 | 9.290643 | 12 |
| 49 | 15 255207 | 259241 | 263252 | 267240 | 271206 | 275149 | 279071 | 282971 | 286850 | 290707 | 11 |
| 50 | 30 255275 | 259308 | 263318 | 267306 | 271272 | 275215 | 279136 | 283036 | 286914 | 290771 | 10 |
| 51 | 45 255342 | 259375 | 263385 | 267372 | 271338 | 275281 | 279202 | 283101 | 286979 | 290835 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.255410 | 9.259442 | 9.263452 | 9.267439 | 9.271404 | 9.275346 | 9.279267 | 9.283166 | 9.287043 | 9.290899 | 8 |
| 53 | 15 255477 | 259509 | 263518 | 267505 | 271469 | 275412 | 279332 | 283230 | 287107 | 290963 | 7 |
| 54 | 30 255545 | 259576 | 263585 | 267571 | 271535 | 275477 | 279397 | 283295 | 287172 | 291027 | 6 |
| 55 | 45 255612 | 259643 | 263652 | 267638 | 271601 | 275543 | 279462 | 283360 | 287236 | 291091 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.255679 | 9.259710 | 9.263718 | 9.267704 | 9.271667 | 9.275608 | 9.279527 | 9.283425 | 9.287301 | 9.291155 | 4 |
| 57 | 15 255747 | 259777 | 263785 | 267770 | 271733 | 275674 | 279592 | 283490 | 287365 | 291219 | 3 |
| 58 | 30 255814 | 259844 | 263851 | 267836 | 271799 | 275739 | 279658 | 283554 | 287430 | 291284 | 2 |
| 59 | 45 255881 | 259911 | 263918 | 267902 | 271865 | 275805 | 279723 | 283619 | 287494 | 291348 | 1 |
| 60 | 60 9.255949 | 9.259978 | 9.263985 | 9.267969 | 9.271930 | 9.275870 | 9.279788 | 9.283684 | 9.287558 | 9.291412 | 0 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| sec. | $10^m$ | $11^m$ | $12^m$ | $13^m$ | $14^m$ | $15^m$ | $16^m$ | $17^m$ | $18^m$ | $19^m$ | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32 deg. | | 33 deg. | | | | 34 deg. | | | | |
| | ′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 | 8.893785 | 8.900261 | 8.906684 | 8.913055 | 8.919377 | 8.925648 | 8.931871 | 8.938045 | 8.944171 | 8.950251 | 60 |
| 1 | 15 | 893894 | 900368 | 906790 | 913161 | 919482 | 925752 | 931974 | 938147 | 944273 | 950351 | 59 |
| 2 | 30 | 894002 | 900475 | 906897 | 913267 | 919587 | 925856 | 932077 | 938250 | 944375 | 950452 | 58 |
| 3 | 45 | 894110 | 900583 | 907003 | 913373 | 919691 | 925960 | 932180 | 938352 | 944476 | 950553 | 57 |
| | | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 | 8.894219 | 8.900690 | 8.907110 | 8.913478 | 8.919796 | 8.926065 | 8.932284 | 8.938455 | 8.944578 | 8.950654 | 56 |
| 5 | 15 | 894327 | 900798 | 907216 | 913584 | 919901 | 926169 | 932387 | 938557 | 944680 | 950755 | 55 |
| 6 | 30 | 894435 | 900905 | 907323 | 913690 | 920006 | 926273 | 932490 | 938660 | 944781 | 950856 | 54 |
| 7 | 45 | 894544 | 901013 | 907430 | 913795 | 920111 | 926377 | 932593 | 938762 | 944883 | 950957 | 53 |
| | | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 | 8.894652 | 8.901120 | 8.907536 | 8.913901 | 8.920216 | 8.926481 | 8.932697 | 8.938864 | 8.944984 | 8.951058 | 52 |
| 9 | 15 | 894760 | 901227 | 907643 | 914007 | 920321 | 926585 | 932800 | 938967 | 945086 | 951158 | 51 |
| 10 | 30 | 894868 | 901335 | 907749 | 914112 | 920425 | 926689 | 932903 | 939069 | 945188 | 951259 | 50 |
| 11 | 45 | 894976 | 901442 | 907855 | 914218 | 920530 | 926793 | 933006 | 939171 | 945289 | 951360 | 49 |
| | | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 | 8.895085 | 8.901549 | 8.907962 | 8.914324 | 8.920635 | 8.926897 | 8.933109 | 8.939274 | 8.945391 | 8.951461 | 48 |
| 13 | 15 | 895193 | 901657 | 908068 | 914429 | 920740 | 927000 | 933212 | 939376 | 945492 | 951562 | 47 |
| 14 | 30 | 895301 | 901764 | 908175 | 914535 | 920844 | 927104 | 933316 | 939479 | 945594 | 951662 | 46 |
| 15 | 45 | 895409 | 901871 | 908281 | 914640 | 920949 | 927208 | 933419 | 939581 | 945695 | 951763 | 45 |
| | | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 | 8.895517 | 8.901978 | 8.908388 | 8.914746 | 8.921054 | 8.927312 | 8.933522 | 8.939683 | 8.945797 | 8.951864 | 44 |
| 17 | 15 | 895625 | 902086 | 908494 | 914852 | 921159 | 927416 | 933625 | 939785 | 945898 | 951965 | 43 |
| 18 | 30 | 895734 | 902193 | 908600 | 914957 | 921263 | 927520 | 933728 | 939888 | 946000 | 952065 | 42 |
| 19 | 45 | 895842 | 902300 | 908707 | 915063 | 921368 | 927624 | 933831 | 939990 | 946101 | 952166 | 41 |
| | | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 | 8.895950 | 8.902407 | 8.908813 | 8.915168 | 8.921473 | 8.927728 | 8.933934 | 8.940092 | 8.946203 | 8.952267 | 40 |
| 21 | 15 | 896058 | 902514 | 908919 | 915274 | 921577 | 927832 | 934037 | 940194 | 946304 | 952367 | 39 |
| 22 | 30 | 896166 | 902622 | 909026 | 915379 | 921682 | 927935 | 934140 | 940297 | 946406 | 952468 | 38 |
| 23 | 45 | 896274 | 902729 | 909132 | 915484 | 921787 | 928039 | 934243 | 940399 | 946507 | 952569 | 37 |
| | | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 | 8.896382 | 8.902836 | 8.909238 | 8.915590 | 8.921891 | 8.928143 | 8.934346 | 8.940501 | 8.946609 | 8.952669 | 36 |
| 25 | 15 | 896490 | 902943 | 909345 | 915695 | 921996 | 928247 | 934449 | 940603 | 946710 | 952770 | 35 |
| 26 | 30 | 896598 | 903050 | 909451 | 915801 | 922100 | 928351 | 934552 | 940705 | 946811 | 952871 | 34 |
| 27 | 45 | 896706 | 903157 | 909557 | 915906 | 922205 | 928454 | 934655 | 940808 | 946913 | 952971 | 33 |
| | | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 | 8.896814 | 8.903264 | 8.909663 | 8.916012 | 8.922310 | 8.928558 | 8.934758 | 8.940910 | 8.947014 | 8.953072 | 32 |
| 29 | 15 | 896922 | 903371 | 909770 | 916117 | 922414 | 928662 | 934861 | 941012 | 947115 | 953172 | 31 |
| 30 | 30 | 897030 | 903479 | 909876 | 916222 | 922519 | 928766 | 934964 | 941114 | 947217 | 953273 | 30 |
| 31 | 45 | 897137 | 903586 | 909982 | 916328 | 922623 | 928869 | 935067 | 941216 | 947318 | 953373 | 29 |
| | | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 | 8.897245 | 8.903693 | 8.910088 | 8.916433 | 8.922728 | 8.928973 | 8.935170 | 8.941318 | 8.947419 | 8.953474 | 28 |
| 33 | 15 | 897353 | 903800 | 910194 | 916538 | 922832 | 929077 | 935272 | 941420 | 947521 | 953574 | 27 |
| 34 | 30 | 897461 | 903907 | 910301 | 916644 | 922937 | 929180 | 935375 | 941522 | 947622 | 953675 | 26 |
| 35 | 45 | 897569 | 904014 | 910407 | 916749 | 923041 | 929284 | 935478 | 941624 | 947723 | 953775 | 25 |
| | | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 | 8.897677 | 8.904121 | 8.910513 | 8.916854 | 8.923146 | 8.929388 | 8.935581 | 8.941726 | 8.947824 | 8.953876 | 24 |
| 37 | 15 | 897785 | 904228 | 910619 | 916959 | 923250 | 929491 | 935684 | 941828 | 947926 | 953976 | 23 |
| 38 | 30 | 897892 | 904334 | 910725 | 917065 | 923354 | 929595 | 935787 | 941930 | 948027 | 954077 | 22 |
| 39 | 45 | 898000 | 904441 | 910831 | 917170 | 923459 | 929698 | 935889 | 942032 | 948128 | 954177 | 21 |
| | | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 | 8.898108 | 8.904548 | 8.910937 | 8.917275 | 8.923563 | 8.929802 | 8.935992 | 8.942134 | 8.948229 | 8.954278 | 20 |
| 41 | 15 | 898216 | 904655 | 911043 | 917380 | 923668 | 929905 | 936095 | 942236 | 948330 | 954378 | 19 |
| 42 | 30 | 898324 | 904762 | 911149 | 917486 | 923772 | 930009 | 936198 | 942338 | 948432 | 954479 | 18 |
| 43 | 45 | 898431 | 904869 | 911255 | 917591 | 923876 | 930112 | 936300 | 942440 | 948533 | 954579 | 17 |
| | | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 | 8.898539 | 8.904976 | 8.911361 | 8.917696 | 8.923981 | 8.930216 | 8.936403 | 8.942542 | 8.948634 | 8.954679 | 16 |
| 45 | 15 | 898647 | 905083 | 911467 | 917801 | 924085 | 930320 | 936506 | 942644 | 948735 | 954780 | 15 |
| 46 | 30 | 898754 | 905190 | 911573 | 917906 | 924189 | 930423 | 936608 | 942746 | 948836 | 954880 | 14 |
| 47 | 45 | 898862 | 905296 | 911679 | 918011 | 924294 | 930527 | 936711 | 942848 | 948937 | 954980 | 13 |
| | | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 | 8.898970 | 8.905403 | 8.911785 | 8.918116 | 8.924398 | 8.930630 | 8.936814 | 8.942950 | 8.949038 | 8.955081 | 12 |
| 49 | 15 | 899077 | 905510 | 911891 | 918222 | 924502 | 930733 | 936916 | 943052 | 949139 | 955181 | 11 |
| 50 | 30 | 899185 | 905617 | 911997 | 918327 | 924606 | 930837 | 937019 | 943153 | 949241 | 955281 | 10 |
| 51 | 45 | 899293 | 905723 | 912103 | 918432 | 924711 | 930940 | 937122 | 943255 | 949342 | 955381 | 9 |
| | | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 | 8.899400 | 8.905830 | 8.912209 | 8.918537 | 8.924815 | 8.931044 | 8.937224 | 8.943357 | 8.949443 | 8.955482 | 8 |
| 53 | 15 | 899508 | 905937 | 912315 | 918642 | 924919 | 931147 | 937327 | 943459 | 949544 | 955582 | 7 |
| 54 | 30 | 899615 | 906044 | 912421 | 918747 | 925023 | 931251 | 937430 | 943561 | 949645 | 955682 | 6 |
| 55 | 45 | 899723 | 906150 | 912526 | 918852 | 925127 | 931354 | 937532 | 943662 | 949746 | 955783 | 5 |
| | | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 | 8.899831 | 8.906257 | 8.912632 | 8.918957 | 8.925232 | 8.931457 | 8.937635 | 8.943764 | 8.949847 | 8.955853 | 4 |
| 57 | 15 | 899938 | 906364 | 912738 | 919062 | 925336 | 931561 | 937737 | 943866 | 949948 | 955983 | 3 |
| 58 | 30 | 900046 | 906470 | 912844 | 919167 | 925440 | 931664 | 937840 | 943968 | 950049 | 956083 | 2 |
| 59 | 45 | 900153 | 906577 | 912950 | 919272 | 925544 | 931767 | 937942 | 944069 | 950150 | 956183 | 1 |
| 60 | 60 | 8.900261 | 8.906684 | 8.913055 | 8.919377 | 8.925648 | 8.931871 | 8.938045 | 8.944171 | 8.950251 | 8.956284 | 0 |
| sec. | | $49^m$ | $48^m$ | $47^m$ | $46^m$ | $45^m$ | $44^m$ | $43^m$ | $42^m$ | $41^m$ | $40^m$ | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 35 deg. | | | | 36 deg. | | | | 37 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 8.956284 | 8.962271 | 8.968213 | 8.974111 | 8.979965 | 8.985775 | 8.991543 | 8.997269 | 9.002953 | 9.008596 | 60 |
| 1 | 15 956384 | 962370 | 968312 | 974209 | 980062 | 985872 | 991639 | 997364 | 003047 | 008690 | 59 |
| 2 | 30 956484 | 962470 | 969410 | 974307 | 980159 | 985968 | 991735 | 997459 | 003142 | 008783 | 58 |
| 3 | 45 956584 | 962569 | 968509 | 974405 | 980256 | 986065 | 991830 | 997554 | 003236 | 008877 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 8.956684 | 8.962668 | 8.968608 | 8.974502 | 8.980353 | 8.986161 | 8.991926 | 8.997649 | 9.003330 | 9.008971 | 56 |
| 5 | 15 956784 | 962768 | 968706 | 974600 | 980451 | 986258 | 992022 | 997744 | 003425 | 009064 | 55 |
| 6 | 30 956884 | 962867 | 968805 | 974698 | 980548 | 986354 | 992118 | 997839 | 003519 | 009158 | 54 |
| 7 | 45 956984 | 962966 | 968903 | 974796 | 980645 | 986450 | 992213 | 997934 | 003613 | 009252 | 53 |
| | 2′ | 17′ | 33′ | 47′ | 2′ | 17′ | 33′ | 47′ | 2′ | 17′ | |
| 8 | 0 8.957085 | 8.963066 | 8.969002 | 8.974894 | 8.980742 | 8.986547 | 8.992309 | 8.998029 | 9.003708 | 9.009345 | 52 |
| 9 | 15 957185 | 963165 | 969101 | 974992 | 980839 | 986643 | 992405 | 998124 | 003802 | 009439 | 51 |
| 10 | 30 957285 | 963264 | 969199 | 975090 | 980936 | 986740 | 992500 | 998219 | 003896 | 009532 | 50 |
| 11 | 45 957385 | 963364 | 969298 | 975187 | 981033 | 986836 | 992596 | 998314 | 003990 | 009626 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 8.957485 | 8.963463 | 8.969396 | 8.975285 | 8.981130 | 8.986932 | 8.992692 | 8.998409 | 9.004085 | 9.009720 | 48 |
| 13 | 15 957585 | 963562 | 969495 | 975383 | 981227 | 987029 | 992787 | 998504 | 004179 | 009813 | 47 |
| 14 | 30 957685 | 963661 | 969593 | 975481 | 981324 | 987125 | 992883 | 998599 | 004273 | 009907 | 46 |
| 15 | 45 957785 | 963761 | 969692 | 975578 | 981421 | 987221 | 992978 | 998694 | 004367 | 010000 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 8.957885 | 8.963860 | 8.969790 | 8.975676 | 8.981518 | 8.987318 | 8.993074 | 8.998789 | 9.004462 | 9.010094 | 44 |
| 17 | 15 957985 | 963959 | 969889 | 975774 | 981615 | 987414 | 993170 | 998883 | 004556 | 010187 | 43 |
| 18 | 30 958085 | 964058 | 969987 | 975872 | 981712 | 987510 | 993265 | 998978 | 004650 | 010281 | 42 |
| 19 | 45 958184 | 964157 | 970086 | 975969 | 981809 | 987606 | 993361 | 999073 | 004744 | 010374 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 8.958284 | 8.964257 | 8.970184 | 8.976067 | 8.981906 | 8.987703 | 8.993456 | 8.999168 | 9.004838 | 9.010468 | 40 |
| 21 | 15 958384 | 964356 | 970282 | 976165 | 982003 | 987799 | 993552 | 999263 | 004933 | 010561 | 39 |
| 22 | 30 958484 | 964455 | 970381 | 976262 | 982100 | 987895 | 993647 | 999358 | 005027 | 010655 | 38 |
| 23 | 45 958584 | 964554 | 970479 | 976360 | 982197 | 987991 | 993743 | 999453 | 005121 | 010749 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 8.958684 | 8.964653 | 8.970578 | 8.976458 | 8.982294 | 8.988088 | 8.993838 | 8.999547 | 9.005215 | 9.010842 | 36 |
| 25 | 15 958784 | 964752 | 970676 | 976555 | 982391 | 988184 | 993934 | 999642 | 005309 | 010935 | 35 |
| 26 | 30 958884 | 964851 | 970774 | 976653 | 982488 | 988280 | 994029 | 999737 | 005403 | 011029 | 34 |
| 27 | 45 958983 | 964950 | 970873 | 976750 | 982585 | 988376 | 994125 | 999832 | 005497 | 011122 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 8.959083 | 8.965050 | 8.970971 | 8.976848 | 8.982682 | 8.988472 | 8.994220 | 8.999927 | 9.005591 | 9.011215 | 32 |
| 29 | 15 959183 | 965149 | 971069 | 976946 | 982778 | 988568 | 994316 | 9.000021 | 005685 | 011309 | 31 |
| 30 | 30 959283 | 965248 | 971168 | 977043 | 982875 | 988665 | 994411 | 000116 | 005779 | 011402 | 30 |
| 31 | 45 959383 | 965347 | 971266 | 977141 | 982972 | 988761 | 994507 | 000211 | 005873 | 011496 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 8.959482 | 8.965446 | 8.971364 | 8.977238 | 8.983069 | 8.988857 | 8.994602 | 9.000305 | 9.005968 | 9.011589 | 28 |
| 33 | 15 959582 | 965545 | 971462 | 977336 | 983166 | 988953 | 994697 | 000400 | 006062 | 011682 | 27 |
| 34 | 30 959682 | 965644 | 971561 | 977433 | 983263 | 989049 | 994793 | 000495 | 006156 | 011776 | 26 |
| 35 | 45 959782 | 965743 | 971659 | 977531 | 983359 | 989145 | 994888 | 000589 | 006250 | 011869 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 8.959881 | 8.965842 | 8.971757 | 8.977628 | 8.983456 | 8.989241 | 8.994984 | 9.000684 | 9.006344 | 9.011962 | 24 |
| 37 | 15 959981 | 965941 | 971855 | 977726 | 983553 | 989337 | 995079 | 000779 | 006438 | 012055 | 23 |
| 38 | 30 960081 | 966040 | 971953 | 977823 | 983650 | 989433 | 995174 | 000874 | 006532 | 012149 | 22 |
| 39 | 45 960180 | 966138 | 972052 | 977921 | 983746 | 989529 | 995270 | 000968 | 006625 | 012242 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 8.960280 | 8.966237 | 8.972150 | 8.978018 | 8.983843 | 8.989625 | 8.995365 | 9.001063 | 9.006719 | 9.012335 | 20 |
| 41 | 15 960380 | 966336 | 972248 | 978116 | 983940 | 989721 | 995460 | 001157 | 006813 | 012429 | 19 |
| 42 | 30 960479 | 966435 | 972346 | 978213 | 984037 | 989817 | 995555 | 001252 | 006907 | 012522 | 18 |
| 43 | 45 960579 | 966534 | 972444 | 978310 | 984133 | 989913 | 995651 | 001346 | 007001 | 012615 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 8.960679 | 8.966633 | 8.972542 | 8.978408 | 8.984230 | 8.990009 | 8.995746 | 9.001441 | 9.007095 | 9.012708 | 16 |
| 45 | 15 960778 | 966732 | 972641 | 978505 | 984327 | 990105 | 995841 | 001536 | 007189 | 012802 | 15 |
| 46 | 30 960878 | 966831 | 972739 | 978603 | 984423 | 990201 | 995937 | 001630 | 007283 | 012895 | 14 |
| 47 | 45 960977 | 966929 | 972837 | 978700 | 984520 | 990297 | 996032 | 001725 | 007377 | 012988 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 8.961077 | 8.967028 | 8.972935 | 8.978797 | 8.984617 | 8.990393 | 8.996127 | 9.001819 | 9.007471 | 9.013081 | 12 |
| 49 | 15 961177 | 967127 | 973033 | 978895 | 984713 | 990489 | 996222 | 001914 | 007564 | 013174 | 11 |
| 50 | 30 961276 | 967226 | 973131 | 978992 | 984810 | 990585 | 996317 | 002008 | 007658 | 013267 | 10 |
| 51 | 45 961376 | 967325 | 973229 | 979089 | 984906 | 990681 | 996413 | 002103 | 007752 | 013361 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 8.961475 | 8.967423 | 8.973327 | 8.979187 | 8.985003 | 8.990777 | 8.996508 | 9.002197 | 9.007846 | 9.013454 | 8 |
| 53 | 15 961575 | 967522 | 973425 | 979284 | 985100 | 990872 | 996603 | 002292 | 007940 | 013547 | 7 |
| 54 | 30 961674 | 967621 | 973523 | 979381 | 985196 | 990968 | 996698 | 002386 | 008033 | 013640 | 6 |
| 55 | 45 961774 | 967720 | 973621 | 979478 | 985293 | 991064 | 996793 | 002481 | 008127 | 013733 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 8.961873 | 8.967818 | 8.973719 | 8.979576 | 8.985389 | 8.991160 | 8.996888 | 9.002575 | 9.008221 | 9.013826 | 4 |
| 57 | 15 961973 | 967917 | 973817 | 979673 | 985486 | 991256 | 996983 | 002670 | 008315 | 013919 | 3 |
| 58 | 30 962072 | 968016 | 973915 | 979770 | 985582 | 991352 | 997079 | 002764 | 008408 | 014012 | 2 |
| 59 | 45 962171 | 968114 | 974013 | 979867 | 985679 | 991447 | 997174 | 002858 | 008502 | 014105 | 1 |
| 60 | 60 8.962271 | 8.968213 | 8.974111 | 8.979965 | 8.985775 | 8.991543 | 8.997269 | 9.002953 | 9.008596 | 9.014198 | 0 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 37 deg. | | 38 deg. | | | | 39 deg. | | | | |
| | ′ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.014198 | 9.019761 | 9.025284 | 9.030768 | 9.036213 | 9.041621 | 9.046991 | 9.052323 | 9.057619 | 9.062879 | 60 |
| 1 | 15 014291 | 019853 | 025375 | 030859 | 036304 | 041710 | 047080 | 052412 | 057707 | 062967 | 59 |
| 2 | 30 014384 | 019946 | 025467 | 030950 | 036394 | 041800 | 047169 | 052500 | 057795 | 063054 | 58 |
| 3 | 45 014477 | 020038 | 025559 | 031041 | 036484 | 041890 | 047258 | 052589 | 057883 | 063141 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.014570 | 9.020130 | 9.025651 | 9.031132 | 9.036575 | 9.041980 | 9.047347 | 9.052677 | 9.057971 | 9.063229 | 56 |
| 5 | 15 014663 | 020223 | 025742 | 031223 | 036665 | 042070 | 047436 | 052766 | 058059 | 063316 | 55 |
| 6 | 30 014756 | 020315 | 025834 | 031314 | 036756 | 042159 | 047525 | 052855 | 058147 | 063403 | 54 |
| 7 | 45 014849 | 020407 | 025926 | 031405 | 036846 | 042249 | 047615 | 052943 | 058235 | 063491 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.014942 | 9.020500 | 9.026017 | 9.031496 | 9.036936 | 9.042339 | 9.047704 | 9.053032 | 9.058323 | 9.063578 | 52 |
| 9 | 15 015035 | 020592 | 026109 | 031587 | 037027 | 042429 | 047793 | 053120 | 058411 | 063665 | 51 |
| 10 | 30 015128 | 020684 | 026201 | 031678 | 037117 | 042518 | 047882 | 053208 | 058499 | 063752 | 50 |
| 11 | 45 015221 | 020776 | 026292 | 031769 | 037207 | 042608 | 047971 | 053297 | 058586 | 063840 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.015314 | 9.020869 | 9.026384 | 9.031860 | 9.037298 | 9.042698 | 9.048060 | 9.053385 | 9.058674 | 9.063927 | 48 |
| 13 | 15 015407 | 020961 | 026475 | 031951 | 037388 | 042787 | 048149 | 053474 | 058762 | 064014 | 47 |
| 14 | 30 015500 | 021053 | 026567 | 032042 | 037478 | 042877 | 048238 | 053562 | 058850 | 064101 | 46 |
| 15 | 45 015593 | 021145 | 026658 | 032133 | 037569 | 042967 | 048327 | 053651 | 058938 | 064189 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.015686 | 9.021237 | 9.026750 | 9.032224 | 9.037659 | 9.043056 | 9.048416 | 9.053739 | 9.059026 | 9.064276 | 44 |
| 17 | 15 015778 | 021330 | 026841 | 032315 | 037749 | 043146 | 048505 | 053827 | 059113 | 064363 | 43 |
| 18 | 30 015871 | 021422 | 026933 | 032405 | 037839 | 043236 | 048594 | 053916 | 059201 | 064450 | 42 |
| 19 | 45 015964 | 021514 | 027025 | 032496 | 037930 | 043325 | 048683 | 054004 | 059289 | 064537 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.016057 | 9.021606 | 9.027116 | 9.032587 | 9.038020 | 9.043415 | 9.048772 | 9.054093 | 9.059377 | 9.064625 | 40 |
| 21 | 15 016150 | 021698 | 027208 | 032678 | 038110 | 043504 | 048861 | 054181 | 059464 | 064712 | 39 |
| 22 | 30 016243 | 021791 | 027299 | 032769 | 038200 | 043594 | 048950 | 054269 | 059552 | 064799 | 38 |
| 23 | 45 016335 | 021883 | 027391 | 032860 | 038291 | 043683 | 049039 | 054358 | 059640 | 064886 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.016428 | 9.021975 | 9.027482 | 9.032951 | 9.038381 | 9.043773 | 9.049128 | 9.054446 | 9.059728 | 9.064973 | 36 |
| 25 | 15 016521 | 022067 | 027573 | 033041 | 038471 | 043863 | 049217 | 054534 | 059815 | 065060 | 35 |
| 26 | 30 016614 | 022159 | 027665 | 033132 | 038561 | 043952 | 049306 | 054623 | 059903 | 065147 | 34 |
| 27 | 45 016706 | 022251 | 027756 | 033223 | 038651 | 044042 | 049395 | 054711 | 059991 | 065234 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.016799 | 9.022343 | 9.027848 | 9.033314 | 9.038741 | 9.044131 | 9.049484 | 9.054799 | 9.060078 | 9.065322 | 32 |
| 29 | 15 016892 | 022435 | 027939 | 033404 | 038832 | 044221 | 049573 | 054888 | 060166 | 065409 | 31 |
| 30 | 30 016985 | 022527 | 028031 | 033495 | 038922 | 044310 | 049661 | 054976 | 060254 | 065496 | 30 |
| 31 | 45 017077 | 022619 | 028122 | 033586 | 039012 | 044400 | 049750 | 055064 | 060341 | 065583 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.017170 | 9.022711 | 9.028213 | 9.033677 | 9.039102 | 9.044489 | 9.049839 | 9.055152 | 9.060429 | 9.065670 | 28 |
| 33 | 15 017263 | 022803 | 028305 | 033767 | 039192 | 044579 | 049928 | 055241 | 060517 | 065757 | 27 |
| 34 | 30 017355 | 022895 | 028396 | 033858 | 039282 | 044668 | 050017 | 055329 | 060604 | 065844 | 26 |
| 35 | 45 017448 | 022987 | 028487 | 033949 | 039372 | 044758 | 050106 | 055417 | 060692 | 065931 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.017541 | 9.023079 | 9.028579 | 9.034040 | 9.039462 | 9.044847 | 9.050195 | 9.055505 | 9.060780 | 9.066018 | 24 |
| 37 | 15 017633 | 023171 | 028670 | 034130 | 039552 | 044936 | 050283 | 055593 | 060867 | 066105 | 23 |
| 38 | 30 017726 | 023263 | 028762 | 034221 | 039642 | 045026 | 050372 | 055682 | 060955 | 066192 | 22 |
| 39 | 45 017818 | 023355 | 028853 | 034312 | 039732 | 045115 | 050461 | 055770 | 061042 | 066279 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.017911 | 9.023447 | 9.028944 | 9.034402 | 9.039822 | 9.045205 | 9.050550 | 9.055858 | 9.061130 | 9.066366 | 20 |
| 41 | 15 018004 | 023539 | 029035 | 034493 | 039912 | 045294 | 050638 | 055946 | 061217 | 066453 | 19 |
| 42 | 30 018096 | 023631 | 029127 | 034584 | 040002 | 045383 | 050727 | 056034 | 061305 | 066540 | 18 |
| 43 | 45 018189 | 023723 | 029218 | 034674 | 040092 | 045473 | 050816 | 056122 | 061393 | 066627 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11 | 26′ | 41′ | 56′ | |
| 44 | 0 9.018281 | 9.023815 | 9.029309 | 9.034765 | 9.040182 | 9.045562 | 9.050905 | 9.056211 | 9.061480 | 9.066714 | 16 |
| 45 | 15 018374 | 023907 | 029400 | 034855 | 040272 | 045652 | 050993 | 056299 | 061568 | 066801 | 15 |
| 46 | 30 018467 | 023999 | 029492 | 034946 | 040362 | 045741 | 051082 | 056387 | 061655 | 066888 | 14 |
| 47 | 45 018559 | 024090 | 029583 | 035037 | 040452 | 045830 | 051171 | 056475 | 061743 | 066974 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.018652 | 9.024182 | 9.029674 | 9.035127 | 9.040542 | 9.045920 | 9.051260 | 9.056563 | 9.061830 | 9.067061 | 12 |
| 49 | 15 018744 | 024274 | 029765 | 035218 | 040632 | 046009 | 051348 | 056651 | 061918 | 067148 | 11 |
| 50 | 30 018837 | 024366 | 029856 | 035308 | 040722 | 046098 | 051437 | 056739 | 062005 | 067235 | 10 |
| 51 | 45 018929 | 024458 | 029948 | 035399 | 040812 | 046187 | 051526 | 056827 | 062093 | 067322 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 59′ | |
| 52 | 0 9.019021 | 9.024550 | 9.030039 | 9.035489 | 9.040902 | 9.046277 | 9.051614 | 9.056915 | 9.062180 | 9.067409 | 8 |
| 53 | 15 019114 | 024641 | 030130 | 035580 | 040992 | 046366 | 051703 | 057003 | 062267 | 067496 | 7 |
| 54 | 30 019206 | 024733 | 030221 | 035670 | 041082 | 046455 | 051792 | 057091 | 062355 | 067583 | 6 |
| 55 | 45 019299 | 024825 | 030312 | 035761 | 041171 | 046544 | 051880 | 057179 | 062442 | 067669 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.019391 | 9.024917 | 9.030403 | 9.035851 | 9.041261 | 9.046634 | 9.051969 | 9.057267 | 9.062530 | 9.067756 | 4 |
| 57 | 15 019484 | 025009 | 030494 | 035942 | 041351 | 046723 | 052057 | 057355 | 062617 | 067843 | 3 |
| 58 | 30 019576 | 025100 | 030586 | 036032 | 041441 | 046812 | 052146 | 057443 | 062704 | 067930 | 2 |
| 59 | 45 019668 | 025192 | 030677 | 036123 | 041531 | 046901 | 052235 | 057531 | 062792 | 068017 | 1 |
| 60 | 60 9.019761 | 9.025284 | 9.030768 | 9.036213 | 9.041621 | 9.046991 | 9.052323 | 9.057619 | 9.062879 | 9.068103 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 deg. | | | | 61 deg. | | | | 62 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0″ | 9·397940 | 9.401214 | 9.404471 | 9.407713 | 9.410938 | 9.414147 | 9.417340 | 9.420517 | 9·423679 | 9.426825 | 60 |
| 15 | 397995 | 401268 | 404526 | 407767 | 410991 | 414200 | 417393 | 420570 | 423731 | 426877 | 59 |
| 30 | 398049 | 401323 | 404580 | 407820 | 411045 | 414253 | 417446 | 420623 | 423784 | 426929 | 58 |
| 45 | 398104 | 401377 | 404634 | 407874 | 411099 | 414307 | 417499 | 420675 | 423836 | 426981 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 0 | 9.398159 | 9.401432 | 9.404688 | 9.407928 | 9.411152 | 9.414360 | 9.417552 | 9.420728 | 9.423889 | 9.427034 | 56 |
| 15 | 398213 | 401486 | 404742 | 407982 | 411206 | 414413 | 417605 | 420781 | 423941 | 427086 | 55 |
| 30 | 398268 | 401540 | 404796 | 408036 | 411259 | 414467 | 417658 | 420834 | 423994 | 427138 | 54 |
| 45 | 398323 | 401595 | 404850 | 408090 | 411313 | 414520 | 417711 | 420887 | 424046 | 427191 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 0 | 9.398377 | 9.401649 | 9.404905 | 9.408144 | 9.411367 | 9·414573 | 9.417764 | 9.420940 | 9.424099 | 9·427242 | 52 |
| 15 | 398432 | 401704 | 404959 | 408197 | 411420 | 414627 | 417817 | 420992 | 424151 | 427295 | 51 |
| 30 | 398487 | 401758 | 405013 | 408251 | 411474 | 414680 | 417870 | 421045 | 424204 | 427347 | 50 |
| 45 | 398541 | 401812 | 405067 | 408305 | 411527 | 414733 | 417923 | 421098 | 424256 | 427400 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 0 | 9.398596 | 9.401867 | 9.405121 | 9.408359 | 9.411581 | 9.414787 | 9.417977 | 9.421151 | 9.424309 | 9.427452 | 48 |
| 15 | 398651 | 401921 | 405175 | 408413 | 411634 | 414840 | 418030 | 421203 | 424362 | 427504 | 47 |
| 30 | 398705 | 401975 | 405229 | 408467 | 411688 | 414893 | 418083 | 421256 | 424414 | 427556 | 46 |
| 45 | 398760 | 402030 | 405283 | 408520 | 411741 | 414946 | 418136 | 421309 | 424467 | 427609 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 0 | 9.398815 | 9.402084 | 9.405337 | 9.408574 | 9.411795 | 9.415000 | 9.418189 | 9.421362 | 9.424519 | 9.427661 | 44 |
| 15 | 398869 | 402139 | 405391 | 408628 | 411849 | 415053 | 418242 | 421414 | 424572 | 427713 | 43 |
| 30 | 398924 | 402193 | 405446 | 408682 | 411902 | 415106 | 418295 | 421467 | 424624 | 427765 | 42 |
| 45 | 398978 | 402247 | 405500 | 408736 | 411956 | 415160 | 418348 | 421520 | 424676 | 427818 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 0 | 9.399033 | 9.402302 | 9.405554 | 9.408789 | 9.412009 | 9.415213 | 9.418401 | 9.421573 | 9.424729 | 9.427870 | 40 |
| 15 | 399088 | 402356 | 405608 | 408843 | 412063 | 415266 | 418454 | 421625 | 424781 | 427922 | 39 |
| 30 | 399142 | 402410 | 405662 | 408896 | 412116 | 415319 | 418507 | 421678 | 424834 | 427974 | 38 |
| 45 | 399197 | 402465 | 405716 | 408951 | 412170 | 415373 | 418560 | 421731 | 424886 | 428026 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 0 | 9.399252 | 9.402519 | 9.405770 | 9.409005 | 9.412223 | 9.415426 | 9.418613 | 9.421784 | 9.424939 | 9.428079 | 36 |
| 15 | 399306 | 402573 | 405824 | 409058 | 412277 | 415479 | 418666 | 421836 | 424991 | 428131 | 35 |
| 30 | 399361 | 402628 | 405879 | 409112 | 412330 | 415532 | 418719 | 421889 | 425044 | 428184 | 34 |
| 45 | 399415 | 402682 | 405932 | 409166 | 412384 | 415586 | 418771 | 421942 | 425096 | 428235 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 0 | 9.399470 | 9.402736 | 9.405986 | 9.409220 | 9.412437 | 9.415639 | 9.418825 | 9.421994 | 9.425149 | 9.428287 | 32 |
| 15 | 399524 | 402790 | 406040 | 409273 | 412491 | 415692 | 418877 | 422047 | 425201 | 428340 | 31 |
| 30 | 399579 | 402845 | 406094 | 409327 | 412544 | 415745 | 418930 | 422100 | 425254 | 428393 | 30 |
| 45 | 399634 | 402899 | 406148 | 409381 | 412598 | 415798 | 418983 | 422152 | 425306 | 428444 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 0 | 9.399688 | 9.402953 | 9.406202 | 9.409435 | 9.412651 | 9.415852 | 9.419036 | 9.422205 | 9.425358 | 9.428496 | 28 |
| 15 | 399743 | 403008 | 406256 | 409488 | 412705 | 415905 | 419089 | 422258 | 425411 | 428549 | 27 |
| 30 | 399797 | 403062 | 406310 | 409542 | 412758 | 415958 | 419142 | 422311 | 425463 | 428601 | 26 |
| 45 | 399852 | 403116 | 406364 | 409596 | 412812 | 416011 | 419195 | 422363 | 425516 | 428653 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 0 | 9.399906 | 9.403170 | 9.406418 | 9.409650 | 9.412865 | 9.416065 | 9.419248 | 9.422416 | 9.425568 | 9.428705 | 24 |
| 15 | 399961 | 403225 | 406472 | 409703 | 412918 | 416118 | 419301 | 422468 | 425620 | 428757 | 23 |
| 30 | 400015 | 403279 | 406526 | 409757 | 412972 | 416171 | 419354 | 422521 | 425673 | 428809 | 22 |
| 45 | 400070 | 403333 | 406580 | 409811 | 413025 | 416224 | 419407 | 422574 | 425725 | 428861 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 0 | 9.400124 | 9.403387 | 9.406634 | 9.409865 | 9.413079 | 9.416277 | 9.419460 | 9.422627 | 9.425778 | 9.428913 | 20 |
| 15 | 400179 | 403442 | 406688 | 409918 | 413132 | 416330 | 419513 | 422679 | 425830 | 428965 | 19 |
| 30 | 400233 | 403496 | 406742 | 409972 | 413186 | 416384 | 419566 | 422732 | 425882 | 429018 | 18 |
| 45 | 400288 | 403550 | 406796 | 410026 | 413239 | 416437 | 419618 | 422784 | 425935 | 429070 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 0 | 9.400343 | 9.403604 | 9.406850 | 9.410079 | 9.413293 | 9.416490 | 9.419671 | 9.422837 | 9.425987 | 9.429122 | 16 |
| 15 | 400397 | 403659 | 406904 | 410133 | 413346 | 416543 | 419724 | 422890 | 426040 | 429174 | 15 |
| 30 | 400451 | 403713 | 406958 | 410187 | 413399 | 416596 | 419777 | 422942 | 426092 | 429226 | 14 |
| 45 | 400506 | 403767 | 407012 | 410240 | 413453 | 416649 | 419830 | 422995 | 426144 | 429278 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 0 | 9.400560 | 9.403821 | 9.407066 | 9.410294 | 9.413506 | 9.416702 | 9.419883 | 9.423048 | 9.426197 | 9.429330 | 12 |
| 15 | 400615 | 403875 | 407120 | 410348 | 413560 | 416756 | 419936 | 423100 | 426249 | 429382 | 11 |
| 30 | 400669 | 403930 | 407174 | 410401 | 413613 | 416809 | 419989 | 423153 | 426301 | 429434 | 10 |
| 45 | 400724 | 403984 | 407228 | 410455 | 413666 | 416862 | 420041 | 423205 | 426354 | 429486 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 0 | 9.400778 | 9.404038 | 9.407281 | 9.410509 | 9.413720 | 9.416915 | 9.420094 | 9.423258 | 9.426406 | 9.429539 | 8 |
| 15 | 400833 | 404092 | 407335 | 410562 | 413773 | 416968 | 420147 | 423311 | 426458 | 429591 | 7 |
| 30 | 400887 | 404146 | 407389 | 410616 | 413827 | 417021 | 420200 | 423363 | 426511 | 429643 | 6 |
| 45 | 400942 | 404201 | 407443 | 410670 | 413880 | 417074 | 420253 | 423416 | 426563 | 429695 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 0 | 9.400996 | 9.404255 | 9.407497 | 9.410723 | 9.413933 | 9.417127 | 9.420306 | 9.423468 | 9.426615 | 9.429747 | 4 |
| 15 | 401051 | 404309 | 407551 | 410777 | 413987 | 417181 | 420359 | 423521 | 426668 | 429799 | 3 |
| 30 | 401105 | 404363 | 407605 | 410831 | 414040 | 417234 | 420411 | 423574 | 426720 | 429851 | 2 |
| 45 | 401159 | 404417 | 407659 | 410884 | 414093 | 417287 | 420464 | 423626 | 426772 | 429903 | 1 |
| 60 | 9.401214 | 9.404471 | 9.407713 | 9.410938 | 9.414147 | 9.417340 | 9.420517 | 9.423679 | 9.426825 | 9.429955 | 0 |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 42 deg. | | 43 deg. | | | | 44 deg. | | | | |
| | ′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 | 9.118468 | 9.123325 | 9.128151 | 9.132946 | 9.137711 | 9.142446 | 9.147151 | 9.151826 | 9.156473 | 9.161090 | 60 |
| 1 | 15 | 118549 | 123405 | 128231 | 133026 | 137790 | 142524 | 147229 | 151904 | 156550 | 161167 | 59 |
| 2 | 30 | 118630 | 123486 | 128311 | 133106 | 137869 | 142603 | 147307 | 151982 | 156627 | 161244 | 58 |
| 3 | 45 | 118711 | 123567 | 128391 | 133185 | 137948 | 142682 | 147385 | 152059 | 156704 | 161320 | 57 |
| | | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 | 9.118792 | 9.123647 | 9.128472 | 9.133265 | 9.138028 | 9.142760 | 9.147463 | 9.152137 | 9.156781 | 9.161397 | 56 |
| 5 | 15 | 118873 | 123728 | 128552 | 133344 | 138107 | 142839 | 147542 | 152215 | 156859 | 161474 | 55 |
| 6 | 30 | 118955 | 123809 | 128632 | 133424 | 138186 | 142918 | 147620 | 152292 | 156936 | 161550 | 54 |
| 7 | 45 | 119036 | 123889 | 128712 | 133504 | 138265 | 142996 | 147698 | 152370 | 157013 | 161627 | 53 |
| | | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 | 9.119117 | 9.123970 | 9.128792 | 9.133583 | 9.138344 | 9.143075 | 9.147776 | 9.152448 | 9.157090 | 9.161704 | 52 |
| 9 | 15 | 119198 | 124051 | 128872 | 133663 | 138423 | 143153 | 147854 | 152525 | 157167 | 161780 | 51 |
| 10 | 30 | 119279 | 124131 | 128952 | 133742 | 138502 | 143232 | 147932 | 152603 | 157244 | 161857 | 50 |
| 11 | 45 | 119360 | 124212 | 129032 | 133822 | 138581 | 143311 | 148010 | 152680 | 157321 | 161934 | 49 |
| | | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 | 9.119441 | 9.124292 | 9.129112 | 9.133902 | 9.138660 | 9.143389 | 9.148088 | 9.152758 | 9.157399 | 9.162010 | 48 |
| 13 | 15 | 119523 | 124373 | 129192 | 133981 | 138739 | 143468 | 148166 | 152836 | 157476 | 162087 | 47 |
| 14 | 30 | 119604 | 124454 | 129273 | 134061 | 138819 | 143546 | 148244 | 152913 | 157553 | 162164 | 46 |
| 15 | 45 | 119685 | 124534 | 129353 | 134140 | 138898 | 143625 | 148322 | 152991 | 157630 | 162240 | 45 |
| | | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 | 9.119766 | 9.124615 | 9.129433 | 9.134220 | 9.138977 | 9.143703 | 9.148401 | 9.153068 | 9.157707 | 9.162317 | 44 |
| 17 | 15 | 119847 | 124695 | 129513 | 134299 | 139056 | 143782 | 148479 | 153146 | 157784 | 162393 | 43 |
| 18 | 30 | 119928 | 124776 | 129593 | 134379 | 139135 | 143860 | 148557 | 153223 | 157861 | 162470 | 42 |
| 19 | 45 | 120009 | 124856 | 129673 | 134458 | 139214 | 143939 | 148635 | 153301 | 157938 | 162546 | 41 |
| | | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 | 9.120090 | 9.124937 | 9.129753 | 9.134538 | 9.139293 | 9.144017 | 9.148713 | 9.153378 | 9.158015 | 9.162623 | 40 |
| 21 | 15 | 120171 | 125017 | 129833 | 134617 | 139372 | 144096 | 148791 | 153456 | 158092 | 162700 | 39 |
| 22 | 30 | 120252 | 125098 | 129913 | 134697 | 139451 | 144174 | 148869 | 153533 | 158169 | 162776 | 38 |
| 23 | 45 | 120333 | 125178 | 129993 | 134776 | 139530 | 144253 | 148947 | 153611 | 158246 | 162853 | 37 |
| | | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 | 9.120414 | 9.125259 | 9.130073 | 9.134856 | 9.139609 | 9.144331 | 9.149025 | 9.153688 | 9.158323 | 9.162929 | 36 |
| 25 | 15 | 120495 | 125339 | 130153 | 134935 | 139687 | 144410 | 149103 | 153766 | 158400 | 163006 | 35 |
| 26 | 30 | 120576 | 125420 | 130233 | 135015 | 139766 | 144488 | 149180 | 153843 | 158477 | 163082 | 34 |
| 27 | 45 | 120657 | 125500 | 130312 | 135094 | 139845 | 144567 | 149258 | 153921 | 158554 | 163159 | 33 |
| | | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 | 9.120738 | 9.125581 | 9.130392 | 9.135174 | 9.139924 | 9.144645 | 9.149336 | 9.153998 | 9.158631 | 9.163235 | 32 |
| 29 | 15 | 120819 | 125661 | 130472 | 135253 | 140003 | 144724 | 149414 | 154076 | 158708 | 163312 | 31 |
| 30 | 30 | 120900 | 125742 | 130552 | 135332 | 140082 | 144802 | 149492 | 154153 | 158785 | 163388 | 30 |
| 31 | 45 | 120981 | 125822 | 130632 | 135412 | 140161 | 144880 | 149570 | 154231 | 158862 | 163465 | 29 |
| | | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 | 9.121062 | 9.125903 | 9.130712 | 9.135491 | 9.140240 | 9.144959 | 9.149648 | 9.154308 | 9.158939 | 9.163541 | 28 |
| 33 | 15 | 121143 | 125983 | 130792 | 135571 | 140319 | 145037 | 149726 | 154385 | 159016 | 163618 | 27 |
| 34 | 30 | 121224 | 126063 | 130872 | 135650 | 140398 | 145116 | 149804 | 154463 | 159093 | 163694 | 26 |
| 35 | 45 | 121305 | 126144 | 130952 | 135729 | 140477 | 145194 | 149882 | 154540 | 159170 | 163771 | 25 |
| | | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54 | |
| 36 | 0 | 9.121386 | 9.126224 | 9.131032 | 9.135809 | 9.140556 | 9.145272 | 9.149960 | 9.154618 | 9.159247 | 9.163847 | 24 |
| 37 | 15 | 121467 | 126304 | 131112 | 135888 | 140634 | 145351 | 150038 | 154695 | 159324 | 163923 | 23 |
| 38 | 30 | 121547 | 126385 | 131191 | 135967 | 140713 | 145429 | 150115 | 154772 | 159401 | 164000 | 22 |
| 39 | 45 | 121628 | 126465 | 131271 | 136047 | 140792 | 145507 | 150193 | 154850 | 159477 | 164076 | 21 |
| | | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 | 9.121709 | 9.126546 | 9.131351 | 9.136126 | 9.140871 | 9.145586 | 9.150271 | 9.154927 | 9.159554 | 9.164153 | 20 |
| 41 | 15 | 121790 | 126626 | 131431 | 136205 | 140950 | 145664 | 150349 | 155004 | 159631 | 164229 | 19 |
| 42 | 30 | 121871 | 126706 | 131511 | 136285 | 141029 | 145742 | 150427 | 155082 | 159708 | 164306 | 18 |
| 43 | 45 | 121952 | 126787 | 131591 | 136364 | 141107 | 145821 | 150505 | 155159 | 159785 | 164382 | 17 |
| | | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 | 9.122033 | 9.126867 | 9.131670 | 9.136443 | 9.141186 | 9.145899 | 9.150582 | 9.155237 | 9.159862 | 9.164458 | 16 |
| 45 | 15 | 122113 | 126947 | 131750 | 136522 | 141265 | 145977 | 150660 | 155314 | 159939 | 164535 | 15 |
| 46 | 30 | 122194 | 127028 | 131830 | 136602 | 141344 | 146056 | 150738 | 155391 | 160015 | 164611 | 14 |
| 47 | 45 | 122275 | 127108 | 131910 | 136681 | 141422 | 146134 | 150816 | 155468 | 160092 | 164687 | 13 |
| | | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 | 9.122356 | 9.127188 | 9.131990 | 9.136761 | 9.141501 | 9.146212 | 9.150894 | 9.155546 | 9.160169 | 9.164764 | 12 |
| 49 | 15 | 122437 | 127268 | 132069 | 136840 | 141580 | 146290 | 150971 | 155623 | 160246 | 164840 | 11 |
| 50 | 30 | 122517 | 127349 | 132149 | 136919 | 141659 | 146369 | 151049 | 155700 | 160323 | 164916 | 10 |
| 51 | 45 | 122598 | 127429 | 132229 | 136998 | 141737 | 146447 | 151127 | 155778 | 160399 | 164993 | 9 |
| | | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 | 9.122679 | 9.127509 | 9.132309 | 9.137077 | 9.141816 | 9.146525 | 9.151205 | 9.155855 | 9.160476 | 9.165069 | 8 |
| 53 | 15 | 122760 | 127589 | 132388 | 137157 | 141895 | 146603 | 151282 | 155932 | 160554 | 165145 | 7 |
| 54 | 30 | 122840 | 127670 | 132468 | 137236 | 141974 | 146682 | 151360 | 156009 | 160630 | 165222 | 6 |
| 55 | 45 | 122921 | 127750 | 132548 | 137315 | 142052 | 146760 | 151438 | 156087 | 160707 | 165298 | 5 |
| | | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 | 9.123002 | 9.127830 | 9.132627 | 9.137394 | 9.142131 | 9.146838 | 9.151516 | 9.156164 | 9.160783 | 9.165374 | 4 |
| 57 | 15 | 123083 | 127910 | 132707 | 137473 | 142210 | 146916 | 151593 | 156241 | 160860 | 165450 | 3 |
| 58 | 30 | 123163 | 127990 | 132787 | 137553 | 142288 | 146994 | 151671 | 156318 | 160937 | 165527 | 2 |
| 59 | 45 | 123244 | 128071 | 132866 | 137632 | 142367 | 147073 | 151749 | 156395 | 161013 | 165603 | 1 |
| 60 | 60 | 9.123325 | 9.128151 | 9.132946 | 9.137711 | 9.142446 | 9.147151 | 9.151826 | 9.156473 | 9.161090 | 9.165679 | 0 |
| sec. | | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 65 deg. | | | | 66 deg. | | | | 67 deg. | | |
| | M | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 | 9.460433 | 9.463400 | 9.466354 | 9.469293 | 9.472218 | 9.475129 | 9.478026 | 9.480909 | 9.483779 | 9.486635 | 60 |
| 1 | 15 | 460483 | 463450 | 466403 | 469341 | 472266 | 475177 | 478074 | 480957 | 483827 | 486683 | 59 |
| 2 | 30 | 460532 | 463499 | 466452 | 469390 | 472315 | 475225 | 478122 | 481005 | 483874 | 486730 | 58 |
| 3 | 45 | 460582 | 463548 | 466501 | 469439 | 472363 | 475274 | 478170 | 481053 | 483922 | 486778 | 57 |
| | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 | 9.460631 | 9.463598 | 9.466550 | 9.469488 | 9.472412 | 9.475322 | 9.478218 | 9.481101 | 9.483970 | 9.486825 | 56 |
| 5 | 15 | 460681 | 463647 | 466599 | 469537 | 472461 | 475371 | 478267 | 481149 | 484018 | 486873 | 55 |
| 6 | 30 | 460730 | 463696 | 466648 | 469586 | 472509 | 475419 | 478315 | 481197 | 484065 | 486921 | 54 |
| 7 | 45 | 460780 | 463746 | 466697 | 469634 | 472558 | 475467 | 478363 | 481245 | 484113 | 486968 | 53 |
| | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 | 9.460830 | 9.463795 | 9.466746 | 9.469683 | 9.472606 | 9.475516 | 9.478411 | 9.481293 | 9.484161 | 9.487016 | 52 |
| 9 | 15 | 460879 | 463844 | 466795 | 469732 | 472655 | 475564 | 478459 | 481341 | 484208 | 487063 | 51 |
| 10 | 30 | 460929 | 463894 | 466844 | 469781 | 472704 | 475612 | 478507 | 481388 | 484256 | 487110 | 50 |
| 11 | 45 | 460978 | 463943 | 466893 | 469830 | 472752 | 475661 | 478555 | 481436 | 484304 | 487157 | 49 |
| | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 | 9.461028 | 9.463992 | 9.466942 | 9.469879 | 9.472801 | 9.475709 | 9.478604 | 9.481484 | 9.484351 | 9.487204 | 48 |
| 13 | 15 | 461077 | 464041 | 466991 | 469927 | 472849 | 475757 | 478652 | 481532 | 484399 | 487251 | 47 |
| 14 | 30 | 461127 | 464091 | 467041 | 469976 | 472898 | 475806 | 478700 | 481580 | 484447 | 487300 | 46 |
| 15 | 45 | 461176 | 464140 | 467090 | 470025 | 472947 | 475854 | 478748 | 481628 | 484494 | 487347 | 45 |
| | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 | 9.461226 | 9.464189 | 9.467139 | 9.470074 | 9.472995 | 9.475903 | 9.478796 | 9.481676 | 9.484542 | 9.487394 | 44 |
| 17 | 15 | 461275 | 464238 | 467188 | 470123 | 473044 | 475951 | 478844 | 481724 | 484590 | 487442 | 43 |
| 18 | 30 | 461325 | 464288 | 467237 | 470172 | 473092 | 475999 | 478892 | 481772 | 484637 | 487489 | 42 |
| 19 | 45 | 461374 | 464337 | 467286 | 470220 | 473141 | 476047 | 478940 | 481819 | 484685 | 487537 | 41 |
| | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 | 9.461424 | 9.464386 | 9.467335 | 9.470269 | 9.473189 | 9.476096 | 9.478988 | 9.481867 | 9.484733 | 9.487584 | 40 |
| 21 | 15 | 461473 | 464436 | 467384 | 470318 | 473238 | 476144 | 479037 | 481915 | 484780 | 487632 | 39 |
| 22 | 30 | 461523 | 464485 | 467433 | 470367 | 473287 | 476192 | 479085 | 481963 | 484828 | 487679 | 38 |
| 23 | 45 | 461572 | 464534 | 467482 | 470415 | 473335 | 476241 | 479133 | 482011 | 484875 | 487727 | 37 |
| | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 | 9.461622 | 9.464583 | 9.467531 | 9.470464 | 9.473384 | 9.476289 | 9.479181 | 9.482059 | 9.484923 | 9.487774 | 36 |
| 25 | 15 | 461671 | 464633 | 467580 | 470513 | 473432 | 476337 | 479229 | 482107 | 484971 | 487822 | 35 |
| 26 | 30 | 461721 | 464682 | 467629 | 470562 | 473481 | 476386 | 479277 | 482154 | 485018 | 487869 | 34 |
| 27 | 45 | 461770 | 464731 | 467678 | 470610 | 473529 | 476434 | 479325 | 482202 | 485066 | 487916 | 33 |
| | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 | 9.461820 | 9.464780 | 9.467727 | 9.470659 | 9.473578 | 9.476482 | 9.479373 | 9.482250 | 9.485114 | 9.487963 | 32 |
| 29 | 15 | 461869 | 464829 | 467776 | 470708 | 473626 | 476531 | 479421 | 482298 | 485161 | 488011 | 31 |
| 30 | 30 | 461919 | 464879 | 467825 | 470757 | 473675 | 476579 | 479469 | 482346 | 485209 | 489058 | 30 |
| 31 | 45 | 461968 | 464928 | 467874 | 470805 | 473723 | 476627 | 479517 | 482394 | 485256 | 488106 | 29 |
| | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 | 9.462017 | 9.464977 | 9.467923 | 9.470854 | 9.473772 | 9.476675 | 9.479565 | 9.482441 | 9.485304 | 9.488153 | 28 |
| 33 | 15 | 462067 | 465026 | 467972 | 470903 | 473820 | 476724 | 479613 | 482489 | 485352 | 488200 | 27 |
| 34 | 30 | 462116 | 465076 | 468021 | 470952 | 473869 | 476772 | 479661 | 482537 | 485399 | 488248 | 26 |
| 35 | 45 | 462166 | 465125 | 468070 | 471000 | 473917 | 476820 | 479709 | 482585 | 485447 | 488295 | 25 |
| | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 | 9.462215 | 9.465174 | 9.468119 | 9.471049 | 9.473966 | 9.476869 | 9.479757 | 9.482633 | 9.485494 | 9.488342 | 24 |
| 37 | 15 | 462265 | 465223 | 468168 | 471098 | 474014 | 476917 | 479806 | 482681 | 485542 | 488390 | 23 |
| 38 | 30 | 462314 | 465272 | 468217 | 471147 | 474063 | 476965 | 479854 | 482728 | 485589 | 488437 | 22 |
| 39 | 45 | 462363 | 465321 | 468265 | 471195 | 474111 | 477013 | 479902 | 482776 | 485637 | 488484 | 21 |
| | | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 | 9.462413 | 9.465371 | 9.468314 | 9.471244 | 9.474160 | 9.477062 | 9.479950 | 9.482824 | 9.485685 | 9.488533 | 20 |
| 41 | 15 | 462462 | 465420 | 468363 | 471293 | 474208 | 477110 | 479998 | 482872 | 485732 | 488579 | 19 |
| 42 | 30 | 462512 | 465469 | 468412 | 471342 | 474257 | 477158 | 480046 | 482919 | 485780 | 488627 | 18 |
| 43 | 45 | 462561 | 465518 | 468462 | 471390 | 474305 | 477206 | 480094 | 482967 | 485827 | 488674 | 17 |
| | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 | 9.462611 | 9.465567 | 9.468510 | 9.471439 | 9.474354 | 9.477255 | 9.480142 | 9.483015 | 9.485875 | 9.488721 | 16 |
| 45 | 15 | 462660 | 465617 | 468559 | 471488 | 474402 | 477303 | 480190 | 483063 | 485922 | 488768 | 15 |
| 46 | 30 | 462709 | 465666 | 468608 | 471536 | 474451 | 477351 | 480238 | 483111 | 485971 | 488816 | 14 |
| 47 | 45 | 462759 | 465715 | 468657 | 471585 | 474499 | 477399 | 480286 | 483158 | 486017 | 488863 | 13 |
| | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 | 9.462808 | 9.465764 | 9.468706 | 9.471634 | 9.474547 | 9.477447 | 9.480334 | 9.483206 | 9.486065 | 9.488910 | 12 |
| 49 | 15 | 462857 | 465813 | 468755 | 471682 | 474596 | 477496 | 480382 | 483254 | 486113 | 488955 | 11 |
| 50 | 30 | 462907 | 465862 | 468804 | 471731 | 474644 | 477544 | 480430 | 483302 | 486160 | 489000 | 10 |
| 51 | 45 | 462956 | 465911 | 468853 | 471780 | 474693 | 477592 | 480478 | 483349 | 486208 | 489045 | 9 |
| | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 | 9.463006 | 9.465961 | 9.468901 | 9.471828 | 9.474741 | 9.477640 | 9.480526 | 9.483397 | 9.486255 | 9.489100 | 8 |
| 53 | 15 | 463055 | 466010 | 468950 | 471877 | 474790 | 477688 | 480574 | 483445 | 486303 | 489147 | 7 |
| 54 | 30 | 463104 | 466059 | 468999 | 471926 | 474838 | 477737 | 480621 | 483493 | 486350 | 489194 | 6 |
| 55 | 45 | 463154 | 466108 | 469048 | 471974 | 474886 | 477785 | 480669 | 483540 | 486398 | 489242 | 5 |
| | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 | 9.463203 | 9.466157 | 9.469097 | 9.472023 | 9.474935 | 9.477833 | 9.480717 | 9.483588 | 9.486445 | 9.489289 | 4 |
| 57 | 15 | 463252 | 466206 | 469146 | 472072 | 474983 | 477881 | 480765 | 483636 | 486493 | 489336 | 3 |
| 58 | 30 | 463302 | 466255 | 469195 | 472120 | 475032 | 477929 | 480813 | 483684 | 486540 | 489383 | 2 |
| 59 | 45 | 463351 | 466304 | 469244 | 472169 | 475080 | 477978 | 480861 | 483731 | 486588 | 489431 | 1 |
| 60 | 60 | 9.463400 | 9.466354 | 9.469293 | 9.472218 | 9.475129 | 9.478026 | 9.480909 | 9.483779 | 9.486635 | 9.489478 | 0 |
| sec. | | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| sec. | 47 deg. | | 48 deg. | | | | 49 deg. | | | | sec. |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.210064 | 9.214358 | 9.218627 | 9.222870 | 9.227089 | 9.231284 | 9.235454 | 9.239600 | 9.243722 | 9.247821 | 60 |
| 1 | 15 210136 | 214429 | 218697 | 222941 | 227159 | 231353 | 235523 | 239669 | 243791 | 247889 | 59 |
| 2 | 30 210207 | 214501 | 218768 | 223011 | 227229 | 231423 | 235593 | 239738 | 243859 | 247957 | 58 |
| 3 | 45 210279 | 214572 | 218839 | 223082 | 227300 | 231493 | 235662 | 239807 | 243928 | 248025 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.210351 | 9.214643 | 9.218910 | 9.223152 | 9.227370 | 9.231562 | 9.235731 | 9.239876 | 9.243996 | 9.248094 | 56 |
| 5 | 15 210423 | 214715 | 218981 | 223223 | 227440 | 231632 | 235800 | 239944 | 244065 | 248162 | 55 |
| 6 | 30 210494 | 214786 | 219052 | 223293 | 227510 | 231702 | 235870 | 240013 | 244133 | 248230 | 54 |
| 7 | 45 210566 | 214857 | 219123 | 223364 | 227580 | 231771 | 235939 | 240082 | 244202 | 248298 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.210638 | 9.214929 | 9.219194 | 9.223434 | 9.227650 | 9.231841 | 9.236008 | 9.240151 | 9.244270 | 9.248366 | 52 |
| 9 | 15 210710 | 215000 | 219265 | 223505 | 227720 | 231911 | 236077 | 240220 | 244339 | 248434 | 51 |
| 10 | 30 210781 | 215071 | 219336 | 223575 | 227790 | 231980 | 236147 | 240289 | 244407 | 248502 | 50 |
| 11 | 45 210853 | 215142 | 219406 | 223646 | 227860 | 232050 | 236216 | 240358 | 244476 | 248570 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.210925 | 9.215214 | 9.219477 | 9.223716 | 9.227930 | 9.232120 | 9.236285 | 9.240426 | 9.244544 | 9.248638 | 48 |
| 13 | 15 210996 | 215285 | 219548 | 223786 | 228000 | 232189 | 236354 | 240495 | 244612 | 248706 | 47 |
| 14 | 30 211068 | 215356 | 219619 | 223857 | 228070 | 232259 | 236423 | 240564 | 244681 | 248774 | 46 |
| 15 | 45 211140 | 215427 | 219690 | 223927 | 228140 | 232329 | 236493 | 240633 | 244749 | 248842 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.211211 | 9.215499 | 9.219761 | 9.223998 | 9.228210 | 9.232398 | 9.236562 | 9.240702 | 9.244818 | 9.248910 | 44 |
| 17 | 15 211283 | 215570 | 219831 | 224068 | 228280 | 232468 | 236631 | 240770 | 244886 | 248978 | 43 |
| 18 | 30 211355 | 215641 | 219902 | 224139 | 228350 | 232537 | 236700 | 240839 | 244954 | 249046 | 42 |
| 19 | 45 211426 | 215712 | 219973 | 224209 | 228420 | 232607 | 236769 | 240908 | 245023 | 249114 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.211498 | 9.215784 | 9.220044 | 9.224279 | 9.228490 | 9.232676 | 9.236839 | 9.240977 | 9.245091 | 9.249182 | 40 |
| 21 | 15 211570 | 215855 | 220115 | 224350 | 228560 | 232746 | 236908 | 241046 | 245160 | 249250 | 39 |
| 22 | 30 211641 | 215926 | 220186 | 224420 | 228630 | 232816 | 236977 | 241114 | 245228 | 249318 | 38 |
| 23 | 45 211713 | 215997 | 220256 | 224490 | 228700 | 232885 | 237046 | 241183 | 245296 | 249386 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.211785 | 9.216068 | 9.220327 | 9.224561 | 9.228770 | 9.232955 | 9.237115 | 9.241252 | 9.245365 | 9.249454 | 36 |
| 25 | 15 211856 | 216140 | 220398 | 224631 | 228840 | 233024 | 237184 | 241321 | 245433 | 249522 | 35 |
| 26 | 30 211928 | 216211 | 220469 | 224702 | 228910 | 233094 | 237254 | 241389 | 245501 | 249590 | 34 |
| 27 | 45 211999 | 216282 | 220539 | 224772 | 228980 | 233163 | 237323 | 241458 | 245570 | 249658 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.212071 | 9.216353 | 9.220610 | 9.224842 | 9.229050 | 9.233233 | 9.237392 | 9.241527 | 9.245638 | 9.249726 | 32 |
| 29 | 15 212143 | 216424 | 220681 | 224912 | 229120 | 233302 | 237461 | 241595 | 245706 | 249794 | 31 |
| 30 | 30 212214 | 216495 | 220752 | 224983 | 229190 | 233372 | 237530 | 241664 | 245775 | 249862 | 30 |
| 31 | 45 212286 | 216566 | 220822 | 225053 | 229259 | 233441 | 237599 | 241733 | 245843 | 249930 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.212357 | 9.216638 | 9.220893 | 9.225123 | 9.229329 | 9.233511 | 9.237668 | 9.241802 | 9.245911 | 9.249998 | 28 |
| 33 | 15 212429 | 216709 | 220964 | 225194 | 229399 | 233580 | 237737 | 241870 | 245980 | 250065 | 27 |
| 34 | 30 212500 | 216780 | 221034 | 225264 | 229469 | 233650 | 237806 | 241939 | 246048 | 250133 | 26 |
| 35 | 45 212572 | 216851 | 221105 | 225334 | 229539 | 233719 | 237875 | 242008 | 246116 | 250201 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.212643 | 9.216922 | 9.221176 | 9.225405 | 9.229609 | 9.233789 | 9.237944 | 9.242076 | 9.246184 | 9.250269 | 24 |
| 37 | 15 212715 | 216993 | 221246 | 225475 | 229679 | 233858 | 238014 | 242145 | 246253 | 250337 | 23 |
| 38 | 30 212786 | 217064 | 221317 | 225545 | 229749 | 233928 | 238083 | 242214 | 246321 | 250405 | 22 |
| 39 | 45 212858 | 217135 | 221388 | 225615 | 229818 | 233997 | 238152 | 242282 | 246389 | 250473 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.212929 | 9.217206 | 9.221459 | 9.225686 | 9.229888 | 9.234067 | 9.238221 | 9.242351 | 9.246457 | 9.250541 | 20 |
| 41 | 15 213001 | 217277 | 221529 | 225756 | 229958 | 234136 | 238290 | 242420 | 246526 | 250608 | 19 |
| 42 | 30 213072 | 217349 | 221600 | 225826 | 230028 | 234205 | 238359 | 242488 | 246594 | 250676 | 18 |
| 43 | 45 213144 | 217420 | 221670 | 225896 | 230098 | 234275 | 238428 | 242557 | 246662 | 250744 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.213215 | 9.217491 | 9.221741 | 9.225967 | 9.230168 | 9.234344 | 9.238497 | 9.242625 | 9.246730 | 9.250812 | 16 |
| 45 | 15 213287 | 217562 | 221812 | 226037 | 230237 | 234414 | 238566 | 242694 | 246799 | 250880 | 15 |
| 46 | 30 213358 | 217633 | 221882 | 226107 | 230307 | 234483 | 238635 | 242763 | 246867 | 250948 | 14 |
| 47 | 45 213430 | 217704 | 221953 | 226177 | 230377 | 234552 | 238704 | 242831 | 246935 | 251015 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.213501 | 9.217775 | 9.222024 | 9.226247 | 9.230447 | 9.234622 | 9.238773 | 9.242900 | 9.247003 | 9.251083 | 12 |
| 49 | 15 213573 | 217846 | 222094 | 226318 | 230517 | 234691 | 238842 | 242968 | 247071 | 251151 | 11 |
| 50 | 30 213644 | 217917 | 222165 | 226388 | 230586 | 234761 | 238911 | 243037 | 247140 | 251219 | 10 |
| 51 | 45 213715 | 217988 | 222235 | 226458 | 230656 | 234830 | 238980 | 243106 | 247208 | 251287 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.213787 | 9.218059 | 9.222306 | 9.226528 | 9.230726 | 9.234899 | 9.239049 | 9.243174 | 9.247276 | 9.251354 | 8 |
| 53 | 15 213858 | 218130 | 222376 | 226598 | 230796 | 234969 | 239118 | 243243 | 247344 | 251422 | 7 |
| 54 | 30 213930 | 218201 | 222447 | 226668 | 230865 | 235038 | 239187 | 243311 | 247412 | 251490 | 6 |
| 55 | 45 214001 | 218272 | 222518 | 226739 | 230935 | 235107 | 239255 | 243380 | 247480 | 251558 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.214072 | 9.218343 | 9.222588 | 9.226809 | 9.231005 | 9.235177 | 9.239324 | 9.243448 | 9.247549 | 9.251626 | 4 |
| 57 | 15 214144 | 218414 | 222659 | 226879 | 231075 | 235246 | 239393 | 243517 | 247617 | 251693 | 3 |
| 58 | 30 214215 | 218485 | 222729 | 226949 | 231144 | 235315 | 239462 | 243585 | 247685 | 251761 | 2 |
| 59 | 45 214286 | 218556 | 222800 | 227019 | 231214 | 235385 | 239531 | 243654 | 247753 | 251829 | 1 |
| 60 | 60 9.214358 | 9.218627 | 9.222870 | 9.227089 | 9.231284 | 9.235454 | 9.239600 | 9.243722 | 9.247821 | 9.251897 | 0 |
| | 49m | 48m | 47m | 46m | 45m | 44m | 43m | 42m | 41m | 40m | sec. |

| | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 70 deg. | | | | 71 deg. | | | | 72 deg. | | |
| sec. | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | sec. |
| 0 | 0 9.517183 | 9.519883 | 9 522570 | 9.525245 | 9.527908 | 9.530559 | 9.533197 | 9.535823 | 9.538437 | 9.541040 | 60 |
| 1 | 15 517228 | 519928 | 522615 | 525290 | 527952 | 530603 | 533241 | 535867 | 538481 | 541083 | 59 |
| 2 | 30 517273 | 519972 | 522660 | 525334 | 527997 | 530647 | 533285 | 535911 | 538524 | 541126 | 58 |
| 3 | 45 517318 | 520017 | 522704 | 525379 | 528041 | 530691 | 533328 | 535954 | 538568 | 541169 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31 | 46′ | 1′ | 16′ | |
| 4 | 0 9.517363 | 9.520062 | 9.522749 | 9.525423 | 9.528085 | 9.530735 | 9.533372 | 9.535998 | 9.538611 | 9.541213 | 56 |
| 5 | 15 517408 | 520107 | 522794 | 525468 | 528129 | 530779 | 533416 | 536041 | 538655 | 541256 | 55 |
| 6 | 30 517453 | 520152 | 522838 | 525512 | 528174 | 530823 | 533460 | 536085 | 538698 | 541299 | 54 |
| 7 | 45 517498 | 520197 | 522883 | 525557 | 528218 | 530867 | 533504 | 536129 | 538741 | 541342 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32 | 47′ | 2′ | 17′ | |
| 8 | 0 9.517543 | 9.520242 | 9.522928 | 9.525601 | 9.528262 | 9.530911 | 9.533548 | 9.536172 | 9.538785 | 9.541386 | 52 |
| 9 | 15 517588 | 520287 | 522972 | 525645 | 528306 | 530955 | 533592 | 536216 | 538828 | 541429 | 51 |
| 10 | 30 517633 | 520331 | 523017 | 525690 | 528351 | 530999 | 533635 | 536260 | 538872 | 541472 | 50 |
| 11 | 45 517679 | 520376 | 523062 | 525734 | 528395 | 531043 | 533679 | 536303 | 538915 | 541515 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.517724 | 9.520421 | 9.523106 | 9.525779 | 9.528439 | 9.531087 | 9.533723 | 9.536347 | 9.538959 | 9.541559 | 48 |
| 13 | 15 517769 | 520466 | 523151 | 525823 | 528483 | 531131 | 533767 | 536391 | 539003 | 541602 | 47 |
| 14 | 30 517814 | 520511 | 523195 | 525868 | 528528 | 531175 | 533811 | 536434 | 539046 | 541645 | 46 |
| 15 | 45 517859 | 520556 | 523240 | 525912 | 528572 | 531219 | 533855 | 536478 | 539089 | 541688 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.517904 | 9.520601 | 9.523285 | 9.525957 | 9.528616 | 9.531263 | 9.533898 | 9.536521 | 9.539132 | 9.541732 | 44 |
| 17 | 15 517949 | 520645 | 523329 | 526001 | 528660 | 531307 | 533942 | 536565 | 539176 | 541775 | 43 |
| 18 | 30 517994 | 520690 | 523374 | 526045 | 528705 | 531351 | 533986 | 536609 | 539219 | 541818 | 42 |
| 19 | 45 518039 | 520735 | 523419 | 526089 | 528749 | 531395 | 534030 | 536652 | 539263 | 541861 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.518084 | 9.520780 | 9.523463 | 9.526134 | 9.528793 | 9.531439 | 9.534074 | 9.536696 | 9.539306 | 9.541904 | 40 |
| 21 | 15 518129 | 520825 | 523508 | 526179 | 528837 | 531483 | 534117 | 536739 | 539349 | 541947 | 39 |
| 22 | 30 518174 | 520870 | 523552 | 526223 | 528881 | 531527 | 534161 | 536783 | 539393 | 541991 | 38 |
| 23 | 45 518219 | 520914 | 523597 | 526267 | 528926 | 531571 | 534205 | 536827 | 539436 | 542034 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.518264 | 9.520959 | 9.523642 | 9.526312 | 9.528970 | 9.531615 | 9.534249 | 9.536870 | 9.539480 | 9.542077 | 36 |
| 25 | 15 518309 | 521004 | 523686 | 526356 | 529014 | 531659 | 534293 | 536914 | 539523 | 542120 | 35 |
| 26 | 30 518354 | 521049 | 523731 | 526401 | 529058 | 531703 | 534336 | 536957 | 539566 | 542164 | 34 |
| 27 | 45 518399 | 521094 | 523775 | 526445 | 529102 | 531747 | 534380 | 537001 | 539610 | 542207 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.518444 | 9.521138 | 9.523820 | 9.526489 | 9.529147 | 9.531791 | 9.534424 | 9.537045 | 9.539653 | 9.542250 | 32 |
| 29 | 15 518489 | 521183 | 523865 | 526534 | 529191 | 531835 | 534468 | 537089 | 539697 | 542293 | 31 |
| 30 | 30 518534 | 521228 | 523909 | 526578 | 529235 | 531879 | 534512 | 537132 | 539740 | 542336 | 30 |
| 31 | 45 518579 | 521273 | 523954 | 526623 | 529279 | 531923 | 534555 | 537175 | 539783 | 542379 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.518624 | 9.521318 | 9.523998 | 9.526667 | 9.529323 | 9.531967 | 9.534599 | 9.537219 | 9.539827 | 9.542423 | 28 |
| 33 | 15 518669 | 521362 | 524043 | 526711 | 529367 | 532011 | 534643 | 537262 | 539870 | 542466 | 27 |
| 34 | 30 518714 | 521407 | 524088 | 526756 | 529412 | 532055 | 534687 | 537306 | 539913 | 542509 | 26 |
| 35 | 45 518759 | 521452 | 524132 | 526800 | 529456 | 532099 | 534730 | 537349 | 539957 | 542552 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.518804 | 9.521497 | 9.524177 | 9.526844 | 9.529500 | 9.532143 | 9.534774 | 9.537393 | 9.540000 | 9.542595 | 24 |
| 37 | 15 518849 | 521541 | 524221 | 526889 | 529544 | 532187 | 534818 | 537437 | 540043 | 542638 | 23 |
| 38 | 30 518894 | 521586 | 524266 | 526933 | 529588 | 532231 | 534862 | 537480 | 540087 | 542682 | 22 |
| 39 | 45 518939 | 521631 | 524310 | 526977 | 529632 | 532275 | 534905 | 537524 | 540130 | 542725 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.518984 | 9.521676 | 9.524355 | 9.527022 | 9.529676 | 9.532319 | 9.534949 | 9.537567 | 9.540174 | 9.542771 | 20 |
| 41 | 15 519029 | 521720 | 524399 | 527066 | 529721 | 532363 | 534993 | 537611 | 540217 | 542817 | 19 |
| 42 | 30 519074 | 521765 | 524444 | 527111 | 529765 | 532407 | 535037 | 537654 | 540260 | 542864 | 18 |
| 43 | 45 519119 | 521810 | 524489 | 527155 | 529809 | 532451 | 535080 | 537698 | 540303 | 542907 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.519164 | 9.521855 | 9.524533 | 9.527199 | 9.529853 | 9.532495 | 9.535124 | 9.537741 | 9.540347 | 9.542940 | 16 |
| 45 | 15 519209 | 521899 | 524578 | 527243 | 529897 | 532539 | 535168 | 537785 | 540390 | 542983 | 15 |
| 46 | 30 519254 | 521944 | 524622 | 527288 | 529941 | 532582 | 535211 | 537828 | 540433 | 543027 | 14 |
| 47 | 45 519299 | 521989 | 524667 | 527332 | 529985 | 532626 | 535255 | 537872 | 540477 | 543070 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.519344 | 9.522034 | 9.524711 | 9.527376 | 9.530029 | 9.532670 | 9.535299 | 9.537915 | 9.540520 | 9.543113 | 12 |
| 49 | 15 519389 | 522078 | 524756 | 527421 | 530074 | 532714 | 535343 | 537959 | 540563 | 543156 | 11 |
| 50 | 30 519433 | 522123 | 524800 | 527465 | 530118 | 532758 | 535386 | 538003 | 540607 | 543199 | 10 |
| 51 | 45 519478 | 522168 | 524845 | 527509 | 530162 | 532802 | 535430 | 538046 | 540650 | 543242 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.519523 | 9.522213 | 9.524889 | 9.527554 | 9.530206 | 9.532846 | 9.535474 | 9.538090 | 9.540693 | 9.543285 | 8 |
| 53 | 15 519568 | 522257 | 524934 | 527598 | 530250 | 532890 | 535517 | 538133 | 540737 | 543328 | 7 |
| 54 | 30 519613 | 522302 | 524978 | 527642 | 530294 | 532934 | 535561 | 538176 | 540780 | 543371 | 6 |
| 55 | 45 519658 | 522347 | 525023 | 527687 | 530338 | 532977 | 535605 | 538220 | 540823 | 543414 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.519703 | 9.522391 | 9 525067 | 9.527731 | 9.530382 | 9.533021 | 9.535648 | 9.538263 | 9.540866 | 9.543458 | 4 |
| 57 | 15 519748 | 522436 | 525112 | 527775 | 530426 | 533065 | 535692 | 538307 | 540910 | 543501 | 3 |
| 58 | 30 519793 | 522481 | 525156 | 527820 | 530470 | 533109 | 535736 | 538350 | 540953 | 543544 | 2 |
| 59 | 45 519838 | 522525 | 525201 | 527864 | 530514 | 533153 | 535779 | 538394 | 540997 | 543587 | 1 |
| 60 | 60 9.519983 | 9.522570 | 9.525245 | 9 527908 | 9.530559 | 9.533197 | 9.535823 | 9.538437 | 9.541040 | 9.543630 | 0 |
| | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11h | 10h | |

| | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| sec. | 72 deg. | | 73 deg. | | | | 74 deg. | | | | sec. |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.543630 | 9.546208 | 9.548775 | 9.551330 | 9.553874 | 9.556406 | 9.558926 | 9.561435 | 9.563933 | 9.566419 | 60 |
| 1 | 15 543673 | 546251 | 548818 | 551373 | 553916 | 556448 | 558968 | 561477 | 563974 | 566460 | 59 |
| 2 | 30 543716 | 546294 | 548861 | 551415 | 553958 | 556490 | 559010 | 561518 | 564016 | 566502 | 58 |
| 3 | 45 543759 | 546337 | 548903 | 551458 | 554001 | 556532 | 559052 | 561560 | 564057 | 566543 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.543802 | 9.546380 | 9.548946 | 9.551500 | 9.554043 | 9.556574 | 9.559094 | 9.561602 | 9.564099 | 9.566584 | 56 |
| 5 | 15 543845 | 546423 | 548989 | 551543 | 554085 | 556616 | 559136 | 561644 | 564140 | 566626 | 55 |
| 6 | 30 543888 | 546466 | 549031 | 551585 | 554127 | 556658 | 559177 | 561685 | 564182 | 566667 | 54 |
| 7 | 45 543931 | 546508 | 549074 | 551628 | 554170 | 556700 | 559219 | 561727 | 564223 | 566708 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.543974 | 9.546551 | 9.549117 | 9.551670 | 9.554212 | 9.556742 | 9.559261 | 9.561769 | 9.564265 | 9.566750 | 52 |
| 9 | 15 544017 | 546594 | 549159 | 551712 | 554254 | 556784 | 559303 | 561810 | 564306 | 566791 | 51 |
| 10 | 30 544061 | 546637 | 549202 | 551755 | 554297 | 556826 | 559345 | 561852 | 564348 | 566832 | 50 |
| 11 | 45 544103 | 546680 | 549244 | 551797 | 554339 | 556869 | 559387 | 561894 | 564389 | 566874 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.544147 | 9.546723 | 9.549287 | 9 551840 | 9.554381 | 9.556911 | 9.559429 | 9.561935 | 9.564431 | 9.566915 | 48 |
| 13 | 15 544190 | 546766 | 549330 | 551882 | 554423 | 556953 | 559471 | 561977 | 564472 | 566956 | 47 |
| 14 | 30 544233 | 546808 | 549372 | 551925 | 554466 | 556995 | 559513 | 562019 | 564514 | 566998 | 46 |
| 15 | 45 544276 | 546851 | 549415 | 551967 | 554507 | 557037 | 559554 | 562061 | 564555 | 567039 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.544319 | 9.546894 | 9.549458 | 9.552010 | 9.554550 | 9.557079 | 9.559596 | 9.562102 | 9.564597 | 9.567080 | 44 |
| 17 | 15 544362 | 546937 | 549500 | 552052 | 554592 | 557121 | 559638 | 562144 | 564638 | 567121 | 43 |
| 18 | 30 544405 | 546980 | 549543 | 552095 | 554635 | 557163 | 559680 | 562186 | 564680 | 567163 | 42 |
| 19 | 45 544448 | 547022 | 549586 | 552137 | 554677 | 557205 | 559722 | 562227 | 564721 | 567204 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.544491 | 9.547065 | 9.549628 | 9.552179 | 9.554719 | 9.557247 | 9.559764 | 9.562269 | 9.564763 | 9.567245 | 40 |
| 21 | 15 544534 | 547108 | 549671 | 552222 | 554761 | 557289 | 559805 | 562311 | 564804 | 567287 | 39 |
| 22 | 30 544577 | 547151 | 549713 | 552264 | 554803 | 557331 | 559847 | 562352 | 564846 | 567328 | 38 |
| 23 | 45 544620 | 547194 | 549756 | 552307 | 554846 | 557373 | 559889 | 562394 | 564887 | 567369 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21 | 36′ | 51′ | |
| 24 | 0 9.544663 | 9.547237 | 9.549799 | 9.552349 | 9.554888 | 9.557415 | 9.559931 | 9.562435 | 9.564929 | 9.567411 | 36 |
| 25 | 15 544706 | 547279 | 549841 | 552391 | 554930 | 557457 | 559973 | 562477 | 564970 | 567452 | 35 |
| 26 | 30 544749 | 547322 | 549884 | 552434 | 554972 | 557499 | 560015 | 562519 | 565012 | 567493 | 34 |
| 27 | 45 544792 | 547365 | 549927 | 552476 | 555014 | 557541 | 560057 | 562560 | 565053 | 567534 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.544825 | 9.547408 | 9.549969 | 9.552519 | 9.555057 | 9.557583 | 9.560098 | 9.562602 | 9.565094 | 9.567576 | 32 |
| 29 | 15 544878 | 547450 | 550012 | 552561 | 555099 | 557625 | 560140 | 562644 | 565136 | 567617 | 31 |
| 30 | 30 544921 | 547493 | 550054 | 552603 | 555141 | 557667 | 560182 | 562685 | 565177 | 567658 | 30 |
| 31 | 45 544964 | 547536 | 550097 | 552646 | 555183 | 557709 | 560224 | 562727 | 565219 | 567699 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.545007 | 9.547579 | 9.550139 | 9.552688 | 9.555226 | 9.557751 | 9.560266 | 9.562769 | 9.565260 | 9.567741 | 28 |
| 33 | 15 545050 | 547622 | 550182 | 552731 | 555268 | 557793 | 560307 | 562810 | 565302 | 567782 | 27 |
| 34 | 30 545093 | 547664 | 550224 | 552773 | 555310 | 557835 | 560349 | 562852 | 565343 | 567823 | 26 |
| 35 | 45 545135 | 547707 | 550267 | 552815 | 555352 | 557877 | 560391 | 562893 | 565384 | 567864 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.545178 | 9.547750 | 9.550310 | 9.552858 | 9.555394 | 9.557919 | 9.560433 | 9.562935 | 9.565426 | 9.567906 | 24 |
| 37 | 15 545221 | 547793 | 550352 | 552900 | 555436 | 557961 | 560475 | 562977 | 565467 | 567947 | 23 |
| 38 | 30 545264 | 547835 | 550395 | 552942 | 555479 | 558003 | 560516 | 563018 | 565509 | 567988 | 22 |
| 39 | 45 545307 | 547878 | 550437 | 552985 | 555521 | 558045 | 560558 | 563060 | 565550 | 568029 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.545350 | 9.547921 | 9.550480 | 9.553027 | 9.555563 | 9.558087 | 9.560600 | 9.563101 | 9 565592 | 9.568070 | 20 |
| 41 | 15 545393 | 547964 | 550522 | 553070 | 555605 | 558129 | 560642 | 563143 | 565633 | 568112 | 19 |
| 42 | 30 545436 | 548006 | 550565 | 553112 | 555647 | 558171 | 560684 | 563185 | 565674 | 568153 | 18 |
| 43 | 45 545479 | 548049 | 550607 | 553154 | 555689 | 558213 | 560725 | 563226 | 565716 | 568194 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.545522 | 9.548092 | 9.550650 | 9.553197 | 9.555732 | 9.558255 | 9.560767 | 9.563268 | 9.565757 | 9.568235 | 16 |
| 45 | 15 545565 | 548135 | 550693 | 553239 | 555774 | 558297 | 560809 | 563309 | 565798 | 568276 | 15 |
| 46 | 30 545608 | 548177 | 550735 | 553281 | 555816 | 558339 | 560851 | 563351 | 565840 | 568318 | 14 |
| 47 | 45 545651 | 548220 | 550778 | 553324 | 555858 | 558381 | 560892 | 563392 | 565881 | 568359 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.545694 | 9.548263 | 9.550820 | 9.553366 | 9.555900 | 9.558423 | 9.560934 | 9.563434 | 9.565923 | 9.568400 | 12 |
| 49 | 15 545737 | 548305 | 550863 | 553408 | 555942 | 558465 | 560976 | 563476 | 565964 | 568441 | 11 |
| 50 | 30 545780 | 548348 | 550905 | 553451 | 555984 | 558507 | 561018 | 563517 | 566005 | 568483 | 10 |
| 51 | 45 545822 | 548391 | 550948 | 553493 | 556027 | 558549 | 561059 | 563559 | 566047 | 568524 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 59′ | |
| 52 | 0 9.545865 | 9.548434 | 9.550990 | 9.553535 | 9.556069 | 9.558591 | 9.561101 | 9.563600 | 9.566088 | 9.568565 | 8 |
| 53 | 15 545908 | 548476 | 551033 | 553578 | 556111 | 558633 | 561143 | 563642 | 566130 | 568606 | 7 |
| 54 | 30 545951 | 548519 | 551075 | 553620 | 556153 | 558675 | 561185 | 563683 | 566171 | 568647 | 6 |
| 55 | 45 545994 | 548562 | 551118 | 553662 | 556195 | 558716 | 561226 | 563725 | 566212 | 568688 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.546037 | 9.548604 | 9.551160 | 9.553705 | 9.556237 | 9.558758 | 9.561268 | 9.563767 | 9.566254 | 9.568730 | 4 |
| 57 | 15 546080 | 548647 | 551203 | 553747 | 556279 | 558800 | 561310 | 563808 | 566295 | 568771 | 3 |
| 58 | 30 546123 | 548690 | 551245 | 553789 | 556321 | 558842 | 561352 | 563850 | 566336 | 568812 | 2 |
| 59 | 45 546166 | 548732 | 551288 | 553831 | 556364 | 558884 | 561393 | 563891 | 566378 | 568853 | 1 |
| 60 | 0 9.546208 | 9.548775 | 9.551330 | 9.553874 | 9.556406 | 9.558926 | 9.561435 | 9.563933 | 9.566419 | 9.568894 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 0m | 1m | 2m. | 3m | 4m | 5m | 6m | 7m | 8m | 9m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 75 deg. | | | | 76 deg. | | | | 77 deg. | |
| | ′ | 0′ 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 | 9.568894 | 9.571358 | 9.573811 | 9.576253 | 9.578684 | 9.581104 | 9.583513 | 9.585911 | 9.588299 | 9.590676 |
| 1 | 15 | 568935 | 571399 | 573852 | 576294 | 578724 | 581144 | 583553 | 585951 | 588339 | 590716 |
| 2 | 30 | 568977 | 571440 | 573893 | 576334 | 578765 | 581184 | 583593 | 585991 | 588379 | 590755 |
| 3 | 45 | 569018 | 571481 | 573933 | 576375 | 578805 | 581225 | 583633 | 586031 | 588418 | 590795 |
| | | 1′ 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ |
| 4 | 0 | 9.569059 | 9.571522 | 9.573974 | 9.576415 | 9.578846 | 9.581265 | 9.583673 | 9.586071 | 9.588458 | 9.590834 |
| 5 | 15 | 569100 | 571563 | 574015 | 576456 | 578886 | 581305 | 583713 | 586111 | 588498 | 590874 |
| 6 | 30 | 569141 | 571604 | 574056 | 576497 | 578926 | 581345 | 583753 | 586151 | 588537 | 590913 |
| 7 | 45 | 569182 | 571645 | 574097 | 576537 | 578967 | 581386 | 583793 | 586191 | 588577 | 590953 |
| | | 2′ 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ |
| 8 | 0 | 9.569223 | 9.571686 | 9.574137 | 9.576578 | 9.579007 | 9.581426 | 9.583834 | 9.586230 | 9.588617 | 9.590993 |
| 9 | 15 | 569265 | 571727 | 574178 | 576618 | 579048 | 581466 | 583873 | 586270 | 588656 | 591033 |
| 10 | 30 | 569306 | 571768 | 574219 | 576659 | 579088 | 581506 | 583914 | 586310 | 588696 | 591073 |
| 11 | 45 | 569347 | 571809 | 574260 | 576699 | 579128 | 581546 | 583954 | 586350 | 588736 | 591111 |
| | | 3′ 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 | 9.569388 | 9.571850 | 9.574300 | 9.576740 | 9.579169 | 9.581587 | 9.583994 | 9.586390 | 9.588775 | 9.591150 |
| 13 | 15 | 569429 | 571891 | 574341 | 576781 | 579209 | 581627 | 584034 | 586430 | 588815 | 591190 |
| 14 | 30 | 569470 | 571932 | 574382 | 576821 | 579250 | 581667 | 584074 | 586470 | 588855 | 591230 |
| 15 | 45 | 569511 | 571973 | 574423 | 576862 | 579290 | 581707 | 584114 | 586509 | 588894 | 591269 |
| | | 4′ 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 | 9.569552 | 9.572013 | 9.574463 | 9.576902 | 9.579330 | 9.581747 | 9.584154 | 9.586549 | 9.588934 | 9.591309 |
| 17 | 15 | 569593 | 572054 | 574504 | 576943 | 579371 | 581788 | 584194 | 586589 | 588974 | 591348 |
| 18 | 30 | 569635 | 572095 | 574545 | 576983 | 579411 | 581828 | 584234 | 586629 | 589013 | 591387 |
| 19 | 45 | 569676 | 572136 | 574586 | 577024 | 579451 | 581868 | 584274 | 586669 | 589053 | 591427 |
| | | 5′ 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 | 9.569717 | 9.572177 | 9.574626 | 9.577065 | 9.579492 | 9.581908 | 9.584314 | 9.586709 | 9.589093 | 9.591466 |
| 21 | 15 | 569758 | 572218 | 574667 | 577105 | 579532 | 581948 | 584354 | 586748 | 589132 | 591506 |
| 22 | 30 | 569799 | 572259 | 574708 | 577146 | 579573 | 581989 | 584394 | 586788 | 589172 | 591545 |
| 23 | 45 | 569840 | 572300 | 574748 | 577186 | 579613 | 582029 | 584434 | 586828 | 589212 | 591585 |
| | | 6′ 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 | 9.569881 | 9.572341 | 9.574789 | 9.577227 | 9.579653 | 9.582069 | 9.584474 | 9.586868 | 9.589251 | 9.591624 |
| 25 | 15 | 569922 | 572382 | 574830 | 577267 | 579694 | 582109 | 584514 | 586908 | 589291 | 591665 |
| 26 | 30 | 569963 | 572423 | 574871 | 577308 | 579734 | 582149 | 584554 | 586947 | 589330 | 591703 |
| 27 | 45 | 570004 | 572463 | 574911 | 577348 | 579774 | 582189 | 584594 | 586987 | 589370 | 591742 |
| | | 7′ 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 | 9.570046 | 9.572504 | 9.574952 | 9.577389 | 9.579815 | 9.582230 | 9.584634 | 9.587027 | 9.589410 | 9.591782 |
| 29 | 15 | 570087 | 572545 | 574993 | 577429 | 579855 | 582270 | 584674 | 587067 | 589450 | 591821 |
| 30 | 30 | 570128 | 572586 | 575033 | 577470 | 579895 | 582310 | 584714 | 587107 | 589489 | 591861 |
| 31 | 45 | 570169 | 572627 | 575074 | 577510 | 579936 | 582350 | 584754 | 587146 | 589529 | 591900 |
| | | 8′ 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 | 9.570210 | 9.572668 | 9.575115 | 9.577551 | 9.579976 | 9.582390 | 9.584794 | 9.587186 | 9.589568 | 9.591939 |
| 33 | 15 | 570251 | 572709 | 575155 | 577591 | 580016 | 582430 | 584833 | 587226 | 589608 | 591978 |
| 34 | 30 | 570292 | 572750 | 575196 | 577632 | 580057 | 582470 | 584874 | 587266 | 589647 | 592018 |
| 35 | 45 | 570333 | 572790 | 575237 | 577672 | 580097 | 582511 | 584913 | 587306 | 589687 | 592057 |
| | | 9′ 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ |
| 36 | 0 | 9.570374 | 9.572831 | 9.575278 | 9.577713 | 9.580137 | 9.582551 | 9.584953 | 9.587345 | 9.589727 | 9.592097 |
| 37 | 15 | 570415 | 572872 | 575318 | 577753 | 580177 | 582591 | 584993 | 587385 | 589766 | 592137 |
| 38 | 30 | 570456 | 572913 | 575359 | 577794 | 580218 | 582631 | 585033 | 587425 | 589806 | 592176 |
| 39 | 45 | 570497 | 572954 | 575400 | 577834 | 580258 | 582671 | 585073 | 587465 | 589845 | 592216 |
| | | 10′ 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ |
| 40 | 0 | 9.570538 | 9.572995 | 9.575440 | 9.577875 | 9.580299 | 9.582711 | 9.585113 | 9.587504 | 9.589885 | 9.592255 |
| 41 | 15 | 570579 | 573036 | 575480 | 577915 | 580339 | 582751 | 585153 | 587544 | 589924 | 592294 |
| 42 | 30 | 570620 | 573076 | 575522 | 577956 | 580379 | 582792 | 585193 | 587584 | 589964 | 592333 |
| 43 | 45 | 570661 | 573117 | 575562 | 577996 | 580419 | 582832 | 585233 | 587624 | 590004 | 592373 |
| | | 11′ 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 | 9.570702 | 9.573158 | 9.575603 | 9.578037 | 9.580460 | 9.582872 | 9.585273 | 9.587663 | 9.590043 | 9.592412 |
| 45 | 15 | 570743 | 573199 | 575644 | 578077 | 580500 | 582912 | 585313 | 587703 | 590083 | 592452 |
| 46 | 30 | 570784 | 573240 | 575684 | 578118 | 580540 | 582952 | 585353 | 587743 | 590122 | 592490 |
| 47 | 45 | 570825 | 573281 | 575725 | 578158 | 580580 | 582992 | 585393 | 587783 | 590162 | 592529 |
| | | 12′ 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 | 9.570866 | 9.573321 | 9.575766 | 9.578199 | 9.580621 | 9.583032 | 9.585433 | 9.587822 | 9.590202 | 9.592571 |
| 49 | 15 | 570907 | 573362 | 575806 | 578239 | 580661 | 583072 | 585473 | 587862 | 590241 | 592609 |
| 50 | 30 | 570948 | 573403 | 575847 | 578280 | 580701 | 583112 | 585513 | 587902 | 590281 | 592648 |
| 51 | 45 | 570989 | 573444 | 575887 | 578320 | 580742 | 583152 | 585552 | 587942 | 590320 | 592686 |
| | | 13′ 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 | 9.571030 | 9.573485 | 9.575928 | 9.578360 | 9.580782 | 9.583193 | 9.585592 | 9.587981 | 9.590360 | 9.592725 |
| 53 | 15 | 571071 | 573525 | 575969 | 578401 | 580822 | 583233 | 585632 | 588021 | 590399 | 592763 |
| 54 | 30 | 571112 | 573566 | 576009 | 57 441 | 580862 | 583273 | 585672 | 588061 | 590439 | 592801 |
| 55 | 45 | 571153 | 573607 | 576050 | 578482 | 580903 | 583313 | 585712 | 588101 | 590478 | 592840 |
| | | 14′ 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 | 9.571194 | 9.573648 | 9.576091 | 9.578522 | 9.580943 | 9.583353 | 9.585752 | 9.588140 | 9.590518 | 9.592885 |
| 57 | 15 | 571235 | 573689 | 576131 | 578563 | 580983 | 583393 | 585792 | 588180 | 590557 | 592924 |
| 58 | 30 | 571276 | 573730 | 576172 | 578603 | 581023 | 583433 | 585832 | 588220 | 590597 | 592964 |
| 59 | 45 | 571317 | 573770 | 576212 | 578643 | 581064 | 583473 | 585872 | 588259 | 590637 | 593003 |
| 60 | 60 | 9.571358 | 9.573811 | 9.576253 | 9.578684 | 9.581104 | 9.583513 | 9.585911 | 9.588299 | 9.590676 | 9.593042 |
| sec. | | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m |

| sec. | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 77 deg. | | 78 deg. | | | | 79 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.593042 | 9.595398 | 9.597741 | 9.600078 | 9.602403 | 9.604717 | 9.607021 | 9.609315 | 9.611598 | 9.613872 | 60 |
| 1 | 15 593082 | 595437 | 597783 | 600117 | 602442 | 604756 | 607059 | 609353 | 611636 | 613909 | 59 |
| 2 | 30 593121 | 595477 | 597822 | 600156 | 602480 | 604794 | 607098 | 609391 | 611674 | 613947 | 58 |
| 3 | 45 593160 | 595516 | 597861 | 600195 | 602519 | 604833 | 607136 | 609429 | 611712 | 613985 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.593200 | 9.595555 | 9.597900 | 9.600234 | 9.602558 | 9.604871 | 9.607174 | 9.609467 | 9.611750 | 9.614023 | 56 |
| 5 | 15 593239 | 595594 | 597939 | 600273 | 602596 | 604910 | 607213 | 609505 | 611788 | 614061 | 55 |
| 6 | 30 593279 | 595633 | 597978 | 600311 | 602635 | 604948 | 607251 | 609544 | 611826 | 614098 | 54 |
| 7 | 45 593318 | 595672 | 598017 | 600350 | 602673 | 604987 | 607289 | 609582 | 611864 | 614136 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.593357 | 9.595712 | 9.598056 | 9.600389 | 9.602712 | 9.605025 | 9.607327 | 9.609620 | 9.611902 | 9.614174 | 52 |
| 9 | 15 593396 | 595751 | 598095 | 600428 | 602751 | 605063 | 607366 | 609658 | 611940 | 614212 | 51 |
| 10 | 30 593436 | 595790 | 598133 | 600467 | 602789 | 605102 | 607404 | 609696 | 611978 | 614250 | 50 |
| 11 | 45 593475 | 595829 | 598172 | 600506 | 602828 | 605140 | 607442 | 609734 | 612016 | 614287 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.593514 | 9.595868 | 9.598211 | 9.600544 | 9.602867 | 9.605179 | 9.607481 | 9.609772 | 9.612054 | 9.614325 | 48 |
| 13 | 15 593554 | 595907 | 598250 | 600583 | 602905 | 605217 | 607519 | 609810 | 612092 | 614363 | 47 |
| 14 | 30 593593 | 595946 | 598289 | 600622 | 602944 | 605256 | 607557 | 609848 | 612130 | 614401 | 46 |
| 15 | 45 593632 | 595985 | 598328 | 600661 | 602983 | 605294 | 607595 | 609886 | 612167 | 614438 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.593672 | 9.596025 | 9.598367 | 9.600699 | 9.603021 | 9.605333 | 9.607634 | 9.609925 | 9.612205 | 9.614476 | 44 |
| 17 | 15 593711 | 596064 | 598406 | 600738 | 603059 | 605371 | 607672 | 609963 | 612243 | 614514 | 43 |
| 18 | 30 593750 | 596103 | 598445 | 600777 | 603098 | 605409 | 607710 | 610001 | 612281 | 614552 | 42 |
| 19 | 45 593789 | 596142 | 598484 | 600816 | 603137 | 605448 | 607748 | 610039 | 612319 | 614590 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.593829 | 9.596181 | 9.598523 | 9.600854 | 9.603176 | 9.605486 | 9.607787 | 9.610077 | 9.612357 | 9.614627 | 40 |
| 21 | 15 593868 | 596220 | 598562 | 600893 | 603215 | 605525 | 607825 | 610115 | 612395 | 614665 | 39 |
| 22 | 30 593907 | 596259 | 598601 | 600932 | 603253 | 605563 | 607863 | 610153 | 612433 | 614703 | 38 |
| 23 | 45 593947 | 596299 | 598640 | 600971 | 603291 | 605601 | 607901 | 610191 | 612471 | 614740 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.593986 | 9.596338 | 9.598679 | 9.601010 | 9.603330 | 9.605640 | 9.607940 | 9.610229 | 9.612509 | 9.614779 | 36 |
| 25 | 15 594025 | 596377 | 598718 | 601048 | 603368 | 605678 | 607978 | 610267 | 612547 | 614816 | 35 |
| 26 | 30 594065 | 596416 | 598757 | 601087 | 603407 | 605717 | 608016 | 610305 | 612585 | 614854 | 34 |
| 27 | 45 594104 | 596455 | 598796 | 601126 | 603446 | 605755 | 608054 | 610344 | 612622 | 614892 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.594143 | 9.596494 | 9.598835 | 9.601165 | 9.603484 | 9.605794 | 9.608093 | 9.610382 | 9.612660 | 9.614929 | 32 |
| 29 | 15 594182 | 596533 | 598873 | 601203 | 603523 | 605832 | 608131 | 610420 | 612698 | 614967 | 31 |
| 30 | 30 594222 | 596572 | 598912 | 601242 | 603561 | 605870 | 608169 | 610458 | 612736 | 615005 | 30 |
| 31 | 45 594261 | 596611 | 598951 | 601281 | 603600 | 605909 | 608207 | 610496 | 612774 | 615042 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.594300 | 9.596650 | 9.598990 | 9.601320 | 9.603638 | 9.605947 | 9.608246 | 9.610534 | 9.612812 | 9.615080 | 28 |
| 33 | 15 594339 | 596689 | 599029 | 601358 | 603677 | 605986 | 608284 | 610572 | 612850 | 615118 | 27 |
| 34 | 30 594379 | 596729 | 599068 | 601397 | 603716 | 606024 | 608322 | 610610 | 612888 | 615155 | 26 |
| 35 | 45 594418 | 596768 | 599107 | 601436 | 603754 | 606062 | 608360 | 610648 | 612926 | 615193 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.594457 | 9.596807 | 9.599146 | 9.601474 | 9.603793 | 9.606101 | 9.608398 | 9.610686 | 9.612963 | 9.615231 | 24 |
| 37 | 15 594496 | 596846 | 599185 | 601513 | 603831 | 606139 | 608436 | 610724 | 613001 | 615268 | 23 |
| 38 | 30 594536 | 596885 | 599224 | 601552 | 603870 | 606177 | 608475 | 610762 | 613039 | 615306 | 22 |
| 39 | 45 594575 | 596924 | 599262 | 601591 | 603908 | 606216 | 608513 | 610800 | 613077 | 615344 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.594614 | 9.596963 | 9.599301 | 9.601629 | 9.603947 | 9.606254 | 9.608551 | 9.610838 | 9.613115 | 9.615382 | 20 |
| 41 | 15 594653 | 597002 | 599340 | 601668 | 603985 | 606293 | 608589 | 610876 | 613153 | 615419 | 19 |
| 42 | 30 594693 | 597041 | 599379 | 601707 | 604024 | 606331 | 608628 | 610914 | 613191 | 615457 | 18 |
| 43 | 45 594732 | 597080 | 599418 | 601745 | 604063 | 606369 | 608666 | 610952 | 613228 | 615495 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.594771 | 9.597119 | 9.599457 | 9.601784 | 9.604101 | 9.606408 | 9.608704 | 9.610990 | 9.613266 | 9.615532 | 16 |
| 45 | 15 594810 | 597158 | 599496 | 601823 | 604140 | 606446 | 608742 | 611028 | 613304 | 615570 | 15 |
| 46 | 30 594850 | 597197 | 599535 | 601862 | 604178 | 606484 | 608780 | 611066 | 613342 | 615608 | 14 |
| 47 | 45 594889 | 597236 | 599573 | 601900 | 604217 | 606523 | 608818 | 611104 | 613380 | 615645 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.594928 | 9.597275 | 9.599612 | 9.601939 | 9.604255 | 9.606561 | 9.608857 | 9.611142 | 9.613418 | 9.615683 | 12 |
| 49 | 15 594967 | 597314 | 599651 | 601978 | 604294 | 606599 | 608896 | 611180 | 613456 | 615721 | 11 |
| 50 | 30 595006 | 597353 | 599690 | 602016 | 604332 | 606638 | 608933 | 611218 | 613493 | 615758 | 10 |
| 51 | 45 595046 | 597392 | 599729 | 602055 | 604371 | 606676 | 608971 | 611256 | 613531 | 615796 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.595085 | 9.597432 | 9.599768 | 9.602094 | 9.604409 | 9.606714 | 9.609009 | 9.611294 | 9.613569 | 9.615834 | 8 |
| 53 | 15 595124 | 597471 | 599807 | 602132 | 604448 | 606753 | 609048 | 611332 | 613607 | 615872 | 7 |
| 54 | 30 595163 | 597510 | 599845 | 602171 | 604486 | 606791 | 609086 | 611370 | 613645 | 615909 | 6 |
| 55 | 45 595202 | 597549 | 599884 | 602210 | 604525 | 606829 | 609124 | 611408 | 613683 | 615947 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.595242 | 9.597588 | 9.599923 | 9.602248 | 9.604563 | 9.606868 | 9.609162 | 9.611446 | 9.613720 | 9.615984 | 4 |
| 57 | 15 595281 | 597627 | 599962 | 602287 | 604602 | 606906 | 609200 | 611484 | 613758 | 616022 | 3 |
| 58 | 30 595320 | 597666 | 600001 | 602326 | 604640 | 606944 | 609238 | 611522 | 613796 | 616060 | 2 |
| 59 | 45 595359 | 597705 | 600040 | 602364 | 604679 | 606983 | 609277 | 611560 | 613834 | 616097 | 1 |
| 60 | 60 9.595398 | 9.597744 | 9.600078 | 9.602403 | 9.604717 | 9.607021 | 9.609315 | 9.611598 | 9.613872 | 9.616135 | 0 |
| sec. | 49m | 48m | 47m | 46m | 45m | 44m | 43m | 42m | 41m | 40m | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 80 deg. | | | | 81 deg. | | | | 82 deg. | | |
| | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.616135 | 9.618388 | 9.620632 | 9.622865 | 9.625089 | 9.627303 | 9.629507 | 9.631701 | 9.633886 | 9.636061 | 60 |
| 1 | 15 616173 | 618426 | 620669 | 622902 | 625126 | 627339 | 629533 | 631738 | 633922 | 636097 | 59 |
| 2 | 30 616210 | 618463 | 620706 | 622939 | 625163 | 627376 | 629580 | 631774 | 633958 | 636133 | 58 |
| 3 | 45 616248 | 618501 | 620744 | 622977 | 625199 | 627413 | 629617 | 631811 | 633995 | 636169 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.616286 | 9.618538 | 9.620781 | 9.623014 | 9.625237 | 9.627450 | 9.629653 | 9.631847 | 9.634031 | 9.636208 | 56 |
| 5 | 15 616323 | 618576 | 620818 | 623051 | 625274 | 627487 | 629690 | 631884 | 634067 | 636242 | 55 |
| 6 | 30 616361 | 618613 | 620856 | 623088 | 625311 | 627524 | 629727 | 631920 | 634104 | 636278 | 54 |
| 7 | 45 616398 | 618650 | 620893 | 623125 | 625348 | 627561 | 629763 | 631956 | 634140 | 636314 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.616436 | 9.618688 | 9.620930 | 9.623162 | 9.625385 | 9.627597 | 9.629800 | 9.631993 | 9.634176 | 9.636350 | 52 |
| 9 | 15 616474 | 618725 | 620967 | 623199 | 625421 | 627634 | 629836 | 632029 | 634213 | 636386 | 51 |
| 10 | 30 616511 | 618763 | 621005 | 623236 | 625458 | 627671 | 629873 | 632066 | 634249 | 636423 | 50 |
| 11 | 45 616548 | 618800 | 621042 | 623274 | 625495 | 627707 | 629910 | 632102 | 634285 | 636459 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.616586 | 9.618838 | 9.621079 | 9.623311 | 9.625532 | 9.627744 | 9.629946 | 9.632139 | 9.634322 | 9.636495 | 48 |
| 13 | 15 616624 | 618875 | 621116 | 623348 | 625569 | 627781 | 629983 | 632175 | 634358 | 636531 | 47 |
| 14 | 30 616662 | 618913 | 621154 | 623385 | 625606 | 627818 | 630020 | 632212 | 634394 | 636567 | 46 |
| 15 | 45 616699 | 618950 | 621191 | 623422 | 625643 | 627855 | 630056 | 632248 | 634430 | 636603 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.616737 | 9.618988 | 9.621228 | 9.623459 | 9.625680 | 9.627891 | 9.630093 | 9.632285 | 9.634467 | 9.636639 | 44 |
| 17 | 15 616774 | 619025 | 621265 | 623496 | 625717 | 627928 | 630129 | 632321 | 634503 | 636675 | 43 |
| 18 | 30 616812 | 619062 | 621303 | 623533 | 625754 | 627965 | 630166 | 632358 | 634539 | 636712 | 42 |
| 19 | 45 616850 | 619100 | 621340 | 623570 | 625791 | 628002 | 630203 | 632394 | 634576 | 636748 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.616887 | 9.619137 | 9.621377 | 9.623608 | 9.625828 | 9.628038 | 9.630239 | 9.632430 | 9.634612 | 9.636784 | 40 |
| 21 | 15 616925 | 619175 | 621414 | 623645 | 625865 | 628075 | 630276 | 632467 | 634648 | 636820 | 39 |
| 22 | 30 616962 | 619212 | 621452 | 623682 | 625902 | 628112 | 630312 | 632503 | 634684 | 636856 | 38 |
| 23 | 45 617000 | 619249 | 621489 | 623719 | 625939 | 628149 | 630349 | 632540 | 634721 | 636892 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.617038 | 9.619287 | 9.621526 | 9.623756 | 9.625976 | 9.628185 | 9.630386 | 9.632576 | 9.634757 | 9.636928 | 36 |
| 25 | 15 617075 | 619324 | 621563 | 623793 | 626012 | 628222 | 630422 | 632613 | 634793 | 636964 | 35 |
| 26 | 30 617113 | 619362 | 621601 | 623830 | 626049 | 628259 | 630459 | 632649 | 634830 | 637001 | 34 |
| 27 | 45 617150 | 619399 | 621638 | 623867 | 626086 | 628296 | 630495 | 632685 | 634866 | 637037 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.617188 | 9.619436 | 9.621675 | 9.623904 | 9.626123 | 9.628332 | 9.630532 | 9.632722 | 9.634902 | 9.637073 | 32 |
| 29 | 15 617225 | 619474 | 621712 | 623941 | 626160 | 628369 | 630569 | 632758 | 634938 | 637109 | 31 |
| 30 | 30 617263 | 619511 | 621750 | 623978 | 626197 | 628406 | 630605 | 632795 | 634975 | 637145 | 30 |
| 31 | 45 617301 | 619549 | 621787 | 624015 | 626234 | 628443 | 630642 | 632831 | 635011 | 637181 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.617338 | 9.619586 | 9.621824 | 9.624052 | 9.626271 | 9.628479 | 9.630678 | 9.632867 | 9.635047 | 9.637217 | 28 |
| 33 | 15 617375 | 619623 | 621861 | 624089 | 626308 | 628516 | 630715 | 632904 | 635083 | 637253 | 27 |
| 34 | 30 617413 | 619661 | 621899 | 624126 | 626345 | 628553 | 630751 | 632940 | 635120 | 637289 | 26 |
| 35 | 45 617451 | 619698 | 621936 | 624163 | 626382 | 628590 | 630788 | 632977 | 635156 | 637325 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.617488 | 9.619736 | 9.621973 | 9.624201 | 9.626418 | 9.628626 | 9.630825 | 9.633013 | 9.635192 | 9.637361 | 24 |
| 37 | 15 617526 | 619773 | 622010 | 624238 | 626455 | 628663 | 630862 | 633049 | 635228 | 637397 | 23 |
| 38 | 30 617563 | 619810 | 622047 | 624275 | 626492 | 628700 | 630898 | 633086 | 635265 | 637434 | 22 |
| 39 | 45 617601 | 619848 | 622085 | 624312 | 626529 | 628736 | 630934 | 633122 | 635301 | 637470 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.617638 | 9.619885 | 9.622122 | 9.624349 | 9.626566 | 9.628773 | 9.630971 | 9.633159 | 9.635337 | 9.637506 | 20 |
| 41 | 15 617676 | 619922 | 622159 | 624386 | 626603 | 628810 | 631007 | 633195 | 635373 | 637542 | 19 |
| 42 | 30 617713 | 619960 | 622196 | 624423 | 626640 | 628847 | 631044 | 633231 | 635409 | 637578 | 18 |
| 43 | 45 617751 | 619997 | 622233 | 624460 | 626676 | 628883 | 631080 | 633268 | 635446 | 637614 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.617788 | 9.620034 | 9.622271 | 9.624497 | 9.626713 | 9.628920 | 9.631117 | 9.633304 | 9.635482 | 9.637650 | 16 |
| 45 | 15 617826 | 620072 | 622308 | 624534 | 626750 | 628957 | 631153 | 633341 | 635518 | 637686 | 15 |
| 46 | 30 617863 | 620109 | 622345 | 624571 | 626787 | 628993 | 631190 | 633377 | 635554 | 637722 | 14 |
| 47 | 45 617901 | 620146 | 622382 | 624608 | 626824 | 629030 | 631226 | 633413 | 635590 | 637758 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.617938 | 9.620184 | 9.622419 | 9.624645 | 9.626861 | 9.629067 | 9.631263 | 9.633450 | 9.635627 | 9.637794 | 12 |
| 49 | 15 617976 | 620221 | 622456 | 624682 | 626897 | 629103 | 631299 | 633486 | 635663 | 637830 | 11 |
| 50 | 30 618013 | 620259 | 622494 | 624719 | 626934 | 629140 | 631336 | 633522 | 635699 | 637866 | 10 |
| 51 | 45 618051 | 620296 | 622531 | 624756 | 626971 | 629177 | 631373 | 633559 | 635735 | 637902 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.618088 | 9.620333 | 9.622568 | 9.624793 | 9.627008 | 9.629213 | 9.631409 | 9.633595 | 9.635771 | 9.637938 | 8 |
| 53 | 15 618126 | 620370 | 622605 | 624830 | 627045 | 629250 | 631446 | 633631 | 635808 | 637974 | 7 |
| 54 | 30 618163 | 620408 | 622642 | 624867 | 627082 | 629287 | 631482 | 633668 | 635844 | 638010 | 6 |
| 55 | 45 618201 | 620445 | 622679 | 624904 | 627118 | 629323 | 631519 | 633704 | 635880 | 638046 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9 618238 | 9.620482 | 9.622717 | 9.624941 | 9.627155 | 9.629360 | 9.631555 | 9.633740 | 9.635916 | 9.638082 | 4 |
| 57 | 15 618276 | 620520 | 622754 | 624978 | 627192 | 629397 | 631592 | 633777 | 635952 | 638118 | 3 |
| 58 | 30 618313 | 620557 | 622791 | 625015 | 627229 | 629433 | 631628 | 633813 | 635989 | 638154 | 2 |
| 59 | 45 618351 | 620594 | 622828 | 625052 | 627266 | 629470 | 631665 | 633849 | 636025 | 638190 | 1 |
| 60 | 60 9.618388 | 9.620632 | 9.622865 | 9.625089 | 9.627303 | 9.629507 | 9.631701 | 9.633886 | 9.636061 | 9.638227 | 0 |
| | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | |

| sec. | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 62 deg. | | 63 deg. | | | | 64 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.429955 | 9.433070 | 9.436170 | 9.439255 | 9.442325 | 9.445379 | 9.448419 | 9.451445 | 9.454455 | 9.457451 | 60 |
| 1 | 15 430007 | 433122 | 436222 | 439306 | 442376 | 445430 | 448470 | 451495 | 454505 | 457501 | 59 |
| 2 | 30 430059 | 433174 | 436273 | 439358 | 442427 | 445481 | 448520 | 451545 | 454555 | 457551 | 58 |
| 3 | 45 430111 | 433226 | 436325 | 439409 | 442478 | 445532 | 448571 | 451595 | 454605 | 457601 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.430163 | 9.433277 | 9.436376 | 9.439460 | 9.442529 | 9.445583 | 9.448622 | 9.451646 | 9.454655 | 9.457651 | 56 |
| 5 | 15 430215 | 433329 | 436428 | 439511 | 442580 | 445633 | 448672 | 451696 | 454705 | 457700 | 55 |
| 6 | 30 430267 | 433381 | 436479 | 439563 | 442631 | 445684 | 448723 | 451746 | 454756 | 457750 | 54 |
| 7 | 45 430319 | 433433 | 436531 | 439614 | 442682 | 445735 | 448773 | 451797 | 454805 | 457800 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.430371 | 9.433485 | 9.436582 | 9.439665 | 9.442733 | 9.445786 | 9.448824 | 9.451847 | 9.454856 | 9.457850 | 52 |
| 9 | 15 430423 | 433536 | 436634 | 439716 | 442784 | 445836 | 448874 | 451897 | 454906 | 457899 | 51 |
| 10 | 30 430475 | 433588 | 436685 | 439768 | 442835 | 445887 | 448925 | 451947 | 454956 | 457949 | 50 |
| 11 | 45 430527 | 433640 | 436737 | 439819 | 442886 | 445938 | 448975 | 451998 | 455006 | 457999 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.430579 | 9.433692 | 9.436788 | 9.439870 | 9.442937 | 9.445989 | 9.449026 | 9.452048 | 9.455056 | 9.458049 | 48 |
| 13 | 15 430631 | 433743 | 436840 | 439921 | 442988 | 446039 | 449076 | 452098 | 455106 | 458099 | 47 |
| 14 | 30 430683 | 433795 | 436891 | 439973 | 443039 | 446090 | 449127 | 452148 | 455156 | 458148 | 46 |
| 15 | 45 430735 | 433847 | 436943 | 440024 | 443090 | 446141 | 449177 | 452199 | 455206 | 458198 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.430787 | 9.433898 | 9.436994 | 9.440075 | 9.443141 | 9.446192 | 9.449228 | 9.452249 | 9.455256 | 9.458248 | 44 |
| 17 | 15 430839 | 433950 | 437046 | 440126 | 443192 | 446242 | 449278 | 452299 | 455306 | 458298 | 43 |
| 18 | 30 430891 | 434002 | 437097 | 440177 | 443243 | 446293 | 449329 | 452349 | 455356 | 458347 | 42 |
| 19 | 45 430943 | 434054 | 437149 | 440229 | 443294 | 446344 | 449379 | 452400 | 455406 | 458397 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.430995 | 9.434105 | 9.437200 | 9.440280 | 9.443345 | 9.446394 | 9.449429 | 9.452450 | 9.455456 | 9.458447 | 40 |
| 21 | 15 431047 | 434157 | 437252 | 440331 | 443396 | 446445 | 449480 | 452500 | 455506 | 458497 | 39 |
| 22 | 30 431099 | 434209 | 437303 | 440382 | 443446 | 446496 | 449530 | 452550 | 455556 | 458546 | 38 |
| 23 | 45 431151 | 434260 | 437354 | 440433 | 443497 | 446547 | 449581 | 452600 | 455605 | 458596 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.431203 | 9.434312 | 9.437406 | 9.440485 | 9.443548 | 9.446597 | 9.449631 | 9.452651 | 9.455655 | 9.458646 | 36 |
| 25 | 15 431255 | 434364 | 437457 | 440536 | 443599 | 446648 | 449682 | 452701 | 455705 | 458695 | 35 |
| 26 | 30 431307 | 434415 | 437509 | 440587 | 443650 | 446699 | 449732 | 452751 | 455755 | 458745 | 34 |
| 27 | 45 431359 | 434467 | 437560 | 440638 | 443701 | 446749 | 449783 | 452801 | 455805 | 458795 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.431411 | 9.434519 | 9.437612 | 9.440689 | 9.443752 | 9.446800 | 9.449833 | 9.452851 | 9.455855 | 9.458845 | 32 |
| 29 | 15 431463 | 434570 | 437663 | 440741 | 443803 | 446851 | 449883 | 452902 | 455905 | 458894 | 31 |
| 30 | 30 431515 | 434622 | 437714 | 440792 | 443854 | 446901 | 449934 | 452952 | 455955 | 458944 | 30 |
| 31 | 45 431567 | 434674 | 437766 | 440843 | 443905 | 446952 | 449984 | 453002 | 456005 | 458994 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.431618 | 9.434725 | 9.437817 | 9.440894 | 9.443956 | 9.447003 | 9.450035 | 9.453052 | 9.456055 | 9.459043 | 28 |
| 33 | 15 431670 | 434777 | 437869 | 440945 | 444007 | 447053 | 450085 | 453102 | 456105 | 459093 | 27 |
| 34 | 30 431722 | 434829 | 437920 | 440996 | 444058 | 447104 | 450136 | 453152 | 456155 | 459143 | 26 |
| 35 | 45 431774 | 434880 | 437971 | 441047 | 444108 | 447155 | 450186 | 453203 | 456205 | 459192 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.431826 | 9.434932 | 9.438023 | 9.441099 | 9.444159 | 9.447205 | 9.450236 | 9.453253 | 9.456255 | 9.459242 | 24 |
| 37 | 15 431878 | 434984 | 438074 | 441150 | 444200 | 447256 | 450287 | 453303 | 456305 | 459292 | 23 |
| 38 | 30 431930 | 435035 | 438126 | 441201 | 444261 | 447306 | 450337 | 453353 | 456354 | 459341 | 22 |
| 39 | 45 431982 | 435087 | 438177 | 441252 | 444312 | 447357 | 450387 | 453403 | 456404 | 459391 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.432034 | 9.435139 | 9.438228 | 9.441303 | 9.444363 | 9.447408 | 9.450438 | 9.453453 | 9.456454 | 9.459441 | 20 |
| 41 | 15 432085 | 435190 | 438280 | 441354 | 444414 | 447458 | 450488 | 453503 | 456505 | 459490 | 19 |
| 42 | 30 432137 | 435242 | 438331 | 441405 | 444465 | 447509 | 450539 | 453554 | 456554 | 459540 | 18 |
| 43 | 45 432189 | 435293 | 438382 | 441456 | 444515 | 447560 | 450589 | 453604 | 456604 | 459590 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.432241 | 9.435345 | 9.438434 | 9.441508 | 9.444566 | 9.447610 | 9.450639 | 9.453654 | 9.456654 | 9.459639 | 16 |
| 45 | 15 432293 | 435397 | 438485 | 441559 | 444617 | 447661 | 450690 | 453704 | 456704 | 459689 | 15 |
| 46 | 30 432345 | 435448 | 438537 | 441610 | 444668 | 447711 | 450740 | 453750 | 456754 | 459739 | 14 |
| 47 | 45 432397 | 435500 | 438588 | 441661 | 444719 | 447762 | 450790 | 453804 | 456803 | 459788 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.432449 | 9.435551 | 9.438639 | 9.441712 | 9.444770 | 9.447813 | 9.450841 | 9.453854 | 9.456853 | 9.459838 | 12 |
| 49 | 15 432500 | 435603 | 438691 | 441763 | 444821 | 447863 | 450891 | 453904 | 456903 | 459887 | 11 |
| 50 | 30 432552 | 435655 | 438742 | 441814 | 444871 | 447914 | 450941 | 453955 | 456953 | 459937 | 10 |
| 51 | 45 432604 | 435706 | 438793 | 441865 | 444922 | 447964 | 450992 | 454005 | 457003 | 459987 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.432656 | 9.435758 | 9.438845 | 9.441916 | 9.444973 | 9.448015 | 9.451042 | 9.454055 | 9.457053 | 9.460036 | 8 |
| 53 | 15 432708 | 435809 | 438896 | 441967 | 445024 | 448065 | 451092 | 454105 | 457102 | 460086 | 7 |
| 54 | 30 432759 | 435861 | 438947 | 442018 | 445075 | 448116 | 451143 | 454155 | 457152 | 460136 | 6 |
| 55 | 45 432811 | 435912 | 438998 | 442069 | 445125 | 448167 | 451193 | 454205 | 457202 | 460185 | 5 |
| | 44 | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.432863 | 9.435964 | 9.439050 | 9.442120 | 9.445176 | 9.448217 | 9.451243 | 9.454255 | 9.457252 | 9.460235 | 4 |
| 57 | 15 432915 | 436016 | 439101 | 442172 | 445227 | 448268 | 451294 | 454305 | 457302 | 460284 | 3 |
| 58 | 30 432967 | 436067 | 439152 | 442223 | 445278 | 448318 | 451344 | 454355 | 457352 | 460334 | 2 |
| 59 | 45 433018 | 436119 | 439204 | 442274 | 445329 | 448369 | 451394 | 454405 | 457401 | 460383 | 1 |
| 60 | 60 9.433070 | 9.436170 | 9.439255 | 9.442325 | 9.445379 | 9.448419 | 9.451445 | 9.454455 | 9.457451 | 9.460433 | 0 |
| sec. | 49m | 48m | 47m | 46m | 45m | 44m | 43m | 42m | 41m | 40m | sec. |

| sec. | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 85 deg. | | | | 86 deg. | | | | 87 deg. | | |
| | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.659367 | 9.661430 | 9.663485 | 9.665530 | 9.667567 | 9.669594 | 9.671613 | 9.673623 | 9.675624 | 9.677617 | 60 |
| 1 | 15 659401 | 661464 | 663519 | 665564 | 667601 | 669628 | 671647 | 673657 | 675658 | 677650 | 59 |
| 2 | 30 659436 | 661499 | 663553 | 665598 | 667634 | 669662 | 671680 | 673690 | 675691 | 677683 | 58 |
| 3 | 45 659470 | 661533 | 663587 | 665632 | 667668 | 669695 | 671714 | 673723 | 675724 | 677716 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.659505 | 9.661567 | 9.663621 | 9.665666 | 9.667702 | 9.669729 | 9.671747 | 9.673757 | 9.675758 | 9.677749 | 56 |
| 5 | 15 659539 | 661602 | 663655 | 665700 | 667736 | 669763 | 671781 | 673790 | 675792 | 677783 | 55 |
| 6 | 30 659573 | 661636 | 663690 | 665734 | 667770 | 669797 | 671815 | 673824 | 675824 | 677816 | 54 |
| 7 | 45 659608 | 661670 | 663724 | 665768 | 667804 | 669831 | 671848 | 673857 | 675857 | 677849 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.659642 | 9.661705 | 9.663758 | 9.665802 | 9.667838 | 9.669864 | 9.671882 | 9.673890 | 9.675891 | 9.677882 | 52 |
| 9 | 15 659677 | 661739 | 663792 | 665836 | 667871 | 669898 | 671915 | 673924 | 675924 | 677915 | 51 |
| 10 | 30 659711 | 661773 | 663826 | 665870 | 667905 | 669931 | 671949 | 673957 | 675957 | 677948 | 50 |
| 11 | 45 659746 | 661807 | 663860 | 665904 | 667939 | 669965 | 671982 | 673991 | 675990 | 677981 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.659780 | 9.661842 | 9.663894 | 9.665938 | 9.667973 | 9.669999 | 9.672016 | 9.674024 | 9.676024 | 9.678014 | 48 |
| 13 | 15 659814 | 661876 | 663928 | 665972 | 668007 | 670033 | 672049 | 674057 | 676057 | 678047 | 47 |
| 14 | 30 659849 | 661910 | 663963 | 666006 | 668041 | 670066 | 672083 | 674091 | 676090 | 678081 | 46 |
| 15 | 45 659883 | 661945 | 663997 | 666040 | 668075 | 670100 | 672116 | 674124 | 676123 | 678114 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.659918 | 9.661979 | 9.664031 | 9.666074 | 9.668108 | 9.670134 | 9.672150 | 9.674158 | 9.676157 | 9.678147 | 44 |
| 17 | 15 659952 | 662013 | 664065 | 666108 | 668142 | 670167 | 672183 | 674191 | 676190 | 678180 | 43 |
| 18 | 30 659987 | 662047 | 664099 | 666142 | 668176 | 670201 | 672217 | 674224 | 676223 | 678213 | 42 |
| 19 | 45 660021 | 662082 | 664133 | 666176 | 668210 | 670235 | 672251 | 674258 | 676256 | 678246 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.660056 | 9.662116 | 9.664167 | 9.666210 | 9.668244 | 9.670268 | 9.672284 | 9.674291 | 9.676290 | 9.678279 | 40 |
| 21 | 15 660090 | 662150 | 664201 | 666244 | 668277 | 670302 | 672318 | 674325 | 676323 | 678312 | 39 |
| 22 | 30 660124 | 662185 | 664236 | 666278 | 668311 | 670336 | 672351 | 674358 | 676356 | 678345 | 38 |
| 23 | 45 660159 | 662219 | 664270 | 666312 | 668345 | 670369 | 672385 | 674391 | 676389 | 678378 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.660193 | 9.662253 | 9.664304 | 9.666346 | 9.668379 | 9.670403 | 9.672418 | 9.674425 | 9.676422 | 9.678412 | 36 |
| 25 | 15 660227 | 662287 | 664338 | 666380 | 668413 | 670437 | 672452 | 674458 | 676456 | 678445 | 35 |
| 26 | 30 660262 | 662322 | 664372 | 666414 | 668446 | 670470 | 672485 | 674491 | 676489 | 678478 | 34 |
| 27 | 45 660296 | 662356 | 664406 | 666448 | 668480 | 670504 | 672519 | 674525 | 676522 | 678511 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.660331 | 9.662390 | 9.664440 | 9.666482 | 9.668514 | 9.670538 | 9.672552 | 9.674558 | 9.676555 | 9.678544 | 32 |
| 29 | 15 660365 | 662424 | 664474 | 666515 | 668548 | 670571 | 672586 | 674591 | 676589 | 678577 | 31 |
| 30 | 30 660400 | 662459 | 664508 | 666549 | 668582 | 670605 | 672619 | 674625 | 676621 | 678610 | 30 |
| 31 | 45 660434 | 662493 | 664542 | 666583 | 668615 | 670638 | 672653 | 674658 | 676655 | 678643 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.660468 | 9.662527 | 9.664577 | 9.666617 | 9.668649 | 9.670672 | 9.672686 | 9.674692 | 9.676688 | 9.678676 | 28 |
| 33 | 15 660503 | 662561 | 664611 | 666651 | 668683 | 670706 | 672720 | 674725 | 676721 | 678709 | 27 |
| 34 | 30 660537 | 662595 | 664645 | 666685 | 668717 | 670739 | 672753 | 674758 | 676755 | 678742 | 26 |
| 35 | 45 660571 | 662630 | 664679 | 666719 | 668751 | 670773 | 672787 | 674792 | 676788 | 678775 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.660606 | 9.662664 | 9.664713 | 9.666753 | 9.668784 | 9.670807 | 9.672820 | 9.674825 | 9.676821 | 9.678808 | 24 |
| 37 | 15 660640 | 662698 | 664747 | 666787 | 668818 | 670840 | 672854 | 674858 | 676854 | 678841 | 23 |
| 38 | 30 660675 | 662732 | 664781 | 666821 | 668852 | 670874 | 672887 | 674892 | 676887 | 678874 | 22 |
| 39 | 45 660709 | 662767 | 664815 | 666855 | 668886 | 670908 | 672921 | 674925 | 676921 | 678907 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.660743 | 9.662801 | 9.664849 | 9.666889 | 9.668919 | 9.670941 | 9.672954 | 9.674958 | 9.676954 | 9.678940 | 20 |
| 41 | 15 660778 | 662835 | 664883 | 666923 | 668953 | 670975 | 672988 | 674992 | 676987 | 678973 | 19 |
| 42 | 30 660812 | 662869 | 664917 | 666957 | 668987 | 671008 | 673021 | 675025 | 677020 | 679007 | 18 |
| 43 | 15 660846 | 662903 | 664951 | 666991 | 669021 | 671042 | 673055 | 675058 | 677053 | 679040 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.660881 | 9.662938 | 9.664986 | 9.667024 | 9.669054 | 9.671076 | 9.673088 | 9.675092 | 9.677086 | 9.679073 | 16 |
| 45 | 15 660915 | 662972 | 665020 | 667058 | 669088 | 671109 | 673121 | 675125 | 677120 | 679106 | 15 |
| 46 | 30 660949 | 663006 | 665054 | 667092 | 669122 | 671143 | 673155 | 675158 | 677153 | 679139 | 14 |
| 47 | 45 660984 | 663040 | 665088 | 667126 | 669156 | 671176 | 673188 | 675192 | 677186 | 679172 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.661018 | 9.663074 | 9.665122 | 9.667160 | 9.669190 | 9.671210 | 9.673222 | 9.675225 | 9.677219 | 9.679205 | 12 |
| 49 | 15 661052 | 663109 | 665156 | 667194 | 669223 | 671244 | 673255 | 675258 | 677252 | 679238 | 11 |
| 50 | 30 661087 | 663143 | 665190 | 667228 | 669257 | 671277 | 673289 | 675291 | 677285 | 679271 | 10 |
| 51 | 45 661121 | 663177 | 665224 | 667262 | 669291 | 671311 | 673322 | 675325 | 677319 | 679304 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.661156 | 9.663211 | 9.665258 | 9.667296 | 9.669324 | 9.671344 | 9.673356 | 9.675358 | 9.677352 | 9.679337 | 8 |
| 53 | 15 661190 | 663245 | 665292 | 667329 | 669358 | 671378 | 673389 | 675391 | 677385 | 679370 | 7 |
| 54 | 30 661224 | 663280 | 665326 | 667363 | 669392 | 671412 | 673423 | 675425 | 677418 | 679403 | 6 |
| 55 | 45 661258 | 663314 | 665360 | 667397 | 669426 | 671445 | 673456 | 675458 | 677451 | 679436 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.661293 | 9.663348 | 9.665394 | 9.667431 | 9.669459 | 9.671479 | 9.673489 | 9.675491 | 9.677484 | 9.679469 | 4 |
| 57 | 15 661327 | 663382 | 665428 | 667465 | 669493 | 671513 | 673523 | 675525 | 677518 | 679502 | 3 |
| 58 | 30 661362 | 663416 | 665462 | 667499 | 669527 | 671546 | 673556 | 675558 | 677551 | 679535 | 2 |
| 59 | 45 661396 | 663450 | 665496 | 667533 | 669561 | 671580 | 673590 | 675591 | 677584 | 679568 | 1 |
| 60 | 60 9.661430 | 9.663485 | 9.665530 | 9.667567 | 9.669594 | 9.671613 | 9.673623 | 9.675624 | 9.677617 | 9.679601 | 0 |
| sec. | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m | sec. |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 87 deg. | | 88 deg. | | | | 89 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.679601 | 9.681576 | 9.683543 | 9.685501 | 9.687450 | 9.689391 | 9.691324 | 9.693248 | 9.695163 | 9.697071 | 60 |
| 1 | 15 679634 | 681609 | 683575 | 685533 | 687482 | 689423 | 691356 | 693280 | 695195 | 697103 | 59 |
| 2 | 30 679667 | 681642 | 683608 | 685566 | 687515 | 689456 | 691388 | 693312 | 695227 | 697134 | 58 |
| 3 | 45 679700 | 681674 | 683641 | 685598 | 687547 | 689488 | 691420 | 693344 | 695259 | 697166 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.679733 | 9.681707 | 9.683673 | 9.685631 | 9.687580 | 9.689520 | 9.691452 | 9.693376 | 9.695291 | 9.697198 | 56 |
| 5 | 15 679766 | 681740 | 683706 | 685663 | 687612 | 689552 | 691484 | 693408 | 695323 | 697229 | 55 |
| 6 | 30 679799 | 681773 | 683739 | 685696 | 687645 | 689585 | 691516 | 693440 | 695355 | 697261 | 54 |
| 7 | 45 679832 | 681806 | 683771 | 685728 | 687677 | 689617 | 691548 | 693472 | 695387 | 697293 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.679865 | 9.681839 | 9.683804 | 9.685761 | 9.687709 | 9.689649 | 9.691581 | 9.693504 | 9.695418 | 9.697325 | 52 |
| 9 | 15 679898 | 681871 | 683837 | 685794 | 687742 | 689681 | 691613 | 693536 | 695450 | 697356 | 51 |
| 10 | 30 679931 | 681904 | 683869 | 685826 | 687774 | 689714 | 691645 | 693568 | 695482 | 697388 | 50 |
| 11 | 45 679964 | 681937 | 683902 | 685859 | 687806 | 689746 | 691677 | 693600 | 695514 | 697420 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.679997 | 9.681970 | 9.683935 | 9.685891 | 9.687839 | 9.689778 | 9.691709 | 9.693632 | 9.695546 | 9.697451 | 48 |
| 13 | 15 680029 | 682003 | 683967 | 685924 | 687871 | 689810 | 691741 | 693663 | 695577 | 697483 | 47 |
| 14 | 30 680062 | 682036 | 684000 | 685956 | 687904 | 689843 | 691773 | 693695 | 695609 | 697515 | 46 |
| 15 | 45 680095 | 682068 | 684033 | 685989 | 687936 | 689875 | 691805 | 693727 | 695641 | 697546 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.680128 | 9.682101 | 9.684066 | 9.686021 | 9.687968 | 9.689907 | 9.691838 | 9.693759 | 9.695673 | 9.697578 | 44 |
| 17 | 15 680161 | 682134 | 684098 | 686054 | 688001 | 689939 | 691870 | 693791 | 695705 | 697610 | 43 |
| 18 | 30 680194 | 682167 | 684131 | 686086 | 688033 | 689972 | 691902 | 693823 | 695737 | 697641 | 42 |
| 19 | 45 680227 | 682200 | 684163 | 686119 | 688066 | 690004 | 691934 | 693855 | 695768 | 697673 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.680260 | 9.682232 | 9.684196 | 9.686151 | 9.688098 | 9.690036 | 9.691966 | 9.693887 | 9.695800 | 9.697705 | 40 |
| 21 | 15 680293 | 682265 | 684229 | 686184 | 688130 | 690068 | 691998 | 693919 | 695832 | 697736 | 39 |
| 22 | 30 680326 | 682298 | 684261 | 686216 | 688163 | 690101 | 692030 | 693951 | 695864 | 697768 | 38 |
| 23 | 45 680359 | 682331 | 684294 | 686249 | 688195 | 690133 | 692062 | 693983 | 695896 | 697800 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.680392 | 9.682364 | 9.684327 | 9.686281 | 9.688227 | 9.690165 | 9.692094 | 9.694015 | 9.695927 | 9.697832 | 36 |
| 25 | 15 680425 | 682396 | 684359 | 686314 | 688260 | 690197 | 692126 | 694047 | 695959 | 697863 | 35 |
| 26 | 30 680458 | 682429 | 684392 | 686346 | 688292 | 690230 | 692158 | 694079 | 695991 | 697895 | 34 |
| 27 | 45 680491 | 682462 | 684425 | 686379 | 688325 | 690262 | 692190 | 694111 | 696023 | 697926 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.680524 | 9.682495 | 9.684457 | 9.686411 | 9.688357 | 9.690294 | 9.692223 | 9.694143 | 9.696055 | 9.697958 | 32 |
| 29 | 15 680557 | 682528 | 684490 | 686444 | 688389 | 690326 | 692255 | 694175 | 696086 | 697990 | 31 |
| 30 | 30 680589 | 682560 | 684523 | 686476 | 688422 | 690358 | 692287 | 694207 | 696118 | 698021 | 30 |
| 31 | 45 680622 | 682593 | 684555 | 686509 | 688454 | 690391 | 692319 | 694239 | 696150 | 698053 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.680655 | 9.682626 | 9.684588 | 9.686541 | 9.688486 | 9.690423 | 9.692351 | 9.694271 | 9.696182 | 9.698085 | 28 |
| 33 | 15 680688 | 682659 | 684620 | 686574 | 688519 | 690455 | 692383 | 694302 | 696214 | 698116 | 27 |
| 34 | 30 680721 | 682691 | 684653 | 686606 | 688551 | 690487 | 692415 | 694334 | 696245 | 698148 | 26 |
| 35 | 45 680754 | 682724 | 684686 | 686639 | 688583 | 690519 | 692447 | 694366 | 696277 | 698180 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.680787 | 9.682757 | 9.684718 | 9.686671 | 9.688616 | 9.690552 | 9.692479 | 9.694398 | 9.696309 | 9.698211 | 24 |
| 37 | 15 680820 | 682790 | 684751 | 686704 | 688648 | 690584 | 692511 | 694430 | 696341 | 698243 | 23 |
| 38 | 30 680853 | 682822 | 684784 | 686736 | 688680 | 690616 | 692543 | 694462 | 696372 | 698275 | 22 |
| 39 | 45 680886 | 682855 | 684816 | 686769 | 688713 | 690648 | 692575 | 694494 | 696404 | 698306 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.680919 | 9.682888 | 9.684849 | 9.686801 | 9.688745 | 9.690680 | 9.692607 | 9.694526 | 9.696436 | 9.698338 | 20 |
| 41 | 15 680951 | 682921 | 684882 | 686834 | 688777 | 690712 | 692639 | 694558 | 696468 | 698369 | 19 |
| 42 | 30 680984 | 682953 | 684914 | 686866 | 688810 | 690745 | 692671 | 694590 | 696500 | 698401 | 18 |
| 43 | 45 681017 | 682986 | 684947 | 686899 | 688843 | 690777 | 692703 | 694622 | 696531 | 698433 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.681050 | 9.683019 | 9.684979 | 9.686931 | 9.688874 | 9.690809 | 9.692735 | 9.694653 | 9.696563 | 9.698464 | 16 |
| 45 | 15 681083 | 683052 | 685012 | 686963 | 688907 | 690841 | 692767 | 694685 | 696595 | 698496 | 15 |
| 46 | 30 681116 | 683084 | 685044 | 686996 | 688939 | 690873 | 692800 | 694717 | 696627 | 698528 | 14 |
| 47 | 15 681149 | 683117 | 685077 | 687028 | 688971 | 690906 | 692831 | 694749 | 696658 | 698559 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.681182 | 9.683150 | 9.685110 | 9.687061 | 9.689004 | 9.690938 | 9.692864 | 9.694781 | 9.696690 | 9.698591 | 12 |
| 49 | 15 681214 | 683183 | 685142 | 687093 | 689036 | 690970 | 692896 | 694813 | 696722 | 698622 | 11 |
| 50 | 30 681247 | 683215 | 685175 | 687126 | 689068 | 691002 | 692925 | 694845 | 696754 | 698654 | 10 |
| 51 | 45 681280 | 683248 | 685207 | 687158 | 689100 | 691034 | 692960 | 694877 | 696785 | 698686 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.681313 | 9.683281 | 9.685240 | 9.687191 | 9.689133 | 9.691066 | 9.692992 | 9.694909 | 9.696817 | 9.698717 | 8 |
| 53 | 15 681346 | 683314 | 685273 | 687223 | 689165 | 691099 | 693024 | 694940 | 696849 | 698749 | 7 |
| 54 | 30 681379 | 683346 | 685305 | 687255 | 689197 | 691131 | 693056 | 694972 | 696881 | 698780 | 6 |
| 55 | 45 681412 | 683379 | 685338 | 687289 | 689230 | 691163 | 693088 | 695004 | 696912 | 698812 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.681445 | 9.683412 | 9.685370 | 9.687320 | 9.689262 | 9.691195 | 9.693120 | 9.695036 | 9.696944 | 9.698844 | 4 |
| 57 | 15 681477 | 683444 | 685403 | 687353 | 689294 | 691227 | 693152 | 695068 | 696976 | 698875 | 3 |
| 58 | 30 681510 | 683477 | 685435 | 687385 | 689326 | 691259 | 693184 | 695100 | 697007 | 698907 | 2 |
| 59 | 45 681543 | 683510 | 685468 | 687418 | 689359 | 691291 | 693216 | 695132 | 697039 | 698938 | 1 |
| 60 | 0 9.681576 | 9.683543 | 9.685501 | 9.687450 | 9.689391 | 9.691324 | 9.693248 | 9.695163 | 9.697071 | 9.698970 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90 deg. | | | | 91 deg. | | | | 92 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.698970 | 9.700860 | 9.702743 | 9.704618 | 9.706484 | 9.708342 | 9.710192 | 9.712034 | 9.713868 | 9.715694 | 60 |
| 1 | 15 699001 | 700892 | 702775 | 704649 | 706515 | 708373 | 710223 | 712065 | 713899 | 715724 | 59 |
| 2 | 30 699033 | 700924 | 702806 | 704680 | 706546 | 708404 | 710254 | 712095 | 713929 | 715755 | 58 |
| 3 | 45 699065 | 700955 | 702837 | 704711 | 706577 | 708435 | 710284 | 712126 | 713960 | 715785 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.699096 | 9.700987 | 9.702869 | 9.704743 | 9.706608 | 9.708466 | 9.710315 | 9.712157 | 9.713990 | 9.715816 | 56 |
| 5 | 15 699128 | 701018 | 702900 | 704774 | 706639 | 708497 | 710346 | 712187 | 714021 | 715846 | 55 |
| 6 | 30 699159 | 701049 | 702931 | 704805 | 706670 | 708528 | 710377 | 712218 | 714051 | 715876 | 54 |
| 7 | 45 699191 | 701081 | 702962 | 704836 | 706701 | 708558 | 710408 | 712249 | 714082 | 715907 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.699223 | 9.701112 | 9.702994 | 9.704867 | 9.706732 | 9.708589 | 9.710438 | 9.712279 | 9.714112 | 9.715937 | 52 |
| 9 | 15 699254 | 701144 | 703025 | 704898 | 706763 | 708620 | 710469 | 712310 | 714143 | 715967 | 51 |
| 10 | 30 699286 | 701175 | 703056 | 704929 | 706794 | 708651 | 710500 | 712340 | 714173 | 715998 | 50 |
| 11 | 45 699317 | 701207 | 703087 | 704961 | 706825 | 708682 | 710531 | 712371 | 714204 | 716028 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.699349 | 9.701238 | 9.703119 | 9.704992 | 9.706856 | 9.708713 | 9.710561 | 9.712402 | 9.714234 | 9.716058 | 48 |
| 13 | 15 699380 | 701269 | 703150 | 705023 | 706887 | 708744 | 710592 | 712432 | 714264 | 716089 | 47 |
| 14 | 30 699412 | 701301 | 703182 | 705054 | 706918 | 708775 | 710623 | 712463 | 714295 | 716119 | 46 |
| 15 | 45 699443 | 701332 | 703213 | 705085 | 706949 | 708805 | 710653 | 712493 | 714325 | 716149 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.699475 | 9.701364 | 9.703244 | 9.705116 | 9.706980 | 9.708836 | 9.710684 | 9.712524 | 9.714356 | 9.716180 | 44 |
| 17 | 15 699506 | 701395 | 703275 | 705147 | 707011 | 708867 | 710715 | 712555 | 714386 | 716210 | 43 |
| 18 | 30 699538 | 701426 | 703307 | 705179 | 707042 | 708898 | 710746 | 712585 | 714417 | 716240 | 42 |
| 19 | 45 699569 | 701458 | 703338 | 705210 | 707073 | 708929 | 710776 | 712616 | 714447 | 716271 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.699601 | 9.701489 | 9.703369 | 9.705241 | 9.707104 | 9.708960 | 9.710807 | 9.712646 | 9.714478 | 9.716301 | 40 |
| 21 | 15 699633 | 701521 | 703400 | 705272 | 707135 | 708991 | 710838 | 712676 | 714508 | 716331 | 39 |
| 22 | 30 699664 | 701552 | 703432 | 705303 | 707166 | 709022 | 710869 | 712708 | 714539 | 716362 | 38 |
| 23 | 45 699696 | 701583 | 703463 | 705334 | 707197 | 709052 | 710899 | 712738 | 714569 | 716392 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.699727 | 9.701615 | 9.703494 | 9.705365 | 9.707228 | 9.709083 | 9.710930 | 9.712769 | 9.714600 | 9.716422 | 36 |
| 25 | 15 699759 | 701646 | 703525 | 705396 | 707259 | 709114 | 710961 | 712799 | 714630 | 716453 | 35 |
| 26 | 30 699790 | 701678 | 703557 | 705428 | 707290 | 709145 | 710991 | 712830 | 714660 | 716483 | 34 |
| 27 | 45 699822 | 701709 | 703588 | 705459 | 707321 | 709176 | 711022 | 712860 | 714691 | 716513 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.699853 | 9.701740 | 9.703619 | 9.705490 | 9.707352 | 9.709207 | 9.711053 | 9.712891 | 9.714721 | 9.716544 | 32 |
| 29 | 15 699885 | 701772 | 703650 | 705521 | 707383 | 709237 | 711084 | 712922 | 714752 | 716574 | 31 |
| 30 | 30 699916 | 701803 | 703682 | 705552 | 707414 | 709268 | 711114 | 712952 | 714782 | 716604 | 30 |
| 31 | 45 699948 | 701834 | 703713 | 705583 | 707445 | 709299 | 711145 | 712983 | 714813 | 716634 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.699979 | 9.701866 | 9.703744 | 9.705614 | 9.707476 | 9.709330 | 9.711176 | 9.713013 | 9.714843 | 9.716665 | 28 |
| 33 | 15 700011 | 701897 | 703775 | 705645 | 707507 | 709361 | 711206 | 713044 | 714873 | 716695 | 27 |
| 34 | 30 700042 | 701929 | 703807 | 705676 | 707538 | 709392 | 711237 | 713074 | 714904 | 716725 | 26 |
| 35 | 45 700074 | 701960 | 703838 | 705707 | 707569 | 709422 | 711268 | 713105 | 714934 | 716756 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.700105 | 9.701991 | 9.703869 | 9.705739 | 9.707600 | 9.709453 | 9.711298 | 9.713136 | 9.714965 | 9.716786 | 24 |
| 37 | 15 700137 | 702023 | 703900 | 705770 | 707631 | 709484 | 711329 | 713166 | 714995 | 716816 | 23 |
| 38 | 30 700168 | 702054 | 703932 | 705801 | 707662 | 709515 | 711360 | 713197 | 715026 | 716846 | 22 |
| 39 | 45 700200 | 702085 | 703963 | 705832 | 707693 | 709546 | 711391 | 713227 | 715056 | 716877 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.700231 | 9.702117 | 9.703994 | 9.705863 | 9.707724 | 9.709576 | 9.711421 | 9.713258 | 9.715086 | 9.716907 | 20 |
| 41 | 15 700263 | 702148 | 704025 | 705894 | 707755 | 709607 | 711452 | 713288 | 715117 | 716937 | 19 |
| 42 | 30 700294 | 702180 | 704056 | 705925 | 707786 | 709638 | 711482 | 713319 | 715147 | 716968 | 18 |
| 43 | 45 700326 | 702211 | 704087 | 705956 | 707817 | 709669 | 711513 | 713349 | 715178 | 716998 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.700357 | 9.702242 | 9.704119 | 9.705987 | 9.707848 | 9.709700 | 9.711544 | 9.713380 | 9.715208 | 9.717028 | 16 |
| 45 | 15 700389 | 702273 | 704150 | 706018 | 707878 | 709730 | 711574 | 713410 | 715238 | 717059 | 15 |
| 46 | 30 700420 | 702305 | 704181 | 706049 | 707909 | 709761 | 711605 | 713441 | 715269 | 717089 | 14 |
| 47 | 45 700452 | 702336 | 704212 | 706080 | 707940 | 709792 | 711636 | 713471 | 715299 | 717119 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.700483 | 9.702368 | 9.704244 | 9.706112 | 9.707971 | 9.709823 | 9.711666 | 9.713502 | 9.715330 | 9.717149 | 12 |
| 49 | 15 700515 | 702399 | 704275 | 706143 | 708002 | 709854 | 711697 | 713533 | 715360 | 717179 | 11 |
| 50 | 30 700546 | 702430 | 704306 | 706174 | 708033 | 709884 | 711728 | 713563 | 715390 | 717210 | 10 |
| 51 | 45 700578 | 702461 | 704337 | 706205 | 708064 | 709915 | 711758 | 713594 | 715421 | 717240 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.700609 | 9.702493 | 9.704368 | 9.706236 | 9.708095 | 9.709946 | 9.711789 | 9.713624 | 9.715451 | 9.717270 | 8 |
| 53 | 15 700641 | 702524 | 704399 | 706267 | 708126 | 709977 | 711820 | 713655 | 715481 | 717300 | 7 |
| 54 | 30 700672 | 702556 | 704431 | 706298 | 708157 | 710008 | 711850 | 713685 | 715512 | 717331 | 6 |
| 55 | 45 700703 | 702587 | 704462 | 706329 | 708188 | 710038 | 711881 | 713716 | 715542 | 717361 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.700735 | 9.702618 | 9.704493 | 9.706360 | 9.708219 | 9.710069 | 9.711912 | 9.713746 | 9.715573 | 9.717391 | 4 |
| 57 | 15 700766 | 702649 | 704524 | 706391 | 708249 | 710100 | 711942 | 713777 | 715603 | 717421 | 3 |
| 58 | 30 700798 | 702681 | 704556 | 706422 | 708280 | 710131 | 711973 | 713807 | 715633 | 717452 | 2 |
| 59 | 45 700829 | 702712 | 704587 | 706453 | 708311 | 710161 | 712004 | 713838 | 715664 | 717482 | 1 |
| 60 | 60 9.700860 | 9.702743 | 9.704618 | 9.706484 | 9.708342 | 9.710192 | 9.712034 | 9.713868 | 9.715694 | 9.717512 | 0 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 72 deg. | | 73 deg. | | | | 74 deg. | | | | |
| | 30' | 45' | 0' | 15' | 30' | 45' | 0' | 15' | 30' | 45' | |
| 0 | 0 9.543630 | 9.546208 | 9.548775 | 9.551330 | 9.553874 | 9.556406 | 9.558926 | 9.561435 | 9.563933 | 9.566419 | 60 |
| 1 | 15 543673 | 546251 | 548818 | 551373 | 553916 | 556448 | 558968 | 561477 | 563974 | 566460 | 59 |
| 2 | 30 543716 | 546294 | 548861 | 551415 | 553958 | 556490 | 559010 | 561518 | 564016 | 566502 | 58 |
| 3 | 45 543759 | 546337 | 548903 | 551458 | 554001 | 556532 | 559052 | 561560 | 564057 | 566543 | 57 |
| | 31' | 46' | 1' | 16' | 31' | 46' | 1' | 16' | 31' | 46' | |
| 4 | 0 9.543802 | 9.546380 | 9.548946 | 9.551500 | 9.554043 | 9.556574 | 9.559094 | 9.561602 | 9.564099 | 9.566584 | 56 |
| 5 | 15 543845 | 546423 | 548989 | 551543 | 554085 | 556616 | 559136 | 561644 | 564140 | 566626 | 55 |
| 6 | 30 543888 | 546466 | 549031 | 551585 | 554127 | 556658 | 559177 | 561685 | 564182 | 566667 | 54 |
| 7 | 45 543931 | 546508 | 549074 | 551628 | 554170 | 556700 | 559219 | 561727 | 564223 | 566708 | 53 |
| | 32' | 47' | 2' | 17' | 32' | 47' | 2' | 17' | 32' | 47' | |
| 8 | 0 9.543974 | 9.546551 | 9.549117 | 9.551670 | 9.554212 | 9.556742 | 9.559261 | 9.561769 | 9.564265 | 9.566750 | 52 |
| 9 | 15 544017 | 546594 | 549159 | 551712 | 554254 | 556784 | 559303 | 561810 | 564306 | 566791 | 51 |
| 10 | 30 544061 | 546637 | 549202 | 551755 | 554297 | 556826 | 559345 | 561852 | 564348 | 566832 | 50 |
| 11 | 45 544103 | 546680 | 549244 | 551797 | 554339 | 556869 | 559387 | 561894 | 564389 | 566874 | 49 |
| | 33' | 48' | 3' | 18' | 33' | 48' | 3' | 18' | 33' | 48' | |
| 12 | 0 9.544147 | 9.546723 | 9.549287 | 9 551840 | 9.554381 | 9.556911 | 9.559429 | 9.561935 | 9.564431 | 9.566915 | 48 |
| 13 | 15 544190 | 546766 | 549330 | 551882 | 554423 | 556953 | 559471 | 561977 | 564472 | 566956 | 47 |
| 14 | 30 544233 | 546808 | 549372 | 551925 | 554466 | 556995 | 559513 | 562019 | 564514 | 566998 | 46 |
| 15 | 45 544276 | 546851 | 549415 | 551967 | 554507 | 557037 | 559554 | 562061 | 564555 | 567039 | 45 |
| | 34' | 49' | 4' | 19' | 34' | 49' | 4' | 19' | 34' | 49' | |
| 16 | 0 9.544319 | 9.546894 | 9.549458 | 9.552010 | 9.554550 | 9.557079 | 9.559596 | 9.562102 | 9.564597 | 9.567080 | 44 |
| 17 | 15 544362 | 546937 | 549500 | 552052 | 554592 | 557121 | 559638 | 562144 | 564638 | 567121 | 43 |
| 18 | 30 544405 | 546980 | 549543 | 552095 | 554635 | 557163 | 559680 | 562186 | 564680 | 567163 | 42 |
| 19 | 45 544448 | 547022 | 549586 | 552137 | 554677 | 557205 | 559722 | 562227 | 564721 | 567204 | 41 |
| | 35' | 50' | 5' | 20' | 35' | 50' | 5' | 20' | 35' | 50' | |
| 20 | 0 9.544491 | 9.547065 | 9.549628 | 9.552179 | 9.554719 | 9.557247 | 9.559764 | 9.562269 | 9.564763 | 9.567245 | 40 |
| 21 | 15 544534 | 547108 | 549671 | 552222 | 554761 | 557289 | 559805 | 562311 | 564804 | 567287 | 39 |
| 22 | 30 544577 | 547151 | 549713 | 552264 | 554803 | 557331 | 559847 | 562352 | 564846 | 567328 | 38 |
| 23 | 45 544620 | 547194 | 549756 | 552307 | 554846 | 557373 | 559889 | 562394 | 564887 | 567369 | 37 |
| | 36' | 51' | 6' | 21' | 36' | 51' | 6' | 21 | 36' | 51' | |
| 24 | 0 9.544663 | 9.547237 | 9.549799 | 9.552349 | 9.554888 | 9.557415 | 9.559931 | 9.562435 | 9.564929 | 9.567411 | 36 |
| 25 | 15 544706 | 547279 | 549841 | 552391 | 554930 | 557457 | 559973 | 562477 | 564970 | 567452 | 35 |
| 26 | 30 544749 | 547322 | 549884 | 552434 | 554972 | 557499 | 560015 | 562519 | 565012 | 567493 | 34 |
| 27 | 45 544792 | 547365 | 549927 | 552476 | 555014 | 557541 | 560057 | 562560 | 565053 | 567534 | 33 |
| | 37' | 52' | 7' | 22' | 37' | 52' | 7' | 22' | 37' | 52' | |
| 28 | 0 9.544825 | 9.547408 | 9.549969 | 9.552519 | 9.555057 | 9.557583 | 9.560098 | 9.562602 | 9.565094 | 9.567576 | 32 |
| 29 | 15 544878 | 547450 | 550012 | 552561 | 555099 | 557625 | 560140 | 562644 | 565136 | 567617 | 31 |
| 30 | 30 544921 | 547493 | 550054 | 552603 | 555141 | 557667 | 560182 | 562685 | 565177 | 567658 | 30 |
| 31 | 45 544964 | 547536 | 550097 | 552646 | 555183 | 557709 | 560224 | 562727 | 565219 | 567699 | 29 |
| | 38' | 53' | 8' | 23' | 38' | 53' | 8' | 23' | 38' | 53' | |
| 32 | 0 9.545007 | 9.547579 | 9.550139 | 9.552688 | 9.555226 | 9.557751 | 9.560266 | 9.562769 | 9.565260 | 9.567741 | 28 |
| 33 | 15 545050 | 547622 | 550182 | 552731 | 555268 | 557793 | 560307 | 562810 | 565302 | 567782 | 27 |
| 34 | 30 545093 | 547664 | 550224 | 552773 | 555310 | 557835 | 560349 | 562852 | 565343 | 567823 | 26 |
| 35 | 45 545135 | 547707 | 550267 | 552815 | 555352 | 557877 | 560391 | 562893 | 565384 | 567864 | 25 |
| | 39' | 54' | 9' | 24' | 39' | 54' | 9' | 24' | 39' | 54' | |
| 36 | 0 9.545178 | 9.547750 | 9.550310 | 9.552858 | 9.555394 | 9.557919 | 9.560433 | 9.562935 | 9.565426 | 9.567906 | 24 |
| 37 | 15 545221 | 547793 | 550352 | 552900 | 555436 | 557961 | 560475 | 562977 | 565467 | 567947 | 23 |
| 38 | 30 545264 | 547835 | 550395 | 552942 | 555479 | 558003 | 560516 | 563018 | 565509 | 567988 | 22 |
| 39 | 45 545307 | 547878 | 550437 | 552985 | 555521 | 558045 | 560558 | 563060 | 565550 | 568029 | 21 |
| | 40' | 55' | 10' | 25' | 40' | 55' | 10' | 25' | 40' | 55' | |
| 40 | 0 9.545350 | 9.547921 | 9.550480 | 9.553027 | 9.555563 | 9.558087 | 9.560600 | 9.563101 | 9 565592 | 9.568070 | 20 |
| 41 | 15 545393 | 547964 | 550522 | 553070 | 555605 | 558129 | 560642 | 563143 | 565633 | 568112 | 19 |
| 42 | 30 545436 | 548006 | 550565 | 553112 | 555647 | 558171 | 560684 | 563185 | 565674 | 568153 | 18 |
| 43 | 45 545479 | 548049 | 550607 | 553154 | 555689 | 558213 | 560725 | 563226 | 565716 | 568194 | 17 |
| | 41' | 56' | 11' | 26' | 41' | 56' | 11' | 26' | 41' | 56' | |
| 44 | 0 9.545522 | 9.548092 | 9.550650 | 9.553197 | 9.555732 | 9.558255 | 9.560767 | 9.563268 | 9.565757 | 9.568235 | 16 |
| 45 | 15 545565 | 548135 | 550693 | 553239 | 555774 | 558297 | 560809 | 563309 | 565798 | 568276 | 15 |
| 46 | 30 545608 | 548177 | 550735 | 553281 | 555816 | 558339 | 560851 | 563351 | 565840 | 568318 | 14 |
| 47 | 45 545651 | 548220 | 550778 | 553324 | 555858 | 558381 | 560892 | 563392 | 565881 | 568359 | 13 |
| | 42' | 57' | 12' | 27' | 42' | 57' | 12' | 27' | 42' | 57' | |
| 48 | 0 9.545694 | 9.548263 | 9.550820 | 9.553366 | 9.555900 | 9.558423 | 9.560934 | 9.563434 | 9.565923 | 9.568400 | 12 |
| 49 | 15 545737 | 548305 | 550863 | 553408 | 555942 | 558465 | 560976 | 563476 | 565964 | 568441 | 11 |
| 50 | 30 545780 | 548348 | 550905 | 553451 | 555984 | 558507 | 561018 | 563517 | 566005 | 568483 | 10 |
| 51 | 45 545822 | 548391 | 550948 | 553493 | 556027 | 558549 | 561059 | 563559 | 566047 | 568524 | 9 |
| | 43' | 58' | 13' | 28' | 43' | 58' | 13' | 29' | 43' | 58' | |
| 52 | 0 9.545865 | 9.548434 | 9.550990 | 9.553535 | 9.556069 | 9.558591 | 9.561101 | 9.563600 | 9.566088 | 9.568565 | 8 |
| 53 | 15 545908 | 548476 | 551033 | 553578 | 556111 | 558633 | 561143 | 563642 | 566130 | 568606 | 7 |
| 54 | 30 545951 | 548519 | 551075 | 553620 | 556153 | 558675 | 561185 | 563683 | 566171 | 568647 | 6 |
| 55 | 45 545994 | 548562 | 551118 | 553662 | 556195 | 558716 | 561226 | 563725 | 566212 | 568688 | 5 |
| | 44' | 59' | 14' | 29' | 44' | 59' | 14' | 29' | 44' | 59' | |
| 56 | 0 9.546037 | 9.548604 | 9.551160 | 9.553705 | 9.556237 | 9.558758 | 9.561268 | 9.563767 | 9.566254 | 9.568730 | 4 |
| 57 | 15 546080 | 548647 | 551203 | 553747 | 556279 | 558800 | 561310 | 563808 | 566295 | 568771 | 3 |
| 58 | 30 546123 | 548690 | 551245 | 553789 | 556321 | 558842 | 561352 | 563850 | 566336 | 568812 | 2 |
| 59 | 45 546166 | 548732 | 551288 | 553831 | 556364 | 558884 | 561393 | 563891 | 566378 | 568853 | 1 |
| 60 | 60 9.546208 | 9.548775 | 9.551330 | 9 553874 | 9.556406 | 9.558926 | 9.561435 | 9.563933 | 9.566419 | 9.568894 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 95 deg. | | | | 96 deg. | | | | 97 deg. | |
| | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 9.735262 | 9.736994 | 9.738719 | 9.740437 | 9.742147 | 9.743849 | 9.745544 | 9.747232 | 9.748912 | 9.750585 |
| 1 | 15 735291 | 737023 | 738748 | 740465 | 742175 | 743878 | 745573 | 747260 | 748940 | 750613 |
| 2 | 30 735320 | 737052 | 738777 | 740494 | 742204 | 743906 | 745601 | 747288 | 748968 | 750641 |
| 3 | 45 735349 | 737081 | 738805 | 740523 | 742232 | 743934 | 745629 | 747316 | 748996 | 750669 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ |
| 4 | 0 9.735378 | 9.737110 | 9.738834 | 9.740551 | 9.742261 | 9.743963 | 9.745657 | 9.747344 | 9.749024 | 9.750696 |
| 5 | 15 735407 | 737139 | 738863 | 740580 | 742289 | 743991 | 745685 | 747372 | 749052 | 750724 |
| 6 | 30 735435 | 737167 | 738892 | 740608 | 742318 | 744019 | 745714 | 747400 | 749080 | 750752 |
| 7 | 45 735464 | 737196 | 738920 | 740637 | 742346 | 744047 | 745742 | 747428 | 749108 | 750780 |
| | 2′ | 17′ | 33′ | 47′ | 2′ | 17′ | 33′ | 47′ | 2′ | 17′ |
| 8 | 0 9.735493 | 9.737225 | 9.738949 | 9.740665 | 9.742374 | 9.744076 | 9.745770 | 9.747457 | 9.749136 | 9.750808 |
| 9 | 15 735522 | 737254 | 738977 | 740694 | 742403 | 744104 | 745798 | 747485 | 749164 | 750836 |
| 10 | 30 735551 | 737282 | 739006 | 740722 | 742431 | 744132 | 745826 | 747513 | 749192 | 750865 |
| 11 | 45 735580 | 737311 | 739035 | 740751 | 742459 | 744161 | 745854 | 747541 | 749219 | 750893 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 9.735609 | 9.737340 | 9.739064 | 9.740780 | 9.742488 | 9.744189 | 9.745883 | 9.747569 | 9.749247 | 9.750919 |
| 13 | 15 735638 | 737379 | 739092 | 740808 | 742516 | 744217 | 745911 | 747597 | 749275 | 750947 |
| 14 | 30 735667 | 737398 | 739121 | 740837 | 742545 | 744246 | 745939 | 747625 | 749303 | 750974 |
| 15 | 45 735696 | 737426 | 739149 | 740865 | 742573 | 744274 | 745967 | 747653 | 749331 | 751002 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 9.735725 | 9.737455 | 9.739178 | 9.740894 | 9.742602 | 9.744302 | 9.745995 | 9.747681 | 9.749359 | 9.751030 |
| 17 | 15 735753 | 737484 | 739207 | 740922 | 742630 | 744330 | 746023 | 747709 | 749387 | 751058 |
| 18 | 30 735782 | 737513 | 739235 | 740951 | 742658 | 744359 | 746052 | 747737 | 749415 | 751086 |
| 19 | 45 735811 | 737541 | 739264 | 740979 | 742687 | 744387 | 746080 | 747765 | 749443 | 751113 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 9.735840 | 9.737570 | 9.739293 | 9.741008 | 9.742715 | 9.744415 | 9.746108 | 9.747793 | 9.749471 | 9.751141 |
| 21 | 15 735869 | 737599 | 739321 | 741036 | 742744 | 744443 | 746136 | 747821 | 749499 | 751169 |
| 22 | 30 735898 | 737628 | 739350 | 741065 | 742772 | 744472 | 746164 | 747849 | 749527 | 751197 |
| 23 | 45 735927 | 737656 | 739379 | 741093 | 742800 | 744500 | 746192 | 747877 | 749554 | 751224 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 9.735956 | 9.737685 | 9.739407 | 9.741122 | 9.742829 | 9.744528 | 9.746220 | 9.747905 | 9.749582 | 9.751252 |
| 25 | 15 735985 | 737714 | 739436 | 741150 | 742857 | 744557 | 746248 | 747933 | 749610 | 751280 |
| 26 | 30 736014 | 737743 | 739465 | 741179 | 742886 | 744585 | 746277 | 747961 | 749638 | 751308 |
| 27 | 45 736042 | 737772 | 739493 | 741207 | 742914 | 744613 | 746305 | 747989 | 749666 | 751335 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 9.736071 | 9.737800 | 9.739522 | 9.741236 | 9.742942 | 9.744641 | 9.746333 | 9.748017 | 9.749694 | 9.751363 |
| 29 | 15 736100 | 737829 | 739551 | 741264 | 742971 | 744669 | 746361 | 748045 | 749722 | 751391 |
| 30 | 30 736129 | 737858 | 739579 | 741293 | 742999 | 744698 | 746389 | 748073 | 749750 | 751419 |
| 31 | 45 736158 | 737887 | 739608 | 741321 | 743027 | 744726 | 746417 | 748101 | 749777 | 751447 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 9.736187 | 9.737915 | 9.739636 | 9.741350 | 9.743056 | 9.744754 | 9.746445 | 9.748129 | 9.749805 | 9.751474 |
| 33 | 15 736216 | 737944 | 739665 | 741378 | 743084 | 744783 | 746473 | 748157 | 749833 | 751502 |
| 34 | 30 736245 | 737973 | 739694 | 741407 | 743113 | 744811 | 746502 | 748185 | 749861 | 751530 |
| 35 | 45 736273 | 738001 | 739722 | 741435 | 743141 | 744839 | 746530 | 748213 | 749889 | 751558 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ |
| 36 | 0 9.736302 | 9.738030 | 9.739751 | 9.741464 | 9.743169 | 9.744867 | 9.746558 | 9.748241 | 9.749917 | 9.751585 |
| 37 | 15 736331 | 738059 | 739779 | 741492 | 743198 | 744895 | 746586 | 748269 | 749945 | 751613 |
| 38 | 30 736360 | 738088 | 739808 | 741521 | 743226 | 744924 | 746614 | 748297 | 749973 | 751641 |
| 39 | 45 736389 | 738116 | 739837 | 741549 | 743254 | 744952 | 746642 | 748325 | 750000 | 751668 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ |
| 40 | 0 9.736418 | 9.738145 | 9.739865 | 9.741578 | 9.743283 | 9.744980 | 9.746670 | 9.748353 | 9.750028 | 9.751696 |
| 41 | 15 736446 | 738174 | 739894 | 741606 | 743311 | 745008 | 746698 | 748381 | 750056 | 751724 |
| 42 | 30 736475 | 738203 | 739922 | 741635 | 743339 | 745037 | 746727 | 748409 | 750084 | 751752 |
| 43 | 45 736504 | 738231 | 739951 | 741663 | 743368 | 745065 | 746755 | 748437 | 750112 | 751779 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 9 736533 | 9.738260 | 9.739980 | 9.741692 | 9.743396 | 9.745093 | 9.746783 | 9.748465 | 9.750140 | 9.751807 |
| 45 | 15 736562 | 738289 | 740008 | 741720 | 743424 | 745121 | 746811 | 748493 | 750168 | 751835 |
| 46 | 30 736591 | 738318 | 740037 | 741749 | 743453 | 745150 | 746839 | 748521 | 750195 | 751863 |
| 47 | 45 736620 | 738346 | 740065 | 741777 | 743481 | 745178 | 746867 | 748549 | 750223 | 751890 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 9.736648 | 9.738375 | 9.740094 | 9.741806 | 9.743510 | 9.745206 | 9.746895 | 9.748577 | 9.750251 | 9.751918 |
| 49 | 15 736677 | 738404 | 740123 | 741834 | 743538 | 745234 | 746923 | 748605 | 750279 | 751946 |
| 50 | 30 736706 | 738432 | 740151 | 741862 | 743566 | 745262 | 746951 | 748633 | 750307 | 751974 |
| 51 | 45 736735 | 738461 | 740180 | 741891 | 743595 | 745291 | 746979 | 748661 | 750335 | 752001 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 9.736764 | 9.738490 | 9.740208 | 9.741919 | 9.743623 | 9.745319 | 9.747007 | 9.748689 | 9.750363 | 9.752029 |
| 53 | 15 736793 | 738518 | 740237 | 741948 | 743651 | 745347 | 747035 | 748717 | 750390 | 752057 |
| 54 | 30 736821 | 738547 | 740266 | 741976 | 743680 | 745375 | 747064 | 748745 | 750418 | 752084 |
| 55 | 45 736850 | 738576 | 740294 | 742005 | 743708 | 745403 | 747092 | 748773 | 750446 | 752112 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 9.736879 | 9.738605 | 9.740323 | 9.742033 | 9.743736 | 9.745432 | 9.747120 | 9.748801 | 9.750474 | 9.752140 |
| 57 | 15 736908 | 738633 | 740351 | 742061 | 743764 | 745460 | 747148 | 748828 | 750502 | 752167 |
| 58 | 30 736937 | 738662 | 740380 | 742090 | 743793 | 745488 | 747176 | 748856 | 750529 | 752195 |
| 59 | 45 736965 | 738691 | 740408 | 742118 | 743821 | 745516 | 747204 | 748884 | 750557 | 752223 |
| 60 | 60 9.736994 | 9 738719 | 9.740437 | 9.742147 | 9.743849 | 9.745544 | 9.747232 | 9 748912 | 9.750585 | 9.752251 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 97 deg. | | 98 deg. | | | | 99 deg. | | | | |
| | ° 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.752261 | 9.753909 | 9.755560 | 9.757203 | 9.758840 | 9.760469 | 9.762091 | 9.763706 | 9.765314 | 9.766914 | 60 |
| 1 | 15 752278 | 753936 | 755587 | 757231 | 758867 | 760496 | 762118 | 763733 | 765341 | 766941 | 59 |
| 2 | 30 752306 | 753964 | 755615 | 757258 | 758894 | 760523 | 762145 | 763760 | 765367 | 766968 | 58 |
| 3 | 45 752333 | 753992 | 755642 | 757285 | 758921 | 760550 | 762172 | 763786 | 765394 | 766995 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.752361 | 9.754019 | 9.755670 | 9.757313 | 9.758949 | 9.760577 | 9.762199 | 9.763813 | 9.765421 | 9.767021 | 56 |
| 5 | 15 752389 | 754047 | 755697 | 757340 | 758976 | 760604 | 762226 | 763840 | 765447 | 767047 | 55 |
| 6 | 30 752417 | 754074 | 755724 | 757367 | 759003 | 760632 | 762253 | 763867 | 765474 | 767074 | 54 |
| 7 | 45 752444 | 754102 | 755752 | 757395 | 759030 | 760659 | 762280 | 763894 | 765501 | 767101 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.752472 | 9.754129 | 9.755779 | 9.757422 | 9.759057 | 9.760686 | 9.762307 | 9.763921 | 9.765528 | 9.767127 | 52 |
| 9 | 15 752500 | 754157 | 755807 | 757449 | 759085 | 760713 | 762334 | 763948 | 765554 | 767154 | 51 |
| 10 | 30 752528 | 754184 | 755834 | 757477 | 759112 | 760740 | 762361 | 763974 | 765581 | 767180 | 50 |
| 11 | 45 752555 | 754212 | 755862 | 757504 | 759139 | 760767 | 762388 | 764001 | 765608 | 767207 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.752583 | 9.754239 | 9.755889 | 9.757531 | 9.759166 | 9.760794 | 9.762415 | 9.764028 | 9.765634 | 9.767234 | 48 |
| 13 | 15 752610 | 754267 | 755916 | 757559 | 759193 | 760821 | 762442 | 764055 | 765661 | 767260 | 47 |
| 14 | 30 752638 | 754295 | 755944 | 757586 | 759221 | 760848 | 762468 | 764082 | 765688 | 767287 | 46 |
| 15 | 45 752676 | 754322 | 755971 | 757613 | 759248 | 760875 | 762495 | 764109 | 765714 | 767313 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.752694 | 9.754350 | 9.755999 | 9.757640 | 9.759275 | 9.760902 | 9.762522 | 9.764135 | 9.765741 | 9.767340 | 44 |
| 17 | 15 752721 | 754377 | 756026 | 757668 | 759302 | 760929 | 762549 | 764162 | 765768 | 767367 | 43 |
| 18 | 30 752749 | 754405 | 756054 | 757695 | 759329 | 760956 | 762576 | 764189 | 765795 | 767393 | 42 |
| 19 | 45 752776 | 754432 | 756081 | 757722 | 759356 | 760983 | 762603 | 764216 | 765821 | 767420 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.752804 | 9.754460 | 9.756108 | 9.757750 | 9.759384 | 9.761010 | 9.762630 | 9.764243 | 9.765848 | 9.767446 | 40 |
| 21 | 15 752832 | 754487 | 756136 | 757777 | 759411 | 761038 | 762657 | 764269 | 765875 | 767473 | 39 |
| 22 | 30 752859 | 754515 | 756163 | 757804 | 759438 | 761065 | 762684 | 764296 | 765901 | 767499 | 38 |
| 23 | 45 752887 | 754542 | 756191 | 757831 | 759465 | 761092 | 762711 | 764323 | 765928 | 767526 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.752915 | 9.754570 | 9.756218 | 9.757859 | 9.759492 | 9.761119 | 9.762738 | 9.764350 | 9.765955 | 9.767553 | 36 |
| 25 | 15 752942 | 754597 | 756245 | 757886 | 759519 | 761146 | 762765 | 764377 | 765981 | 767579 | 35 |
| 26 | 30 752970 | 754625 | 756273 | 757913 | 759547 | 761173 | 762792 | 764403 | 766008 | 767606 | 34 |
| 27 | 45 752998 | 754653 | 756300 | 757941 | 759574 | 761200 | 762819 | 764430 | 766035 | 767632 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.753025 | 9.754680 | 9.756328 | 9.757968 | 9.759601 | 9.761227 | 9.762846 | 9.764457 | 9.766062 | 9.767659 | 32 |
| 29 | 15 753053 | 754708 | 756355 | 757995 | 759628 | 761254 | 762872 | 764484 | 766088 | 767685 | 31 |
| 30 | 30 753081 | 754735 | 756382 | 758022 | 759655 | 761281 | 762899 | 764511 | 766115 | 767712 | 30 |
| 31 | 45 753108 | 754763 | 756410 | 758050 | 759682 | 761308 | 762926 | 764537 | 766142 | 767739 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.753136 | 9.754790 | 9.756437 | 9.758077 | 9.759710 | 9.761335 | 9.762953 | 9.764564 | 9.766168 | 9.767765 | 28 |
| 33 | 15 753163 | 754818 | 756465 | 758104 | 759737 | 761362 | 762980 | 764591 | 766195 | 767792 | 27 |
| 34 | 30 753191 | 754845 | 756492 | 758132 | 759764 | 761389 | 763007 | 764618 | 766222 | 767818 | 26 |
| 35 | 45 753219 | 754873 | 756519 | 758159 | 759791 | 761416 | 763034 | 764645 | 766248 | 767845 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.753246 | 9.754900 | 9.756547 | 9.758186 | 9.759818 | 9.761443 | 9.763061 | 9.764671 | 9.766275 | 9.767871 | 24 |
| 37 | 15 753274 | 754928 | 756574 | 758213 | 759845 | 761470 | 763088 | 764698 | 766302 | 767898 | 23 |
| 38 | 30 753302 | 754955 | 756602 | 758241 | 759872 | 761497 | 763115 | 764724 | 766328 | 767924 | 22 |
| 39 | 45 753329 | 754983 | 756629 | 758268 | 759899 | 761524 | 763142 | 764751 | 766355 | 767951 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.753357 | 9.755010 | 9.756656 | 9.758295 | 9 759927 | 9.761551 | 9.763168 | 9.764779 | 9.766382 | 9.767978 | 20 |
| 41 | 15 753384 | 755038 | 756684 | 758322 | 759954 | 761578 | 763195 | 764805 | 766408 | 768004 | 19 |
| 42 | 30 753412 | 755065 | 756711 | 758350 | 759981 | 761605 | 763222 | 764832 | 766435 | 768031 | 18 |
| 43 | 45 753440 | 755093 | 756738 | 758377 | 760008 | 761632 | 763249 | 764859 | 766462 | 768057 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.753467 | 9.755120 | 9.756766 | 9.758404 | 9.760035 | 9.761659 | 9.763276 | 9.764886 | 9.766488 | 9.768084 | 16 |
| 45 | 15 753495 | 755148 | 756793 | 758431 | 760062 | 761686 | 763303 | 764912 | 766515 | 768110 | 15 |
| 46 | 30 753523 | 755175 | 756821 | 758459 | 760089 | 761713 | 763330 | 764939 | 766541 | 768137 | 14 |
| 47 | 45 753550 | 755203 | 756848 | 758487 | 760117 | 761740 | 763357 | 764966 | 766568 | 768163 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.753578 | 9.755230 | 9.756875 | 9.758513 | 9.760144 | 9.761767 | 9.763384 | 9.764993 | 9.766595 | 9.768190 | 12 |
| 49 | 15 753605 | 755258 | 756903 | 758540 | 760171 | 761794 | 763410 | 765019 | 766621 | 768216 | 11 |
| 50 | 30 753633 | 755285 | 756930 | 758568 | 760198 | 761821 | 763437 | 765046 | 766648 | 768243 | 10 |
| 51 | 45 753661 | 755313 | 756957 | 758595 | 760225 | 761848 | 763464 | 765073 | 766675 | 768269 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.753688 | 9.755340 | 9.756985 | 9.758622 | 9 760252 | 9.761875 | 9.763491 | 9.765100 | 9.766701 | 9.768296 | 8 |
| 53 | 15 753716 | 755367 | 757012 | 758649 | 760279 | 761902 | 763518 | 765126 | 766728 | 768322 | 7 |
| 54 | 30 753743 | 755395 | 757039 | 758676 | 760306 | 761929 | 763545 | 765153 | 766755 | 768349 | 6 |
| 55 | 45 753771 | 755422 | 757067 | 758704 | 760333 | 761956 | 763572 | 765180 | 766781 | 768375 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.753799 | 9.755450 | 9.757094 | 9.758731 | 9.760361 | 9.761983 | 9.763598 | 9.765207 | 9.766808 | 9.768402 | 4 |
| 57 | 15 753826 | 755477 | 757121 | 758758 | 760388 | 762010 | 763625 | 765233 | 766835 | 768428 | 3 |
| 58 | 30 753854 | 755505 | 757149 | 758785 | 760415 | 762037 | 763652 | 765260 | 766861 | 768455 | 2 |
| 59 | 45 753881 | 755532 | 757176 | 758813 | 760442 | 762064 | 763679 | 765287 | 766888 | 768481 | 1 |
| 60 | 60 9.753909 | 9.755560 | 9.757203 | 9.758840 | 9.760469 | 9.762091 | 9.763706 | 9.765314 | 9.766914 | 9.768508 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 deg. | | | | 101 deg. | | | | 102 deg. | | |
| sec. | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | ′ | sec. |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.768508 | 9.770094 | 9.771674 | 9.773247 | 9.774812 | 9.776371 | 9.777922 | 9.779467 | 9.781005 | 9.782536 | 60 |
| 1 | 15 768534 | 770121 | 771700 | 773273 | 774838 | 776397 | 777948 | 779493 | 781031 | 782562 | 59 |
| 2 | 30 768561 | 770147 | 771727 | 773299 | 774864 | 776423 | 777974 | 779519 | 781056 | 782587 | 58 |
| 3 | 45 768587 | 770174 | 771753 | 773325 | 774890 | 776448 | 778000 | 779544 | 781082 | 782613 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.768614 | 9.770200 | 9.771779 | 9.773351 | 9.774916 | 9.776474 | 9.778026 | 9.779576 | 9.781107 | 9.782638 | 56 |
| 5 | 15 768640 | 770226 | 771805 | 773377 | 774942 | 776500 | 778051 | 779596 | 781133 | 782663 | 55 |
| 6 | 30 768667 | 770253 | 771832 | 773403 | 774968 | 776526 | 778077 | 779621 | 781159 | 782689 | 54 |
| 7 | 45 768693 | 770279 | 771858 | 773429 | 774994 | 776552 | 778103 | 779647 | 781184 | 782715 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.768720 | 9.770305 | 9.771884 | 9.773456 | 9.775020 | 9.776578 | 9.778129 | 9.779673 | 9.781210 | 9.782740 | 52 |
| 9 | 15 768746 | 770332 | 771910 | 773482 | 775046 | 776604 | 778155 | 779698 | 781235 | 782765 | 51 |
| 10 | 30 768773 | 770358 | 771937 | 773508 | 775072 | 776629 | 778180 | 779724 | 781261 | 782791 | 50 |
| 11 | 45 768799 | 770385 | 771963 | 773534 | 775098 | 776656 | 778206 | 779750 | 781286 | 782816 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.768826 | 9.770411 | 9.771989 | 9.773560 | 9.775124 | 9.776682 | 9.778232 | 9.779775 | 9.781312 | 9.782842 | 48 |
| 13 | 15 768852 | 770437 | 772015 | 773586 | 775150 | 776707 | 778258 | 779801 | 781337 | 782867 | 47 |
| 14 | 30 768879 | 770464 | 772042 | 773612 | 775176 | 776733 | 778284 | 779827 | 781363 | 782893 | 46 |
| 15 | 45 768905 | 770490 | 772068 | 773639 | 775202 | 776759 | 778309 | 779852 | 781389 | 782919 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.768932 | 9.770516 | 9.772094 | 9.773665 | 9.775228 | 9.776785 | 9.778335 | 9.779878 | 9.781414 | 9.782943 | 44 |
| 17 | 15 768958 | 770543 | 772120 | 773691 | 775254 | 776811 | 778361 | 779904 | 781440 | 782969 | 43 |
| 18 | 30 768985 | 770569 | 772147 | 773717 | 775280 | 776837 | 778387 | 779929 | 781465 | 782994 | 42 |
| 19 | 45 769011 | 770595 | 772173 | 773743 | 775306 | 776863 | 778412 | 779955 | 781491 | 783020 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.769038 | 9.770622 | 9.772199 | 9.773769 | 9.775332 | 9.776889 | 9.778438 | 9.779981 | 9.781516 | 9.783045 | 40 |
| 21 | 15 769064 | 770648 | 772225 | 773795 | 775358 | 776915 | 778464 | 780006 | 781542 | 783071 | 39 |
| 22 | 30 769090 | 770674 | 772251 | 773821 | 775384 | 776940 | 778490 | 780032 | 781567 | 783096 | 38 |
| 23 | 45 769117 | 770701 | 772277 | 773847 | 775410 | 776966 | 778515 | 780057 | 781593 | 783121 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.769143 | 9.770727 | 9.772304 | 9.773874 | 9.775436 | 9.776992 | 9.778541 | 9.780083 | 9.781618 | 9.783147 | 36 |
| 25 | 15 769170 | 770753 | 772330 | 773900 | 775462 | 777018 | 778567 | 780109 | 781644 | 783173 | 35 |
| 26 | 30 769196 | 770780 | 772356 | 773926 | 775488 | 777044 | 778593 | 780135 | 781670 | 783199 | 34 |
| 27 | 45 769223 | 770806 | 772382 | 773952 | 775514 | 777070 | 778618 | 780160 | 781695 | 783224 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.769249 | 9.770832 | 9.772409 | 9.773978 | 9.775540 | 9.777096 | 9.778644 | 9.780186 | 9.781721 | 9.783248 | 32 |
| 29 | 15 769276 | 770859 | 772435 | 774004 | 775566 | 777122 | 778670 | 780211 | 781746 | 783274 | 31 |
| 30 | 30 769302 | 770885 | 772461 | 774030 | 775592 | 777147 | 778696 | 780237 | 781772 | 783299 | 30 |
| 31 | 45 769328 | 770911 | 772487 | 774056 | 775618 | 777173 | 778721 | 780263 | 781797 | 783325 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.769355 | 9.770938 | 9.772514 | 9.774082 | 9.775644 | 9.777199 | 9.778747 | 9.780288 | 9.781823 | 9.783350 | 28 |
| 33 | 15 769381 | 770964 | 772540 | 774108 | 775670 | 777225 | 778773 | 780314 | 781848 | 783375 | 27 |
| 34 | 30 769408 | 770990 | 772566 | 774135 | 775696 | 777251 | 778799 | 780340 | 781874 | 783401 | 26 |
| 35 | 45 769434 | 771017 | 772592 | 774161 | 775722 | 777277 | 778824 | 780365 | 781899 | 783426 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.769461 | 9.771043 | 9.772618 | 9.774187 | 9.775748 | 9.777303 | 9.778850 | 9.780391 | 9.781925 | 9.783452 | 24 |
| 37 | 15 769487 | 771069 | 772645 | 774213 | 775774 | 777328 | 778876 | 780416 | 781950 | 783477 | 23 |
| 38 | 30 769514 | 771096 | 772671 | 774239 | 775800 | 777354 | 778902 | 780442 | 781976 | 783503 | 22 |
| 39 | 45 769540 | 771122 | 772697 | 774265 | 775826 | 777380 | 778927 | 780468 | 782001 | 783528 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.769566 | 9.771148 | 9.772723 | 9.774291 | 9.775852 | 9.777406 | 9.778953 | 9.780493 | 9.782027 | 9.783553 | 20 |
| 41 | 15 769593 | 771174 | 772749 | 774317 | 775878 | 777432 | 778979 | 780519 | 782052 | 783579 | 19 |
| 42 | 30 769619 | 771201 | 772776 | 774343 | 775904 | 777458 | 779005 | 780545 | 782078 | 783604 | 18 |
| 43 | 45 769646 | 771227 | 772802 | 774369 | 775930 | 777483 | 779030 | 780570 | 782103 | 783629 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.769672 | 9.771253 | 9.772828 | 9.774395 | 9.775956 | 9.777509 | 9.779056 | 9.780596 | 9.782129 | 9.783655 | 16 |
| 45 | 15 769698 | 771280 | 772854 | 774421 | 775982 | 777535 | 779082 | 780621 | 782154 | 783680 | 15 |
| 46 | 30 769725 | 771306 | 772880 | 774447 | 776008 | 777561 | 779107 | 780647 | 782180 | 783706 | 14 |
| 47 | 45 769751 | 771332 | 772906 | 774473 | 776034 | 777587 | 779133 | 780672 | 782205 | 783731 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.769778 | 9.771359 | 9.772933 | 9.774500 | 9.776060 | 9.777613 | 9.779159 | 9.780698 | 9.782231 | 9.783756 | 12 |
| 49 | 15 769804 | 771385 | 772959 | 774526 | 776085 | 777638 | 779185 | 780724 | 782256 | 783782 | 11 |
| 50 | 30 769831 | 771411 | 772985 | 774551 | 776111 | 777664 | 779210 | 780749 | 782282 | 783807 | 10 |
| 51 | 45 769857 | 771437 | 773011 | 774578 | 776137 | 777690 | 779236 | 780775 | 782307 | 783832 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.769883 | 9.771464 | 9.773037 | 9.774604 | 9.776163 | 9.777716 | 9.779262 | 9.780801 | 9.782333 | 9.783858 | 8 |
| 53 | 15 769910 | 771490 | 773063 | 774630 | 776189 | 777742 | 779287 | 780826 | 782358 | 783883 | 7 |
| 54 | 30 769936 | 771516 | 773090 | 774656 | 776215 | 777768 | 779313 | 780852 | 782383 | 783908 | 6 |
| 55 | 45 769962 | 771543 | 773116 | 774682 | 776241 | 777793 | 779339 | 780877 | 782409 | 783934 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.769989 | 9.771569 | 9.773142 | 9.774708 | 9.776267 | 9.777819 | 9.779364 | 9.780903 | 9.782434 | 9.783959 | 4 |
| 57 | 15 770015 | 771595 | 773168 | 774734 | 776293 | 777845 | 779390 | 780928 | 782460 | 783984 | 3 |
| 58 | 30 770042 | 771621 | 773194 | 774760 | 776319 | 777871 | 779416 | 780954 | 782485 | 784010 | 2 |
| 59 | 45 770068 | 771648 | 773220 | 774786 | 776345 | 777897 | 779441 | 780980 | 782511 | 784035 | 1 |
| 60 | 60 9.770094 | 9.771674 | 9.773247 | 9.774812 | 9.776371 | 9.777922 | 9.779467 | 9.781005 | 9.782536 | 9.784061 | 0 |
| sec. | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m | sec. |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 82 deg. | | 83 deg. | | | | 84 deg | | | | |
| | ′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 | 9.638227 | 9.640383 | 9.642529 | 9.644666 | 9.646794 | 9.648913 | 9.651022 | 9.653122 | 9.655213 | 9.657294 | 60 |
| 1 | 15 | 638263 | 640418 | 642565 | 644702 | 646829 | 648948 | 651057 | 653157 | 655247 | 657329 | 59 |
| 2 | 30 | 638299 | 640454 | 642601 | 644737 | 646865 | 648983 | 651092 | 653192 | 655282 | 657363 | 58 |
| 3 | 45 | 638335 | 640490 | 642636 | 644773 | 646900 | 649018 | 651127 | 653227 | 655317 | 657398 | 57 |
| | | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 | 9.638371 | 9.640526 | 9.642672 | 9.644808 | 9.646936 | 9.649053 | 9.651162 | 9.653261 | 9.655352 | 9.657433 | 56 |
| 5 | 15 | 638407 | 640562 | 642708 | 644844 | 646971 | 649088 | 651197 | 653296 | 655387 | 657467 | 55 |
| 6 | 30 | 638443 | 640598 | 642743 | 644880 | 647006 | 649124 | 651232 | 653331 | 655421 | 657502 | 54 |
| 7 | 45 | 638479 | 640633 | 642779 | 644915 | 647042 | 649159 | 651267 | 653366 | 655456 | 657536 | 53 |
| | | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 | 9.638515 | 9.640669 | 9.642815 | 9.644951 | 9.647077 | 9.649194 | 9.651302 | 9.653401 | 9.655491 | 9.657571 | 52 |
| 9 | 15 | 638551 | 640705 | 642850 | 644986 | 647112 | 649230 | 651337 | 653436 | 655525 | 657606 | 51 |
| 10 | 30 | 638587 | 640741 | 642886 | 645022 | 647148 | 649265 | 651372 | 653471 | 655560 | 657640 | 50 |
| 11 | 45 | 638622 | 640777 | 642922 | 645057 | 647183 | 649300 | 651407 | 653506 | 655595 | 657675 | 49 |
| | | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 | 9.638658 | 9.640813 | 9.642957 | 9.645093 | 9.647219 | 9.649335 | 9.651443 | 9.653541 | 9.655630 | 9.657709 | 48 |
| 13 | 15 | 638694 | 640848 | 642993 | 645128 | 647254 | 649370 | 651478 | 653575 | 655664 | 657744 | 47 |
| 14 | 30 | 638730 | 640884 | 643029 | 645164 | 647289 | 649406 | 651513 | 653610 | 655699 | 657779 | 46 |
| 15 | 45 | 638766 | 640920 | 643064 | 645199 | 647325 | 649441 | 651548 | 653645 | 655734 | 657813 | 45 |
| | | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 | 9.638802 | 9.640956 | 9.643100 | 9.645235 | 9.647360 | 9.649476 | 9.651583 | 9.653680 | 9.655769 | 9.657848 | 44 |
| 17 | 15 | 638838 | 640992 | 643136 | 645270 | 647395 | 649511 | 651618 | 653715 | 655803 | 657883 | 43 |
| 18 | 30 | 638874 | 641028 | 643171 | 645306 | 647431 | 649546 | 651653 | 653750 | 655838 | 657917 | 42 |
| 19 | 45 | 638910 | 641063 | 643207 | 645341 | 647466 | 649581 | 651688 | 653785 | 655873 | 657951 | 41 |
| | | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 | 9.638946 | 9.641099 | 9.643243 | 9.645377 | 9.647501 | 9.649617 | 9.651723 | 9.653820 | 9.655907 | 9.657986 | 40 |
| 21 | 15 | 638982 | 641135 | 643278 | 645412 | 647537 | 649652 | 651758 | 653854 | 655942 | 658020 | 39 |
| 22 | 30 | 639018 | 641171 | 643314 | 645448 | 647572 | 649687 | 651793 | 653889 | 655977 | 658055 | 38 |
| 23 | 45 | 639054 | 641207 | 643349 | 645483 | 647607 | 649722 | 651828 | 653924 | 656011 | 658090 | 37 |
| | | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 | 9.639090 | 9.641242 | 9.643385 | 9.645519 | 9.647643 | 9.649757 | 9.651863 | 9.653959 | 9.656046 | 9.658124 | 36 |
| 25 | 15 | 639126 | 641278 | 643421 | 645554 | 647678 | 649792 | 651898 | 653994 | 656081 | 658159 | 35 |
| 26 | 30 | 639162 | 641314 | 643456 | 645590 | 647713 | 649828 | 651933 | 654029 | 656116 | 658193 | 34 |
| 27 | 45 | 639198 | 641350 | 643492 | 645625 | 647749 | 649863 | 651968 | 654064 | 656150 | 658228 | 33 |
| | | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 | 9.639234 | 9.641385 | 9.643528 | 9.645660 | 9.647784 | 9.649898 | 9.652003 | 9.654099 | 9.656185 | 9.658262 | 32 |
| 29 | 15 | 639270 | 641421 | 643563 | 645696 | 647819 | 649933 | 652038 | 654133 | 656220 | 658297 | 31 |
| 30 | 30 | 639306 | 641457 | 643599 | 645731 | 647855 | 649968 | 652073 | 654168 | 656254 | 658332 | 30 |
| 31 | 45 | 639342 | 641493 | 643635 | 645766 | 647890 | 650003 | 652108 | 654203 | 656288 | 658366 | 29 |
| | | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 | 9.639378 | 9.641529 | 9.643670 | 9.645802 | 9.647925 | 9.650039 | 9.652143 | 9.654238 | 9.656324 | 9.658401 | 28 |
| 33 | 15 | 639414 | 641564 | 643706 | 645838 | 647960 | 650074 | 652178 | 654273 | 656358 | 658435 | 27 |
| 34 | 30 | 639449 | 641600 | 643741 | 645873 | 647996 | 650109 | 652213 | 654308 | 656393 | 658470 | 26 |
| 35 | 45 | 639485 | 641636 | 643777 | 645909 | 648031 | 650144 | 652248 | 654342 | 656428 | 658504 | 25 |
| | | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 | 9.639521 | 9.641672 | 9.643813 | 9.645944 | 9.648066 | 9.650179 | 9.652283 | 9.654377 | 9.656463 | 9.658539 | 24 |
| 37 | 15 | 639557 | 641707 | 643848 | 645980 | 648101 | 650214 | 652318 | 654412 | 656497 | 658573 | 23 |
| 38 | 30 | 639593 | 641743 | 643884 | 646015 | 648137 | 650249 | 652353 | 654447 | 656532 | 658608 | 22 |
| 39 | 45 | 639629 | 641779 | 643919 | 646050 | 648172 | 650285 | 652388 | 654482 | 656567 | 658642 | 21 |
| | | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 | 9.639665 | 9.641815 | 9.643955 | 9.646086 | 9.648207 | 9.650320 | 9.652423 | 9.654517 | 9.656601 | 9.658677 | 20 |
| 41 | 15 | 639701 | 641851 | 643991 | 646121 | 648243 | 650355 | 652458 | 654551 | 656636 | 658711 | 19 |
| 42 | 30 | 639737 | 641886 | 644026 | 646157 | 648278 | 650390 | 652493 | 654586 | 656671 | 658746 | 18 |
| 43 | 45 | 639773 | 641922 | 644062 | 646192 | 648313 | 650425 | 652528 | 654621 | 656705 | 658780 | 17 |
| | | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 | 9.639809 | 9.641958 | 9.644097 | 9.646228 | 9.648349 | 9.650460 | 9.652563 | 9.654656 | 9.656740 | 9.658815 | 16 |
| 45 | 15 | 639844 | 641993 | 644133 | 646263 | 648384 | 650495 | 652598 | 654691 | 656775 | 658849 | 15 |
| 46 | 30 | 639880 | 642029 | 644168 | 646298 | 648419 | 650530 | 652633 | 654726 | 656809 | 658884 | 14 |
| 47 | 45 | 639916 | 642065 | 644204 | 646334 | 648454 | 650566 | 652667 | 654760 | 656844 | 658918 | 13 |
| | | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 | 9.639952 | 9.642101 | 9.644240 | 9.646369 | 9.648490 | 9.650601 | 9.652702 | 9.654795 | 9.656879 | 9.658953 | 12 |
| 49 | 15 | 639988 | 642136 | 644275 | 646405 | 648525 | 650636 | 652737 | 654830 | 656913 | 658987 | 11 |
| 50 | 30 | 640024 | 642172 | 644311 | 646440 | 648560 | 650671 | 652772 | 654865 | 656948 | 659022 | 10 |
| 51 | 45 | 640060 | 642208 | 644346 | 646476 | 648595 | 650706 | 652807 | 654899 | 656982 | 659056 | 9 |
| | | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 | 9.640096 | 9.642243 | 9.644382 | 9.646511 | 9.648631 | 9.650741 | 9.652842 | 9.654934 | 9.657017 | 9.659091 | 8 |
| 53 | 15 | 640131 | 642279 | 644417 | 646546 | 648666 | 650776 | 652877 | 654969 | 657052 | 659125 | 7 |
| 54 | 30 | 640167 | 642315 | 644453 | 646582 | 648701 | 650811 | 652912 | 655004 | 657086 | 659160 | 6 |
| 55 | 45 | 640203 | 642351 | 644489 | 646617 | 648736 | 650846 | 652947 | 655039 | 657121 | 659194 | 5 |
| | | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 | 9.640239 | 9.642386 | 9.644524 | 9.646653 | 9.648772 | 9.650881 | 9.652982 | 9.655073 | 9.657156 | 9.659229 | 4 |
| 57 | 15 | 640275 | 642422 | 644560 | 646688 | 648807 | 650916 | 653017 | 655108 | 657190 | 659263 | 3 |
| 58 | 30 | 640311 | 642458 | 644595 | 646723 | 648842 | 650952 | 653052 | 655143 | 657225 | 659298 | 2 |
| 59 | 45 | 640347 | 642493 | 644631 | 646759 | 648877 | 650987 | 653087 | 655178 | 657259 | 659332 | 1 |
| 60 | 60 | 9.640383 | 9.642529 | 9.644666 | 9.646794 | 9.648913 | 9.651022 | 9.653122 | 9.655213 | 9.657294 | 9.659367 | 0 |
| sec. | | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | |

| sec. | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 8m | 9m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 100 deg. | | | | 101 deg. | | | | 107 deg. | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | | 0′ | 15′ |
| 0 | 9.768508 | 9.770094 | 9.771674 | 9.773247 | 9.774812 | 9.776371 | 9.777 | 805952 | 9.810357 | 9.811756 |
| 1 | 768534 | 770121 | 771700 | 773273 | 774838 | 776397 | 77 | 808975 | 810381 | 811780 |
| 2 | 768561 | 770147 | 771727 | 773299 | 774864 | 776423 | | 808999 | 810404 | 811804 |
| 3 | 768587 | 770174 | 771753 | 773325 | 774890 | 776448 | 1 | 809022 | 810428 | 811828 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | | 46′ | 1′ | 16′ |
| 4 | 9.768614 | 9.770200 | 9.771779 | 9.773351 | 9.774916 | 9.77647 | 335 | 9.809046 | 9.810451 | 9.811851 |
| 5 | 768640 | 770226 | 771805 | 773377 | 774942 | 776 | 658 | 809069 | 810474 | 811875 |
| 6 | 768667 | 770253 | 771832 | 773403 | 774968 | 77 | 7682 | 809093 | 810498 | 811898 |
| 7 | 768693 | 770279 | 771858 | 773429 | 774994 | 7 | 807705 | 809116 | 810521 | 811921 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | | 47′ | 2′ | 17′ |
| 8 | 9.768720 | 9.770305 | 9.771884 | 9.773456 | 9.775020 | | 32′ | 9.809140 | 9.810544 | 9.811944 |
| 9 | 768746 | 770332 | 771910 | 773482 | 77504 | 335 | 807729 | 809163 | 810568 | 811968 |
| 10 | 768773 | 770358 | 771937 | 773508 | 7750 | 06359 | 807752 | 809187 | 810591 | 811991 |
| 11 | 768799 | 770385 | 771963 | 773534 | 77 | 806382 | 807776 | 809210 | 810614 | 812014 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 807800 | 48′ | 3′ | 18′ |
| 12 | 9.768826 | 9.770411 | 9.771989 | 9.773560 | 9 | 883 | 33′ | 9.809234 | 9.810638 | 9.812037 |
| 13 | 768852 | 770437 | 772015 | 773586 | | 5006 | 9.806406 | 809257 | 810661 | 812060 |
| 14 | 768879 | 770464 | 772042 | 773611 | | 805030 | 806430 | 809281 | 810684 | 812083 |
| 15 | 768905 | 770490 | 772068 | 7736 | | 805054 | 806453 | 809304 | 810708 | 812106 |
| | 4′ | 19′ | 34′ | 49′ | | | 806477 | 807894 | 810731 | 812130 |
| 16 | 9.768932 | 9.770516 | 9.772094 | 9.7 | 4′ | 19′ | 807894 | 49′ | 4′ | 19′ |
| 17 | 768958 | 770543 | 772120 | | 9.805078 | 9.806501 | 9.807917 | 9.809327 | 9.810731 | 9.812129 |
| 18 | 768985 | 770569 | 772147 | | 805102 | 806524 | 807941 | 809351 | 810755 | 812153 |
| 19 | 769011 | 770595 | 772173 | | 805125 | 806548 | 807964 | 809374 | 810778 | 812177 |
| | 5′ | 20′ | 35′ | | 805149 | 806572 | 807988 | 809398 | 810801 | 812201 |
| 20 | 9.769038 | 9.770622 | 9.772 | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 21 | 769064 | 770648 | 77 | | 9.805173 | 9.806595 | 9.808012 | 9.809421 | 9.810824 | 9.812224 |
| 22 | 769090 | 770674 | | | 805197 | 806619 | 808035 | 809445 | 810848 | 812248 |
| 23 | 769117 | 770701 | | | 805220 | 806643 | 808059 | 809468 | 810871 | 812272 |
| | 6′ | 21′ | | | 805244 | 806666 | 808082 | 809491 | 810895 | 812295 |
| 24 | 9.769143 | 9.7707 | | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 25 | 769170 | 770 | | | 9.805268 | 9.805690 | 9.808106 | 9.809515 | 9.810918 | 9.812319 |
| 26 | 769196 | 77 | | | 805292 | 806714 | 808129 | 809538 | 810942 | 812343 |
| 27 | 769223 | | | | 805315 | 806737 | 808153 | 809562 | 810964 | 812366 |
| | 7′ | | | | 805339 | 806761 | 808176 | 809585 | 810988 | 812389 |
| 28 | 9.769249 | | | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 29 | 769276 | | | | 9.805363 | 9.806785 | 9.808200 | 9.809609 | 9.811011 | 9.812412 |
| 30 | 7693 | | | | 805387 | 806808 | 808223 | 809632 | 811034 | 812435 |
| 31 | 769 | | | | 805410 | 806832 | 808247 | 809656 | 811058 | 812459 |
| | 8′ | | | | 805434 | 806856 | 808270 | 809679 | 811081 | 812482 |
| 32 | 9.76 | | | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 33 | 15 | | | | 9.805458 | 9.806879 | 9.808294 | 9.809702 | 9.811104 | 9.812505 |
| 34 | 30 | | | | 805482 | 806903 | 808317 | 809726 | 811128 | 812528 |
| 35 | 45 | | | | 805505 | 806926 | 808341 | 809749 | 811151 | 812551 |
| | | | | | 805529 | 806949 | 808365 | 809773 | 811174 | 812574 |
| 36 | | | | | | 24′ | 39′ | 54′ | 9′ | 24′ |
| 37 | | | | | 9′ | 9.806974 | 9.808388 | 9.809796 | 9.811198 | 9.812598 |
| 38 | | | | | 9.805553 | 806997 | 808412 | 809819 | 811221 | 812621 |
| 3 | | | | | 805577 | 807021 | 808435 | 809843 | 811244 | 812644 |
| | | | | | 805600 | 807045 | 808459 | 809866 | 811267 | 812667 |
| | | | | | 805624 | 25′ | 40′ | 55′ | 10′ | 25′ |
| | | | | | 10′ | 9.807068 | 9.808482 | 9.809890 | 9.811291 | 9.812691 |
| | | | | | 9.805648 | 807092 | 808506 | 809913 | 811314 | 812714 |
| | | | | | 805672 | 807115 | 808529 | 809936 | 811337 | 812737 |
| | | | | | 805695 | 807139 | 808553 | 809960 | 811361 | 812760 |
| | | | | | 805719 | 26′ | 41′ | 56′ | 11′ | 26′ |
| | | | | | 11′ | 9.807163 | 9.808576 | 9.809983 | 9.811384 | 9.812783 |
| | | | | | 9.805743 | 807186 | 808600 | 810007 | 811407 | 812806 |
| | | | | | 805766 | 807210 | 808623 | 810030 | 811431 | 812829 |
| | | | | | 805790 | 807233 | 808647 | 810053 | 811454 | 812852 |
| | | | | | 805814 | 27′ | 42′ | 57′ | 12′ | 27′ |
| | | | | | 12′ | 9.807257 | 9.808670 | 9.810077 | 9.811477 | 9.812875 |
| | | | | | 9.805838 | 807281 | 808694 | 810100 | 811500 | 812898 |
| | | | | | 805861 | 807304 | 808717 | 810124 | 811524 | 812921 |
| | | | | | 805885 | 807328 | 808741 | 810147 | 811547 | 812944 |
| | | | | | 805909 | 28′ | 43′ | 58′ | 13′ | 28′ |
| | | | | | 13′ | 9.807351 | 9.808764 | 9.810170 | 9.811570 | 9.812968 |
| | | | | | 9.805932 | 807375 | 808788 | 810194 | 811594 | 812991 |
| | | | | | 805956 | 807399 | 808811 | 810217 | 811617 | 813014 |
| | | | | | 805980 | 807422 | 808835 | 810241 | 811640 | 813037 |
| | | | | | 806003 | 29′ | 44′ | 59′ | 14′ | 29′ |
| | | | | | 14′ | 9.807446 | 9.808858 | 9.810264 | 9.811663 | 9.813060 |
| | | | | | 9.806027 | 807469 | 808882 | 810287 | 811687 | 813083 |
| | | | | | 806051 | 807493 | 808905 | 810311 | 811710 | 813106 |
| | | | | | 806075 | 807517 | 808929 | 810334 | 811733 | 813129 |
| | | | | | 806098 | 807540 | 808952 | 810357 | 811756 | 813149 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 87 deg. | | 88 deg. | | | | 89 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.679601 | 9.681576 | 9.683543 | 9.685501 | 9.687450 | 9.689391 | 9.691324 | 9.693248 | 9.695163 | 9.697071 | 60 |
| 1 | 15 679634 | 681609 | 683575 | 685533 | 687482 | 689423 | 691356 | 693280 | 695195 | 697103 | 59 |
| 2 | 30 679667 | 681642 | 683608 | 685566 | 687515 | 689456 | 691388 | 693312 | 695227 | 697134 | 58 |
| 3 | 45 679700 | 681674 | 683641 | 685598 | 687547 | 689488 | 691420 | 693344 | 695259 | 697166 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.679733 | 9.681707 | 9.683673 | 9.685631 | 9.687580 | 9.689520 | 9.691452 | 9.693376 | 9.695291 | 9.697198 | 56 |
| 5 | 15 679766 | 681740 | 683706 | 685663 | 687612 | 689552 | 691484 | 693408 | 695323 | 697229 | 55 |
| 6 | 30 679799 | 681773 | 683739 | 685696 | 687645 | 689585 | 691516 | 693440 | 695355 | 697261 | 54 |
| 7 | 45 679832 | 681806 | 683771 | 685728 | 687677 | 689617 | 691548 | 693472 | 695387 | 697293 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.679865 | 9.681839 | 9.683804 | 9.685761 | 9.687709 | 9.689649 | 9.691581 | 9.693504 | 9.695418 | 9.697325 | 52 |
| 9 | 15 679898 | 681871 | 683837 | 685794 | 687742 | 689681 | 691613 | 693536 | 695450 | 697356 | 51 |
| 10 | 30 679931 | 681904 | 683869 | 685826 | 687774 | 689714 | 691645 | 693568 | 695482 | 697388 | 50 |
| 11 | 45 679964 | 681937 | 683902 | 685859 | 687806 | 689746 | 691677 | 693600 | 695514 | 697420 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.679997 | 9.681970 | 9.683935 | 9.685891 | 9.687839 | 9.689778 | 9.691709 | 9.693632 | 9.695546 | 9.697451 | 48 |
| 13 | 15 680029 | 682003 | 683967 | 685924 | 687871 | 689810 | 691741 | 693663 | 695577 | 697483 | 47 |
| 14 | 30 680062 | 682036 | 684000 | 685956 | 687904 | 689843 | 691773 | 693695 | 695609 | 697515 | 46 |
| 15 | 45 680095 | 682068 | 684033 | 685989 | 687936 | 689875 | 691805 | 693727 | 695641 | 697546 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.680128 | 9.682101 | 9.684066 | 9.686021 | 9.687968 | 9.689907 | 9.691838 | 9.693759 | 9.695673 | 9.697578 | 44 |
| 17 | 15 680161 | 682134 | 684098 | 686054 | 688001 | 689939 | 691870 | 693791 | 695705 | 697610 | 43 |
| 18 | 30 680194 | 682167 | 684131 | 686086 | 688033 | 689972 | 691902 | 693823 | 695737 | 697641 | 42 |
| 19 | 45 680227 | 682200 | 684163 | 686119 | 688066 | 690004 | 691934 | 693855 | 695768 | 697673 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.680260 | 9.682232 | 9.684196 | 9.686151 | 9.688098 | 9.690036 | 9.691966 | 9.693887 | 9.695800 | 9.697705 | 40 |
| 21 | 15 680293 | 682265 | 684229 | 686184 | 688130 | 690068 | 691998 | 693919 | 695832 | 697736 | 39 |
| 22 | 30 680326 | 682298 | 684261 | 686216 | 688163 | 690101 | 692030 | 693951 | 695864 | 697768 | 38 |
| 23 | 45 680359 | 682331 | 684294 | 686249 | 688195 | 690133 | 692062 | 693983 | 695896 | 697800 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.680392 | 9.682364 | 9.684327 | 9.686281 | 9.688227 | 9.690165 | 9.692094 | 9.694015 | 9.695927 | 9.697832 | 36 |
| 25 | 15 680425 | 682396 | 684359 | 686314 | 688260 | 690197 | 692126 | 694047 | 695959 | 697863 | 35 |
| 26 | 30 680458 | 682429 | 684392 | 686346 | 688292 | 690230 | 692158 | 694079 | 695991 | 697895 | 34 |
| 27 | 45 680491 | 682462 | 684425 | 686379 | 688325 | 690262 | 692190 | 694111 | 696023 | 697926 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.680524 | 9.682495 | 9.684457 | 9.686411 | 9.688357 | 9.690294 | 9.692223 | 9.694143 | 9.696055 | 9.697958 | 32 |
| 29 | 15 680557 | 682528 | 684490 | 686444 | 688389 | 690326 | 692255 | 694175 | 696086 | 697990 | 31 |
| 30 | 30 680589 | 682560 | 684523 | 686476 | 688422 | 690358 | 692287 | 694207 | 696118 | 698021 | 30 |
| 31 | 45 680622 | 682593 | 684555 | 686509 | 688454 | 690391 | 692319 | 694239 | 696150 | 698053 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.680655 | 9.682626 | 9.684588 | 9.686541 | 9.688486 | 9.690423 | 9.692351 | 9.694271 | 9.696182 | 9.698085 | 28 |
| 33 | 15 680688 | 682659 | 684620 | 686574 | 688519 | 690455 | 692383 | 694302 | 696214 | 698116 | 27 |
| 34 | 30 680721 | 682691 | 684653 | 686606 | 688551 | 690487 | 692415 | 694334 | 696245 | 698148 | 26 |
| 35 | 45 680754 | 682724 | 684686 | 686639 | 688583 | 690519 | 692447 | 694366 | 696277 | 698180 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.680787 | 9.682757 | 9.684718 | 9.686671 | 9.688616 | 9.690552 | 9.692479 | 9.694398 | 9.696309 | 9.698211 | 24 |
| 37 | 15 680820 | 682790 | 684751 | 686704 | 688648 | 690584 | 692511 | 694430 | 696341 | 698243 | 23 |
| 38 | 30 680853 | 682822 | 684784 | 686736 | 688680 | 690616 | 692543 | 694462 | 696372 | 698275 | 22 |
| 39 | 45 680886 | 682855 | 684816 | 686769 | 688713 | 690648 | 692575 | 694494 | 696404 | 698306 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.680919 | 9.682888 | 9.684849 | 9.686801 | 9.688745 | 9.690680 | 9.692607 | 9.694526 | 9.696436 | 9.698338 | 20 |
| 41 | 15 680951 | 682921 | 684882 | 686834 | 688777 | 690712 | 692639 | 694558 | 696468 | 698369 | 19 |
| 42 | 30 680984 | 682953 | 684914 | 686866 | 688810 | 690745 | 692671 | 694590 | 696500 | 698401 | 18 |
| 43 | 45 681017 | 682986 | 684947 | 686899 | 688843 | 690777 | 692703 | 694622 | 696531 | 698433 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.681050 | 9.683019 | 9.684979 | 9.686931 | 9.688874 | 9.690809 | 9.692735 | 9.694653 | 9.696563 | 9.698464 | 16 |
| 45 | 15 681083 | 683052 | 685012 | 686963 | 688907 | 690841 | 692767 | 694685 | 696595 | 698496 | 15 |
| 46 | 30 681116 | 683084 | 685044 | 686996 | 688939 | 690873 | 692800 | 694717 | 696627 | 698528 | 14 |
| 47 | 45 681149 | 683117 | 685077 | 687028 | 688971 | 690906 | 692831 | 694749 | 696658 | 698559 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.681182 | 9.683150 | 9.685110 | 9.687061 | 9.689004 | 9.690938 | 9.692864 | 9.694781 | 9.696690 | 9.698591 | 12 |
| 49 | 15 681214 | 683183 | 685142 | 687093 | 689036 | 690970 | 692896 | 694813 | 696722 | 698622 | 11 |
| 50 | 30 681247 | 683215 | 685175 | 687126 | 689068 | 691002 | 692928 | 694845 | 696754 | 698654 | 10 |
| 51 | 45 681280 | 683248 | 685207 | 687158 | 689100 | 691034 | 692960 | 694877 | 696785 | 698686 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.681313 | 9.683281 | 9.685240 | 9.687191 | 9.689133 | 9.691066 | 9.692992 | 9.694909 | 9.696817 | 9.698717 | 8 |
| 53 | 15 681346 | 683314 | 685273 | 687223 | 689165 | 691099 | 693024 | 694940 | 696849 | 698749 | 7 |
| 54 | 30 681379 | 683346 | 685305 | 687255 | 689197 | 691131 | 693056 | 694972 | 696881 | 698780 | 6 |
| 55 | 45 681412 | 683379 | 685338 | 687289 | 689230 | 691163 | 693088 | 695004 | 696912 | 698812 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.681445 | 9.683412 | 9.685370 | 9.687320 | 9.689262 | 9.691195 | 9.693120 | 9.695036 | 9.696944 | 9.698844 | 4 |
| 57 | 15 681477 | 683444 | 685403 | 687353 | 689294 | 691227 | 693152 | 695068 | 696976 | 698875 | 3 |
| 58 | 30 681510 | 683477 | 685435 | 687385 | 689326 | 691259 | 693184 | 695100 | 697007 | 698907 | 2 |
| 59 | 45 681543 | 683510 | 685468 | 687418 | 689359 | 691291 | 693216 | 695132 | 697039 | 698938 | 1 |
| 60 | 0 9.681576 | 9.683543 | 9.685501 | 9.687450 | 9.689391 | 9.691324 | 9.693248 | 9.695163 | 9.697071 | 9.698970 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 85 deg. | | | | 86 deg. | | | | 87 deg. | | |
| sec. | ′ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | sec. |
| 0 | 0 9.659367 | 9.661430 | 9.663485 | 9.665530 | 9.667567 | 9.669594 | 9.671613 | 9.673623 | 9.675624 | 9.677617 | 60 |
| 1 | 15 659401 | 661464 | 663519 | 665564 | 667601 | 669628 | 671647 | 673657 | 675658 | 677650 | 59 |
| 2 | 30 659436 | 661499 | 663553 | 665598 | 667634 | 669662 | 671680 | 673690 | 675691 | 677683 | 58 |
| 3 | 45 659470 | 661533 | 663587 | 665632 | 667668 | 669695 | 671714 | 673723 | 675724 | 677716 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.659505 | 9.661567 | 9.663621 | 9.665666 | 9.667702 | 9.669729 | 9.671747 | 9.673757 | 9.675758 | 9.677749 | 56 |
| 5 | 15 659539 | 661602 | 663655 | 665700 | 667736 | 669763 | 671781 | 673790 | 675792 | 677783 | 55 |
| 6 | 30 659573 | 661636 | 663690 | 665734 | 667770 | 669797 | 671815 | 673824 | 675824 | 677816 | 54 |
| 7 | 45 659608 | 661670 | 663724 | 665768 | 667804 | 669831 | 671848 | 673857 | 675857 | 677849 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.659642 | 9.661705 | 9.663758 | 9.665802 | 9.667838 | 9.669864 | 9.671882 | 9.673890 | 9.675891 | 9.677882 | 52 |
| 9 | 15 659677 | 661739 | 663792 | 665836 | 667871 | 669898 | 671915 | 673924 | 675924 | 677915 | 51 |
| 10 | 30 659711 | 661773 | 663826 | 665870 | 667905 | 669931 | 671949 | 673957 | 675957 | 677948 | 50 |
| 11 | 45 659746 | 661807 | 663860 | 665904 | 667939 | 669965 | 671982 | 673991 | 675990 | 677981 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.659780 | 9.661842 | 9.663894 | 9.665938 | 9.667973 | 9.669999 | 9.672016 | 9.674024 | 9.676024 | 9.678014 | 48 |
| 13 | 15 659814 | 661876 | 663928 | 665972 | 668007 | 670033 | 672049 | 674057 | 676057 | 678047 | 47 |
| 14 | 30 659849 | 661910 | 663963 | 666006 | 668041 | 670066 | 672083 | 674091 | 676090 | 678081 | 46 |
| 15 | 45 659883 | 661945 | 663997 | 666040 | 668075 | 670100 | 672116 | 674124 | 676123 | 678114 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.659918 | 9.661979 | 9.664031 | 9.666074 | 9.668108 | 9.670134 | 9.672150 | 9.674158 | 9.676157 | 9.678147 | 44 |
| 17 | 15 659952 | 662013 | 664065 | 666108 | 668142 | 670167 | 672183 | 674191 | 676190 | 678180 | 43 |
| 18 | 30 659987 | 662047 | 664099 | 666142 | 668176 | 670201 | 672217 | 674224 | 676223 | 678213 | 42 |
| 19 | 45 660021 | 662082 | 664133 | 666176 | 668210 | 670235 | 672251 | 674258 | 676256 | 678246 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.660056 | 9.662116 | 9.664167 | 9.666210 | 9.668244 | 9.670268 | 9.672284 | 9.674291 | 9.676290 | 9.678279 | 40 |
| 21 | 15 660090 | 662150 | 664201 | 666244 | 668277 | 670302 | 672318 | 674325 | 676323 | 678312 | 39 |
| 22 | 30 660124 | 662185 | 664236 | 666278 | 668311 | 670336 | 672351 | 674358 | 676356 | 678345 | 38 |
| 23 | 45 660159 | 662219 | 664270 | 666312 | 668345 | 670369 | 672385 | 674391 | 676389 | 678378 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.660193 | 9.662253 | 9.664304 | 9.666346 | 9.668379 | 9.670403 | 9.672418 | 9.674425 | 9.676422 | 9.678411 | 36 |
| 25 | 15 660227 | 662287 | 664338 | 666380 | 668413 | 670437 | 672452 | 674458 | 676456 | 678444 | 35 |
| 26 | 30 660262 | 662322 | 664372 | 666414 | 668446 | 670470 | 672485 | 674491 | 676489 | 678477 | 34 |
| 27 | 45 660296 | 662356 | 664406 | 666448 | 668480 | 670504 | 672519 | 674525 | 676522 | 678511 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.660331 | 9.662390 | 9.664440 | 9.666482 | 9.668514 | 9.670538 | 9.672552 | 9.674558 | 9.676555 | 9.678544 | 32 |
| 29 | 15 660365 | 662424 | 664474 | 666515 | 668548 | 670571 | 672586 | 674591 | 676589 | 678577 | 31 |
| 30 | 30 660400 | 662459 | 664508 | 666549 | 668582 | 670605 | 672619 | 674625 | 676621 | 678610 | 30 |
| 31 | 45 660434 | 662493 | 664542 | 666583 | 668615 | 670638 | 672653 | 674658 | 676655 | 678644 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.660468 | 9.662527 | 9.664577 | 9.666617 | 9.668649 | 9.670672 | 9.672686 | 9.674692 | 9.676685 | 9.678676 | 28 |
| 33 | 15 660503 | 662561 | 664611 | 666651 | 668683 | 670706 | 672720 | 674725 | 676721 | 678709 | 27 |
| 34 | 30 660537 | 662595 | 664645 | 666685 | 668717 | 670739 | 672753 | 674758 | 676755 | 678743 | 26 |
| 35 | 45 660571 | 662630 | 664679 | 666719 | 668751 | 670773 | 672787 | 674792 | 676788 | 678775 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.660606 | 9.662664 | 9.664713 | 9.666753 | 9.668784 | 9.670807 | 9.672820 | 9.674825 | 9.676821 | 9.678808 | 24 |
| 37 | 15 660640 | 662698 | 664747 | 666787 | 668818 | 670840 | 672854 | 674858 | 676854 | 678841 | 23 |
| 38 | 30 660675 | 662732 | 664781 | 666821 | 668852 | 670874 | 672887 | 674892 | 676887 | 678874 | 22 |
| 39 | 45 660709 | 662767 | 664815 | 666855 | 668886 | 670908 | 672921 | 674925 | 676921 | 678907 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.660743 | 9.662801 | 9.664849 | 9.666889 | 9.668919 | 9.670941 | 9.672954 | 9.674958 | 9.676954 | 9.678940 | 20 |
| 41 | 15 660778 | 662835 | 664883 | 666923 | 668953 | 670975 | 672988 | 674992 | 676987 | 678973 | 19 |
| 42 | 30 660812 | 662869 | 664917 | 666957 | 668987 | 671008 | 673021 | 675025 | 677020 | 679006 | 18 |
| 43 | 45 660846 | 662903 | 664951 | 666991 | 669021 | 671042 | 673055 | 675058 | 677053 | 679040 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.660881 | 9.662938 | 9.664986 | 9.667024 | 9.669054 | 9.671076 | 9.673088 | 9.675092 | 9.677086 | 9.679073 | 16 |
| 45 | 15 660915 | 662972 | 665020 | 667058 | 669088 | 671109 | 673121 | 675125 | 677120 | 679106 | 15 |
| 46 | 30 660949 | 663006 | 665054 | 667092 | 669122 | 671143 | 673155 | 675158 | 677153 | 679139 | 14 |
| 47 | 45 660984 | 663040 | 665088 | 667126 | 669156 | 671176 | 673188 | 675192 | 677186 | 679172 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.661018 | 9.663074 | 9.665122 | 9.667160 | 9.669190 | 9.671210 | 9.673222 | 9.675225 | 9.677219 | 9.679205 | 12 |
| 49 | 15 661052 | 663109 | 665156 | 667194 | 669223 | 671244 | 673255 | 675258 | 677252 | 679238 | 11 |
| 50 | 30 661087 | 663143 | 665190 | 667228 | 669257 | 671277 | 673289 | 675291 | 677285 | 679271 | 10 |
| 51 | 45 661121 | 663177 | 665224 | 667262 | 669291 | 671311 | 673322 | 675325 | 677319 | 679304 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.661156 | 9.663211 | 9.665258 | 9.667296 | 9.669324 | 9.671344 | 9.673356 | 9.675358 | 9.677352 | 9.679337 | 8 |
| 53 | 15 661190 | 663245 | 665292 | 667329 | 669358 | 671378 | 673389 | 675391 | 677385 | 679371 | 7 |
| 54 | 30 661224 | 663280 | 665326 | 667363 | 669392 | 671412 | 673423 | 675425 | 677418 | 679404 | 6 |
| 55 | 45 661258 | 663314 | 665360 | 667397 | 669426 | 671445 | 673456 | 675458 | 677451 | 679437 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.661293 | 9.663348 | 9.665394 | 9.667431 | 9.669459 | 9.671479 | 9.673489 | 9.675491 | 9.677484 | 9.679470 | 4 |
| 57 | 15 661327 | 663382 | 665428 | 667465 | 669493 | 671513 | 673523 | 675525 | 677518 | 679503 | 3 |
| 58 | 30 661362 | 663416 | 665462 | 667499 | 669527 | 671546 | 673556 | 675558 | 677551 | 679536 | 2 |
| 59 | 45 661396 | 663450 | 665496 | 667533 | 669561 | 671580 | 673590 | 675591 | 677584 | 679569 | 1 |
| 60 | 60 9.661430 | 9.663485 | 9.665530 | 9.667567 | 9.669594 | 9.671613 | 9.673623 | 9.675624 | 9.677617 | 9.679602 | 0 |
| | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m | |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 87 deg. | | 88 deg. | | | | 89 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.679601 | 9.681576 | 9.683543 | 9.685501 | 9.687450 | 9.689391 | 9.691324 | 9.693248 | 9.695163 | 9.697071 | 60 |
| 1 | 15 679634 | 681609 | 683575 | 685533 | 687482 | 689423 | 691356 | 693280 | 695195 | 697103 | 59 |
| 2 | 30 679667 | 681642 | 683608 | 685566 | 687515 | 689456 | 691388 | 693312 | 695227 | 697134 | 58 |
| 3 | 45 679700 | 681674 | 683641 | 685598 | 687547 | 689488 | 691420 | 693344 | 695259 | 697166 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.679733 | 9.681707 | 9.683673 | 9.685631 | 9.687580 | 9.689520 | 9.691452 | 9.693376 | 9.695291 | 9.697198 | 56 |
| 5 | 15 679766 | 681740 | 683706 | 685663 | 687612 | 689552 | 691484 | 693408 | 695323 | 697229 | 55 |
| 6 | 30 679799 | 681773 | 683739 | 685696 | 687645 | 689585 | 691516 | 693440 | 695355 | 697261 | 54 |
| 7 | 45 679832 | 681806 | 683771 | 685728 | 687677 | 689617 | 691548 | 693472 | 695387 | 697293 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.679865 | 9.681839 | 9.683804 | 9.685761 | 9.687709 | 9.689649 | 9.691581 | 9.693504 | 9.695418 | 9.697325 | 52 |
| 9 | 15 679898 | 681871 | 683837 | 685794 | 687742 | 689681 | 691613 | 693536 | 695450 | 697356 | 51 |
| 10 | 30 679931 | 681904 | 683869 | 685826 | 687774 | 689714 | 691645 | 693568 | 695482 | 697388 | 50 |
| 11 | 45 679964 | 681937 | 683902 | 685859 | 687806 | 689746 | 691677 | 693600 | 695514 | 697420 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.679997 | 9.681970 | 9.683935 | 9.685891 | 9.687839 | 9.689778 | 9.691709 | 9.693632 | 9.695546 | 9.697451 | 48 |
| 13 | 15 680029 | 682003 | 683967 | 685924 | 687871 | 689810 | 691741 | 693663 | 695577 | 697483 | 47 |
| 14 | 30 680062 | 682036 | 684000 | 685956 | 687904 | 689843 | 691773 | 693695 | 695609 | 697515 | 46 |
| 15 | 45 680095 | 682068 | 684033 | 685989 | 687936 | 689875 | 691805 | 693727 | 695641 | 697546 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.680128 | 9.682101 | 9.684066 | 9.686021 | 9.687968 | 9.689907 | 9.691838 | 9.693759 | 9.695673 | 9.697578 | 44 |
| 17 | 15 680161 | 682134 | 684098 | 686054 | 688001 | 689939 | 691870 | 693791 | 695705 | 697610 | 43 |
| 18 | 30 680194 | 682167 | 684131 | 686086 | 688033 | 689972 | 691902 | 693823 | 695737 | 697641 | 42 |
| 19 | 45 680227 | 682200 | 684163 | 686119 | 688066 | 690004 | 691934 | 693855 | 695768 | 697673 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.680260 | 9.682232 | 9.684196 | 9.686151 | 9.688098 | 9.690036 | 9.691966 | 9.693887 | 9.695800 | 9.697705 | 40 |
| 21 | 15 680293 | 682265 | 684229 | 686184 | 688130 | 690068 | 691998 | 693919 | 695832 | 697736 | 39 |
| 22 | 30 680326 | 682298 | 684261 | 686216 | 688163 | 690101 | 692030 | 693951 | 695864 | 697768 | 38 |
| 23 | 45 680359 | 682331 | 684294 | 686249 | 688195 | 690133 | 692062 | 693983 | 695896 | 697800 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.680392 | 9.682364 | 9.684327 | 9.686281 | 9.688227 | 9.690165 | 9.692094 | 9.694015 | 9.695927 | 9.697832 | 36 |
| 25 | 15 680425 | 682396 | 684359 | 686314 | 688260 | 690197 | 692126 | 694047 | 695959 | 697863 | 35 |
| 26 | 30 680458 | 682429 | 684392 | 686346 | 688292 | 690230 | 692158 | 694079 | 695991 | 697895 | 34 |
| 27 | 45 680491 | 682462 | 684425 | 686379 | 688325 | 690262 | 692190 | 694111 | 696023 | 697926 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.680524 | 9.682495 | 9.684457 | 9.686411 | 9.688357 | 9.690294 | 9.692223 | 9.694143 | 9.696055 | 9.697958 | 32 |
| 29 | 15 680557 | 682528 | 684490 | 686444 | 688389 | 690326 | 692255 | 694175 | 696086 | 697990 | 31 |
| 30 | 30 680589 | 682560 | 684523 | 686476 | 688422 | 690358 | 692287 | 694207 | 696118 | 698021 | 30 |
| 31 | 45 680622 | 682593 | 684555 | 686509 | 688454 | 690391 | 692319 | 694239 | 696150 | 698053 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.680655 | 9.682626 | 9.684588 | 9.686541 | 9.688486 | 9.690423 | 9.692351 | 9.694271 | 9.696182 | 9.698085 | 28 |
| 33 | 15 680688 | 682659 | 684620 | 686574 | 688519 | 690455 | 692383 | 694302 | 696214 | 698116 | 27 |
| 34 | 30 680721 | 682691 | 684653 | 686606 | 688551 | 690487 | 692415 | 694334 | 696245 | 698148 | 26 |
| 35 | 45 680754 | 682724 | 684686 | 686639 | 688583 | 690519 | 692447 | 694366 | 696277 | 698180 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.680787 | 9.682757 | 9.684718 | 9.686671 | 9.688616 | 9.690552 | 9.692479 | 9.694398 | 9.696309 | 9.698211 | 24 |
| 37 | 15 680820 | 682790 | 684751 | 686704 | 688648 | 690584 | 692511 | 694430 | 696341 | 698243 | 23 |
| 38 | 30 680853 | 682822 | 684784 | 686736 | 688680 | 690616 | 692543 | 694462 | 696372 | 698275 | 22 |
| 39 | 45 680886 | 682855 | 684816 | 686769 | 688713 | 690648 | 692575 | 694494 | 696404 | 698306 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.680919 | 9.682888 | 9.684849 | 9.686801 | 9.688745 | 9.690680 | 9.692607 | 9.694526 | 9.696436 | 9.698338 | 20 |
| 41 | 15 680951 | 682921 | 684882 | 686834 | 688777 | 690712 | 692639 | 694558 | 696468 | 698369 | 19 |
| 42 | 30 680984 | 682953 | 684914 | 686866 | 688810 | 690745 | 692671 | 694590 | 696500 | 698401 | 18 |
| 43 | 45 681017 | 682986 | 684947 | 686899 | 688843 | 690777 | 692703 | 694622 | 696531 | 698433 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.681050 | 9.683019 | 9.684979 | 9.686931 | 9.688874 | 9.690809 | 9.692735 | 9.694653 | 9.696563 | 9.698464 | 16 |
| 45 | 15 681083 | 683052 | 685012 | 686963 | 688907 | 690841 | 692767 | 694685 | 696595 | 698496 | 15 |
| 46 | 30 681116 | 683084 | 685044 | 686996 | 688939 | 690873 | 692800 | 694717 | 696627 | 698528 | 14 |
| 47 | 45 681149 | 683117 | 685077 | 687028 | 688971 | 690906 | 692831 | 694749 | 696658 | 698559 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.681182 | 9.683150 | 9.685110 | 9.687061 | 9.689004 | 9.690938 | 9.692864 | 9.694781 | 9.696690 | 9.698591 | 12 |
| 49 | 15 681214 | 683183 | 685142 | 687093 | 689036 | 690970 | 692896 | 694813 | 696722 | 698622 | 11 |
| 50 | 30 681247 | 683215 | 685175 | 687126 | 689068 | 691002 | 692928 | 694845 | 696754 | 698654 | 10 |
| 51 | 45 681280 | 683248 | 685207 | 687158 | 689100 | 691034 | 692960 | 694877 | 696785 | 698686 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.681313 | 9.683281 | 9.685240 | 9.687191 | 9.689133 | 9.691066 | 9.692992 | 9.694909 | 9.696817 | 9.698717 | 8 |
| 53 | 15 681346 | 683314 | 685273 | 687223 | 689165 | 691099 | 693024 | 694940 | 696849 | 698749 | 7 |
| 54 | 30 681379 | 683346 | 685305 | 687255 | 689197 | 691131 | 693056 | 694972 | 696881 | 698780 | 6 |
| 55 | 45 681412 | 683379 | 685338 | 687289 | 689230 | 691163 | 693088 | 695004 | 696912 | 698812 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.681445 | 9.683412 | 9.685370 | 9.687320 | 9.689262 | 9.691195 | 9.693120 | 9.695036 | 9.696944 | 9.698844 | 4 |
| 57 | 15 681477 | 683444 | 685403 | 687353 | 689294 | 691227 | 693152 | 695068 | 696976 | 698875 | 3 |
| 58 | 30 681510 | 683477 | 685435 | 687385 | 689326 | 691259 | 693184 | 695100 | 697007 | 698907 | 2 |
| 59 | 45 681543 | 683510 | 685468 | 687418 | 689359 | 691291 | 693216 | 695132 | 697039 | 698938 | 1 |
| 60 | 0 9.681576 | 9.683543 | 9.685501 | 9.687450 | 9.689391 | 9.691324 | 9.693248 | 9.695163 | 9.697071 | 9.698970 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 90 deg. | | | | 91 deg. | | | | 92 deg. | | |
| | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.698970 | 9.700860 | 9.702743 | 9.704618 | 9.706484 | 9.708342 | 9.710192 | 9.712034 | 9.713868 | 9.715694 | 60 |
| 1 | 15 699001 | 700892 | 702775 | 704649 | 706515 | 708373 | 710223 | 712065 | 713899 | 715724 | 59 |
| 2 | 30 699033 | 700924 | 702806 | 704680 | 706546 | 708404 | 710254 | 712095 | 713929 | 715755 | 58 |
| 3 | 45 699065 | 700955 | 702837 | 704711 | 706577 | 708435 | 710284 | 712126 | 713960 | 715785 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16 | |
| 4 | 0 9.699096 | 9.700987 | 9.702869 | 9.704743 | 9.706608 | 9.708466 | 9.710315 | 9.712157 | 9.713990 | 9.715816 | 56 |
| 5 | 15 699128 | 701018 | 702900 | 704774 | 706639 | 708497 | 710346 | 712187 | 714021 | 715846 | 55 |
| 6 | 30 699159 | 701049 | 702931 | 704805 | 706670 | 708528 | 710377 | 712218 | 714051 | 715876 | 54 |
| 7 | 45 699191 | 701081 | 702962 | 704836 | 706701 | 708558 | 710408 | 712249 | 714082 | 715907 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.699223 | 9.701112 | 9.702994 | 9.704867 | 9.706732 | 9.708589 | 9.710438 | 9.712279 | 9.714112 | 9.715937 | 52 |
| 9 | 15 699254 | 701144 | 703025 | 704898 | 706763 | 708620 | 710469 | 712310 | 714143 | 715967 | 51 |
| 10 | 30 699286 | 701175 | 703056 | 704929 | 706794 | 708651 | 710500 | 712340 | 714173 | 715998 | 50 |
| 11 | 45 699317 | 701207 | 703087 | 704961 | 706825 | 708682 | 710531 | 712371 | 714204 | 716028 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.699349 | 9.701238 | 9.703119 | 9.704992 | 9.706856 | 9.708713 | 9.710561 | 9.712402 | 9.714234 | 9.716058 | 48 |
| 13 | 15 699380 | 701269 | 703150 | 705023 | 706887 | 708744 | 710592 | 712432 | 714264 | 716089 | 47 |
| 14 | 30 699412 | 701301 | 703182 | 705054 | 706918 | 708775 | 710623 | 712463 | 714295 | 716119 | 46 |
| 15 | 45 699443 | 701332 | 703213 | 705085 | 706949 | 708805 | 710653 | 712493 | 714325 | 716149 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.699475 | 9.701864 | 9.703244 | 9.705116 | 9.706980 | 9.708836 | 9.710684 | 9.712524 | 9.714356 | 9.716180 | 44 |
| 17 | 15 699506 | 701395 | 703275 | 705147 | 707011 | 708867 | 710715 | 712555 | 714386 | 716210 | 43 |
| 18 | 30 699538 | 701426 | 703307 | 705179 | 707042 | 708898 | 710746 | 712585 | 714417 | 716240 | 42 |
| 19 | 45 699569 | 701458 | 703338 | 705210 | 707073 | 708929 | 710776 | 712616 | 714447 | 716271 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.699601 | 9.701489 | 9.703369 | 9.705241 | 9.707104 | 9.708960 | 9.710807 | 9.712646 | 9.714478 | 9.716301 | 40 |
| 21 | 15 699633 | 701521 | 703400 | 705272 | 707135 | 708991 | 710838 | 712676 | 714508 | 716331 | 39 |
| 22 | 30 699664 | 701552 | 703432 | 705303 | 707166 | 709022 | 710869 | 712708 | 714539 | 716362 | 38 |
| 23 | 45 699696 | 701583 | 703463 | 705334 | 707197 | 709052 | 710899 | 712738 | 714569 | 716392 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.699727 | 9.701615 | 9.703494 | 9.705365 | 9.707228 | 9.709083 | 9.710930 | 9.712769 | 9.714600 | 9.716422 | 36 |
| 25 | 15 699759 | 701646 | 703525 | 705396 | 707259 | 709114 | 710961 | 712799 | 714630 | 716453 | 35 |
| 26 | 30 699790 | 701678 | 703557 | 705428 | 707290 | 709145 | 710991 | 712830 | 714660 | 716483 | 34 |
| 27 | 45 699822 | 701709 | 703588 | 705459 | 707321 | 709176 | 711022 | 712860 | 714691 | 716513 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.699853 | 9.701740 | 9.703619 | 9.705490 | 9.707352 | 9.709207 | 9.711053 | 9.712891 | 9.714721 | 9.716544 | 32 |
| 29 | 15 699885 | 701772 | 703650 | 705521 | 707383 | 709237 | 711084 | 712922 | 714752 | 716574 | 31 |
| 30 | 30 699916 | 701803 | 703682 | 705552 | 707414 | 709268 | 711114 | 712952 | 714782 | 716604 | 30 |
| 31 | 45 699948 | 701834 | 703713 | 705583 | 707445 | 709299 | 711145 | 712983 | 714813 | 716634 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.699979 | 9.701866 | 9.703744 | 9.705614 | 9.707476 | 9.709330 | 9.711176 | 9.713013 | 9.714843 | 9.716665 | 28 |
| 33 | 15 700011 | 701897 | 703775 | 705645 | 707507 | 709361 | 711206 | 713044 | 714873 | 716695 | 27 |
| 34 | 30 700042 | 701929 | 703807 | 705676 | 707538 | 709392 | 711237 | 713074 | 714904 | 716725 | 26 |
| 35 | 45 700074 | 701960 | 703838 | 705707 | 707569 | 709422 | 711268 | 713105 | 714934 | 716756 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.700105 | 9.701991 | 9.703869 | 9.705739 | 9.707600 | 9.709453 | 9.711298 | 9.713136 | 9.714965 | 9.716786 | 24 |
| 37 | 15 700137 | 702023 | 703900 | 705770 | 707631 | 709484 | 711329 | 713166 | 714995 | 716816 | 23 |
| 38 | 30 700168 | 702054 | 703932 | 705801 | 707662 | 709515 | 711360 | 713197 | 715026 | 716846 | 22 |
| 39 | 45 700200 | 702085 | 703963 | 705832 | 707693 | 709546 | 711391 | 713227 | 715056 | 716877 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.700231 | 9.702117 | 9.703994 | 9.705863 | 9.707724 | 9.709576 | 9.711421 | 9.713258 | 9.715086 | 9.716907 | 20 |
| 41 | 15 700263 | 702148 | 704025 | 705894 | 707755 | 709607 | 711452 | 713288 | 715117 | 716937 | 19 |
| 42 | 30 700294 | 702180 | 704056 | 705925 | 707786 | 709638 | 711482 | 713319 | 715147 | 716968 | 18 |
| 43 | 45 700326 | 702211 | 704087 | 705956 | 707817 | 709669 | 711513 | 713349 | 715178 | 716998 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.700357 | 9.702242 | 9.704119 | 9.705987 | 9.707848 | 9.709700 | 9.711544 | 9.713380 | 9.715208 | 9.717028 | 16 |
| 45 | 15 700389 | 702273 | 704150 | 706018 | 707878 | 709730 | 711574 | 713410 | 715238 | 717058 | 15 |
| 46 | 30 700420 | 702305 | 704181 | 706049 | 707909 | 709761 | 711605 | 713441 | 715269 | 717089 | 14 |
| 47 | 45 700452 | 702336 | 704212 | 706080 | 707940 | 709792 | 711636 | 713471 | 715299 | 717119 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.700483 | 9.702368 | 9.704244 | 9.706112 | 9.707971 | 9.709823 | 9.711666 | 9.713502 | 9.715330 | 9.717149 | 12 |
| 49 | 15 700515 | 702399 | 704275 | 706143 | 708002 | 709854 | 711697 | 713533 | 715360 | 717179 | 11 |
| 50 | 30 700546 | 702430 | 704306 | 706174 | 708033 | 709884 | 711728 | 713563 | 715390 | 717210 | 10 |
| 51 | 45 700578 | 702461 | 704337 | 706205 | 708064 | 709915 | 711758 | 713594 | 715421 | 717240 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.700609 | 9.702493 | 9.704368 | 9.706236 | 9.708095 | 9.709946 | 9.711789 | 9.713624 | 9.715451 | 9.717270 | 8 |
| 53 | 15 700641 | 702524 | 704399 | 706267 | 708126 | 709977 | 711820 | 713655 | 715481 | 717300 | 7 |
| 54 | 30 700672 | 702556 | 704431 | 706298 | 708157 | 710008 | 711850 | 713685 | 715512 | 717331 | 6 |
| 55 | 45 700703 | 702587 | 704462 | 706329 | 708188 | 710038 | 711881 | 713716 | 715542 | 717361 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.700735 | 9.702618 | 9.704493 | 9.706360 | 9.708219 | 9.710069 | 9.711912 | 9.713746 | 9.715575 | 9.717391 | 4 |
| 57 | 15 700766 | 702649 | 704524 | 706391 | 708249 | 710100 | 711942 | 713777 | 715603 | 717421 | 3 |
| 58 | 30 700798 | 702681 | 704556 | 706422 | 708280 | 710131 | 711973 | 713807 | 715633 | 717452 | 2 |
| 59 | 45 700829 | 702712 | 704587 | 706453 | 708311 | 710161 | 712004 | 713838 | 715664 | 717482 | 1 |
| 60 | 60 9.700860 | 9.702743 | 9.704618 | 9.706484 | 9.708342 | 9.710192 | 9.712034 | 9.713868 | 9.715694 | 9.717512 | 0 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

| | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 92 deg. | | 93 deg. | | | | 94 deg. | | | | |
| m | 30′ | 45′ | 0° | 15° | 30° | 45° | 0° | 15° | 30° | 45° | sec. |
| 0 | 0 9.717512 | 9.719322 | 9.721124 | 9.722919 | 9.724705 | 9.726484 | 9.728255 | 9.730018 | 9.731773 | 9.733520 | 60 |
| 1 | 15 717542 | 719350 | 721154 | 722949 | 724735 | 726513 | 728284 | 730047 | 731803 | 733551 | 59 |
| 2 | 30 717573 | 719382 | 721184 | 722978 | 724765 | 726543 | 728314 | 730077 | 731832 | 733580 | 58 |
| 3 | 45 717603 | 719413 | 721214 | 723008 | 724794 | 726573 | 728343 | 730106 | 731861 | 733609 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.717638 | 9.719443 | 9.721244 | 9.723038 | 9.724824 | 9.726602 | 9.728373 | 9.730135 | 9.731890 | 9.733638 | 56 |
| 5 | 15 717663 | 719473 | 721274 | 723068 | 724854 | 726632 | 728402 | 730165 | 731920 | 733667 | 55 |
| 6 | 30 717694 | 719503 | 721304 | 723098 | 724883 | 726661 | 728432 | 730194 | 731949 | 733696 | 54 |
| 7 | 45 717724 | 719533 | 721334 | 723128 | 724913 | 726691 | 728461 | 730223 | 731978 | 733725 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.717754 | 9.719563 | 9.721364 | 9.723157 | 9.724943 | 9.726721 | 9.728490 | 9.730253 | 9.732007 | 9.733754 | 52 |
| 9 | 15 717784 | 719593 | 721394 | 723187 | 724973 | 726750 | 728520 | 730282 | 732036 | 733783 | 51 |
| 10 | 30 717814 | 719623 | 721424 | 723217 | 725002 | 726780 | 728549 | 730311 | 732066 | 733812 | 50 |
| 11 | 45 717845 | 719653 | 721454 | 723247 | 725032 | 726809 | 728579 | 730341 | 732095 | 733841 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.717875 | 9.719683 | 9.721484 | 9.723277 | 9.725062 | 9.726839 | 9.728608 | 9.730370 | 9.732124 | 9.733870 | 48 |
| 13 | 15 717905 | 719713 | 721514 | 723306 | 725091 | 726868 | 728638 | 730399 | 732153 | 733899 | 47 |
| 14 | 30 717935 | 719743 | 721544 | 723336 | 725121 | 726898 | 728667 | 730428 | 732182 | 733928 | 46 |
| 15 | 45 717965 | 719773 | 721574 | 723366 | 725151 | 726927 | 728696 | 730458 | 732211 | 733957 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.717996 | 9.719804 | 9.721604 | 9.723396 | 9.725180 | 9.726957 | 9.728726 | 9.730487 | 9.732241 | 9.733986 | 44 |
| 17 | 15 718026 | 719834 | 721634 | 723426 | 725210 | 726986 | 728755 | 730516 | 732270 | 734015 | 43 |
| 18 | 30 718056 | 719864 | 721664 | 723456 | 725240 | 727016 | 728785 | 730546 | 732299 | 734044 | 42 |
| 19 | 45 718086 | 719894 | 721693 | 723485 | 725269 | 727046 | 728814 | 730575 | 732328 | 734073 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.718116 | 9.719924 | 9.721723 | 9.723515 | 9.725299 | 9.727075 | 9.728844 | 9.730604 | 9.732357 | 9.734102 | 40 |
| 21 | 15 718147 | 719954 | 721753 | 723545 | 725329 | 727105 | 728873 | 730633 | 732386 | 734131 | 39 |
| 22 | 30 718177 | 719984 | 721783 | 723575 | 725358 | 727134 | 728902 | 730663 | 732415 | 734161 | 38 |
| 23 | 45 718207 | 720014 | 721813 | 723604 | 725388 | 727164 | 728932 | 730692 | 732445 | 734189 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.718237 | 9.720044 | 9.721843 | 9.723634 | 9.725418 | 9.727193 | 9.728961 | 9.730721 | 9.732474 | 9.734219 | 36 |
| 25 | 15 718267 | 720074 | 721873 | 723664 | 725447 | 727223 | 728991 | 730751 | 732503 | 734247 | 35 |
| 26 | 30 718297 | 720104 | 721903 | 723694 | 725477 | 727252 | 729020 | 730780 | 732532 | 734277 | 34 |
| 27 | 45 718328 | 720134 | 721933 | 723724 | 725507 | 727282 | 729049 | 730809 | 732561 | 734306 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.718358 | 9.720164 | 9.721963 | 9.723753 | 9.725536 | 9.727311 | 9.729079 | 9.730838 | 9.732590 | 9.734335 | 32 |
| 29 | 15 718388 | 720194 | 721993 | 723783 | 725566 | 727341 | 729108 | 730868 | 732619 | 734364 | 31 |
| 30 | 30 718418 | 720224 | 722023 | 723813 | 725596 | 727370 | 729138 | 730897 | 732649 | 734393 | 30 |
| 31 | 45 718448 | 720254 | 722052 | 723843 | 725625 | 727400 | 729167 | 730926 | 732678 | 734422 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.718479 | 9.720284 | 9.722082 | 9.723873 | 9.725655 | 9.727429 | 9.729196 | 9.730955 | 9.732707 | 9.734451 | 28 |
| 33 | 15 718509 | 720314 | 722112 | 723902 | 725684 | 727459 | 729226 | 730985 | 732736 | 734480 | 27 |
| 34 | 30 718539 | 720344 | 722142 | 723932 | 725714 | 727488 | 729255 | 731014 | 732765 | 734509 | 26 |
| 35 | 45 718569 | 720374 | 722172 | 723962 | 725744 | 727518 | 729284 | 731043 | 732794 | 734538 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.718599 | 9.720404 | 9.722202 | 9.723992 | 9.725773 | 9.727547 | 9.729314 | 9.731072 | 9.732823 | 9.734567 | 24 |
| 37 | 15 718629 | 720435 | 722232 | 724021 | 725803 | 727577 | 729343 | 731102 | 732852 | 734596 | 23 |
| 38 | 30 718659 | 720465 | 722262 | 724051 | 725833 | 727606 | 729373 | 731131 | 732882 | 734625 | 22 |
| 39 | 45 718689 | 720495 | 722292 | 724081 | 725862 | 727636 | 729402 | 731160 | 732911 | 734653 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.718720 | 9.720525 | 9.722322 | 9.724111 | 9.725892 | 9.727665 | 9.729431 | 9.731189 | 9.732940 | 9.734683 | 20 |
| 41 | 15 718750 | 720555 | 722351 | 724140 | 725922 | 727695 | 729461 | 731219 | 732969 | 734711 | 19 |
| 42 | 30 718780 | 720585 | 722381 | 724170 | 725951 | 727724 | 729490 | 731248 | 732998 | 734741 | 18 |
| 43 | 45 718810 | 720615 | 722411 | 724200 | 725981 | 727754 | 729519 | 731277 | 733027 | 734769 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.718840 | 9.720645 | 9.722441 | 9.724230 | 9.726010 | 9.727783 | 9.729549 | 9.731306 | 9.733056 | 9.734798 | 16 |
| 45 | 15 718870 | 720675 | 722471 | 724259 | 726040 | 727813 | 729578 | 731335 | 733085 | 734827 | 15 |
| 46 | 30 718901 | 720705 | 722501 | 724289 | 726070 | 727842 | 729607 | 731365 | 733114 | 734856 | 14 |
| 47 | 45 718931 | 720735 | 722531 | 724319 | 726099 | 727872 | 729637 | 731394 | 733143 | 734885 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.718961 | 9.720765 | 9.722561 | 9.724349 | 9.726129 | 9.727901 | 9.729666 | 9.731423 | 9.733173 | 9.734914 | 12 |
| 49 | 15 718991 | 720795 | 722590 | 724378 | 726158 | 727931 | 729695 | 731452 | 733202 | 734943 | 11 |
| 50 | 30 719021 | 720825 | 722620 | 724408 | 726188 | 727960 | 729725 | 731482 | 733231 | 734972 | 10 |
| 51 | 45 719051 | 720855 | 722650 | 724438 | 726218 | 727990 | 729754 | 731511 | 733260 | 735001 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 59′ | |
| 52 | 0 9.719081 | 9.720885 | 9.722680 | 9.724468 | 9.726247 | 9.728019 | 9.729784 | 9.731540 | 9.733289 | 9.735030 | 8 |
| 53 | 15 719111 | 720915 | 722710 | 724497 | 726276 | 728049 | 729813 | 731569 | 733318 | 735059 | 7 |
| 54 | 30 719142 | 720945 | 722740 | 724527 | 726306 | 728078 | 729842 | 731598 | 733347 | 735088 | 6 |
| 55 | 45 719172 | 720975 | 722770 | 724557 | 726336 | 728108 | 729871 | 731628 | 733376 | 735117 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.719202 | 9.721005 | 9.722799 | 9.724586 | 9.726366 | 9.728137 | 9.729901 | 9.731657 | 9.733405 | 9.735146 | 4 |
| 57 | 15 719232 | 721034 | 722829 | 724616 | 726395 | 728167 | 729930 | 731687 | 733434 | 735175 | 3 |
| 58 | 30 719262 | 721064 | 722859 | 724646 | 726425 | 728196 | 729960 | 731715 | 733463 | 735204 | 2 |
| 59 | 45 719292 | 721094 | 722889 | 724676 | 726454 | 728225 | 729989 | 731744 | 733492 | 735233 | 1 |
| 60 | 0 9.719322 | 9.721124 | 9.722919 | 9.724705 | 9.726484 | 9.728255 | 9.730018 | 9.731773 | 9.733520 | 9.735262 | 0 |
| m | 49m | 48m | 47m | 46m | 45m | 44m | 43m | 42m | 41m | 40m | sec. |

| | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 95 deg. | | | | 96 deg. | | | | 97 deg. | | |
| sec. | ′ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.735262 | 9.736994 | 9.738719 | 9.740437 | 9.742147 | 9.743849 | 9.745544 | 9.747232 | 9.748912 | 9.750585 | 60 |
| 1 | 15 735291 | 737023 | 738748 | 740465 | 742175 | 743878 | 745573 | 747260 | 748940 | 750613 | 59 |
| 2 | 30 735320 | 737052 | 738777 | 740494 | 742204 | 743906 | 745601 | 747288 | 748968 | 750641 | 58 |
| 3 | 45 735349 | 737081 | 738805 | 740523 | 742232 | 743934 | 745629 | 747316 | 748996 | 750669 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.735378 | 9.737110 | 9.738834 | 9.740551 | 9.742261 | 9.743963 | 9.745657 | 9.747344 | 9.749024 | 9.750696 | 56 |
| 5 | 15 735407 | 737139 | 738863 | 740580 | 742289 | 743991 | 745685 | 747372 | 749052 | 750724 | 55 |
| 6 | 30 735435 | 737167 | 738892 | 740608 | 742318 | 744019 | 745714 | 747400 | 749080 | 750752 | 54 |
| 7 | 45 735464 | 737196 | 738920 | 740637 | 742346 | 744047 | 745742 | 747428 | 749108 | 750780 | 53 |
| | 2′ | 17′ | 33′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.735493 | 9.737225 | 9.738949 | 9.740665 | 9.742374 | 9.744076 | 9.745770 | 9.747457 | 9.749136 | 9.750808 | 52 |
| 9 | 15 735522 | 737254 | 738977 | 740694 | 742403 | 744104 | 745798 | 747485 | 749164 | 750836 | 51 |
| 10 | 30 735551 | 737282 | 739006 | 740722 | 742431 | 744132 | 745826 | 747513 | 749192 | 750864 | 50 |
| 11 | 45 735580 | 737311 | 739035 | 740751 | 742459 | 744161 | 745854 | 747541 | 749219 | 750891 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.735609 | 9.737340 | 9.739064 | 9.740780 | 9.742488 | 9.744189 | 9.745883 | 9.747569 | 9.749247 | 9.750919 | 48 |
| 13 | 15 735638 | 737379 | 739092 | 740808 | 742516 | 744217 | 745911 | 747597 | 749275 | 750947 | 47 |
| 14 | 30 735667 | 737398 | 739121 | 740837 | 742545 | 744246 | 745939 | 747625 | 749303 | 750974 | 46 |
| 15 | 45 735696 | 737426 | 739149 | 740865 | 742573 | 744274 | 745967 | 747653 | 749331 | 751002 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.735725 | 9.737455 | 9.739178 | 9.740894 | 9.742602 | 9.744302 | 9.745995 | 9.747681 | 9.749359 | 9.751030 | 44 |
| 17 | 15 735753 | 737484 | 739207 | 740922 | 742630 | 744330 | 746023 | 747709 | 749387 | 751058 | 43 |
| 18 | 30 735782 | 737513 | 739235 | 740951 | 742658 | 744359 | 746052 | 747737 | 749415 | 751086 | 42 |
| 19 | 45 735811 | 737541 | 739264 | 740979 | 742687 | 744387 | 746080 | 747765 | 749443 | 751114 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.735840 | 9.737570 | 9.739293 | 9.741008 | 9.742715 | 9.744415 | 9.746108 | 9.747793 | 9.749471 | 9.751141 | 40 |
| 21 | 15 735869 | 737599 | 739321 | 741036 | 742744 | 744443 | 746136 | 747821 | 749499 | 751169 | 39 |
| 22 | 30 735898 | 737628 | 739350 | 741065 | 742772 | 744472 | 746164 | 747849 | 749527 | 751197 | 38 |
| 23 | 45 735927 | 737656 | 739379 | 741093 | 742800 | 744500 | 746192 | 747877 | 749554 | 751224 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.735956 | 9.737685 | 9.739407 | 9.741122 | 9.742829 | 9.744528 | 9.746220 | 9.747905 | 9.749582 | 9.751252 | 36 |
| 25 | 15 735985 | 737714 | 739436 | 741150 | 742857 | 744557 | 746248 | 747933 | 749610 | 751280 | 35 |
| 26 | 30 736014 | 737743 | 739465 | 741179 | 742886 | 744585 | 746277 | 747961 | 749638 | 751308 | 34 |
| 27 | 45 736042 | 737772 | 739493 | 741207 | 742914 | 744613 | 746305 | 747989 | 749666 | 751335 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.736071 | 9.737800 | 9.739522 | 9.741236 | 9.742942 | 9.744641 | 9.746333 | 9.748017 | 9.749694 | 9.751363 | 32 |
| 29 | 15 736100 | 737829 | 739551 | 741264 | 742971 | 744669 | 746361 | 748045 | 749722 | 751391 | 31 |
| 30 | 30 736129 | 737858 | 739579 | 741293 | 742999 | 744698 | 746389 | 748073 | 749750 | 751419 | 30 |
| 31 | 45 736158 | 737887 | 739608 | 741321 | 743027 | 744726 | 746417 | 748101 | 749777 | 751447 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.736187 | 9.737915 | 9.739636 | 9.741350 | 9.743056 | 9.744754 | 9.746445 | 9.748129 | 9.749805 | 9.751474 | 28 |
| 33 | 15 736216 | 737944 | 739665 | 741378 | 743084 | 744783 | 746473 | 748157 | 749833 | 751502 | 27 |
| 34 | 30 736245 | 737973 | 739694 | 741407 | 743113 | 744811 | 746502 | 748185 | 749861 | 751530 | 26 |
| 35 | 45 736273 | 738001 | 739722 | 741435 | 743141 | 744839 | 746530 | 748213 | 749889 | 751558 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.736302 | 9.738030 | 9.739751 | 9.741464 | 9.743169 | 9.744867 | 9.746559 | 9.748241 | 9.749917 | 9.751585 | 24 |
| 37 | 15 736331 | 738059 | 739779 | 741492 | 743198 | 744895 | 746586 | 748269 | 749945 | 751613 | 23 |
| 38 | 30 736360 | 738088 | 739808 | 741521 | 743226 | 744924 | 746614 | 748297 | 749973 | 751641 | 22 |
| 39 | 45 736389 | 738116 | 739837 | 741549 | 743254 | 744952 | 746642 | 748325 | 750000 | 751668 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.736418 | 9.738145 | 9.739865 | 9.741578 | 9.743283 | 9.744980 | 9.746670 | 9.748353 | 9.750028 | 9.751696 | 20 |
| 41 | 15 736446 | 738174 | 739894 | 741606 | 743311 | 745008 | 746698 | 748381 | 750056 | 751724 | 19 |
| 42 | 30 736475 | 738203 | 739922 | 741635 | 743339 | 745037 | 746727 | 748409 | 750084 | 751752 | 18 |
| 43 | 45 736504 | 738231 | 739951 | 741663 | 743368 | 745065 | 746755 | 748437 | 750112 | 751779 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9 736533 | 9.738260 | 9.739980 | 9.741692 | 9.743396 | 9.745093 | 9.746783 | 9.748465 | 9.750140 | 9.751807 | 16 |
| 45 | 15 736562 | 738289 | 740008 | 741720 | 743424 | 745121 | 746811 | 748493 | 750168 | 751835 | 15 |
| 46 | 30 736591 | 738318 | 740037 | 741749 | 743453 | 745150 | 746839 | 748521 | 750195 | 751863 | 14 |
| 47 | 45 736620 | 738346 | 740065 | 741777 | 743481 | 745178 | 746867 | 748549 | 750223 | 751890 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.736648 | 9.738375 | 9.740094 | 9.741806 | 9.743510 | 9.745206 | 9.746895 | 9.748577 | 9 750251 | 9.751918 | 12 |
| 49 | 15 736677 | 738404 | 740123 | 741834 | 743538 | 745234 | 746923 | 748605 | 750279 | 751946 | 11 |
| 50 | 30 736706 | 738432 | 740151 | 741862 | 743566 | 745262 | 746951 | 748633 | 750307 | 751974 | 10 |
| 51 | 45 736735 | 738461 | 740180 | 741891 | 743595 | 745291 | 746979 | 748661 | 750335 | 752001 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.736764 | 9.738490 | 9.740208 | 9.741919 | 9.743623 | 9.745319 | 9.747007 | 9.748689 | 9.750363 | 9.752029 | 8 |
| 53 | 15 736793 | 738518 | 740237 | 741948 | 743651 | 745347 | 747035 | 748717 | 750390 | 752057 | 7 |
| 54 | 30 736821 | 738547 | 740266 | 741976 | 743680 | 745375 | 747064 | 748745 | 750418 | 752084 | 6 |
| 55 | 45 736850 | 738576 | 740294 | 742005 | 743708 | 745403 | 747092 | 748773 | 750446 | 752112 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.736879 | 9.738605 | 9.740323 | 9.742033 | 9.743736 | 9.745432 | 9.747120 | 9.748801 | 9.750474 | 9.752140 | 4 |
| 57 | 15 736908 | 738633 | 740351 | 742061 | 743764 | 745460 | 747148 | 748828 | 750502 | 752167 | 3 |
| 58 | 30 736937 | 738662 | 740380 | 742090 | 743793 | 745488 | 747176 | 748856 | 750529 | 752195 | 2 |
| 59 | 45 736965 | 738691 | 740408 | 742118 | 743821 | 745516 | 747204 | 748884 | 750557 | 752223 | 1 |
| 60 | 60 9.736994 | 9 738719 | 9.740437 | 9.742147 | 9.743849 | 9.745544 | 9.747232 | 9 748912 | 9.750585 | 9.752251 | 0 |
| sec. | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | |

| | | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | deg. | 103 deg. | | | | 104 deg. | | | | |
| | | | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | sec. |
| | | 5578 | 9.787089 | 9.788593 | 9.790090 | 9.791580 | 9.793064 | 9.794541 | 9.796012 | 9.797476 | 60 |
| | | 03 | 787114 | 788618 | 790115 | 791605 | 793089 | 794566 | 796036 | 797500 | 59 |
| | | 9 | 787139 | 788643 | 790140 | 791630 | 793114 | 794591 | 796061 | 797525 | 58 |
| | | | 787164 | 788668 | 790165 | 791655 | 793138 | 794615 | 796085 | 797549 | 57 |
| | | | | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| | | | 7189 | 9.788693 | 9.790189 | 9.791680 | 9.793163 | 9.794640 | 9.796110 | 9.797573 | 56 |
| | | | 14 | 788718 | 790214 | 791704 | 793188 | 794664 | 796134 | 797598 | 55 |
| | | | 9 | 788743 | 790239 | 791729 | 793212 | 794689 | 796159 | 797622 | 54 |
| | | | | 788768 | 790264 | 791754 | 793237 | 794713 | 796183 | 797646 | 53 |
| | | | | | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| | | | | .788793 | 9.790289 | 9.791779 | 9.793262 | 9.794738 | 9.796208 | 9.797671 | 52 |
| | | | | 788818 | 790314 | 791803 | 793286 | 794762 | 796232 | 797695 | 51 |
| | | | 340 | 788843 | 790339 | 791828 | 793311 | 794787 | 796256 | 797719 | 50 |
| | | | 87365 | 788868 | 790364 | 791853 | 793336 | 794812 | 796281 | 797744 | 49 |
| | | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| | | | 9.787390 | 9.788893 | 9.790389 | 9.791878 | 9.793360 | 9.794836 | 9.796305 | 797768 | 48 |
| | | | 306 | 787415 | 788918 | 790413 | 791902 | 793385 | 794861 | 796330 | 797792 | 47 |
| | | | 35931 | 787440 | 788943 | 790438 | 791927 | 793410 | 794885 | 796354 | 797817 | 46 |
| | | | 785956 | 787465 | 788968 | 790463 | 791952 | 793434 | 794910 | 796379 | 797849 | 45 |
| | | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | | |
| | | 466 | 9.785982 | 9.787490 | 9.788993 | 9.790488 | 9.791977 | 9.793459 | 9.794934 | 9.796403 | 9.797865 | 44 |
| | | 84491 | 786007 | 787515 | 789018 | 790513 | 792001 | 793483 | 794959 | 796427 | 797890 | 43 |
| | | 784517 | 786032 | 787541 | 789043 | 790538 | 792026 | 793508 | 794983 | 796452 | 797914 | 42 |
| | 0 | 784542 | 786057 | 787566 | 789067 | 790563 | 792051 | 793533 | 795008 | 796476 | 797938 | 41 |
| | | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 0 | 0 | 9.784567 | 9.786082 | 9.787591 | 9.789093 | 9.790588 | 9.792076 | 9.793557 | 9.795032 | 9.796501 | 9.797962 | 40 |
| 1 | 15 | 784592 | 786107 | 787616 | 789117 | 790612 | 792100 | 793582 | 795057 | 796525 | 797987 | 39 |
| 2 | 30 | 784618 | 786133 | 787641 | 789142 | 790637 | 792125 | 793607 | 795081 | 796550 | 798011 | 38 |
| 3 | 45 | 784643 | 786158 | 787666 | 789167 | 790662 | 792150 | 793631 | 795106 | 796574 | 798035 | 37 |
| | | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 4 | 0 | 9.784668 | 9.786183 | 9.787691 | 9.789192 | 9.790687 | 9.792175 | 9.793656 | 9.795130 | 9.796598 | 9.798060 | 36 |
| 5 | 15 | 784694 | 786208 | 787716 | 789217 | 790712 | 792199 | 793681 | 795155 | 796623 | 798084 | 35 |
| 6 | 30 | 784719 | 786234 | 787741 | 789242 | 790737 | 792224 | 793705 | 795180 | 796647 | 798108 | 34 |
| 7 | 45 | 784744 | 786259 | 787766 | 789267 | 790761 | 792249 | 793730 | 795204 | 796672 | 798133 | 33 |
| | | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 8 | 0 | 9.784770 | 9.786284 | 9.787791 | 9.789292 | 9.790786 | 9.792274 | 9.793754 | 9.795229 | 9.796696 | 9.798157 | 32 |
| 9 | 15 | 784795 | 786309 | 787816 | 789317 | 790811 | 792298 | 793779 | 795253 | 796720 | 798181 | 31 |
| 0 | 30 | 784820 | 786334 | 787842 | 789342 | 790836 | 792323 | 793804 | 795278 | 796745 | 798205 | 30 |
| 1 | 45 | 784845 | 786359 | 787867 | 789367 | 790861 | 792348 | 793828 | 795302 | 796769 | 798230 | 29 |
| | | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 2 | 0 | 9.784871 | 9.786385 | 9.787892 | 9.789392 | 9.790886 | 9.792373 | 9.793853 | 9.795327 | 9.796794 | 9.798254 | 28 |
| 3 | 15 | 784896 | 786410 | 787917 | 789417 | 790911 | 792397 | 793878 | 795351 | 796818 | 798278 | 27 |
| 4 | 30 | 784921 | 786435 | 787942 | 789442 | 790935 | 792422 | 793902 | 795376 | 796842 | 798303 | 26 |
| 5 | 45 | 784946 | 786460 | 787967 | 789467 | 790960 | 792447 | 793927 | 795400 | 796867 | 798327 | 25 |
| | | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 6 | 0 | 9.784972 | 9.786485 | 9.787992 | 9.789492 | 9.790985 | 9.792472 | 9.793951 | 9.795425 | 9.796891 | 9.798351 | 24 |
| 7 | 15 | 784997 | 786510 | 788017 | 789517 | 791010 | 792496 | 793976 | 795449 | 796916 | 798375 | 23 |
| 8 | 30 | 785022 | 786536 | 788042 | 789542 | 791035 | 792521 | 794001 | 795474 | 796940 | 798400 | 22 |
| 9 | 45 | 785048 | 786561 | 788067 | 789567 | 791059 | 792546 | 794025 | 795498 | 796964 | 798424 | 21 |
| | | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 0 | 0 | 9.785073 | 9.786586 | 9.788092 | 9.789592 | 9.791084 | 9.792570 | 9.794050 | 9.795523 | 9.796989 | 9.798448 | 20 |
| 1 | 15 | 785098 | 786611 | 788117 | 789617 | 791109 | 792595 | 794074 | 795547 | 797013 | 798473 | 19 |
| 2 | 30 | 785124 | 786636 | 788142 | 789641 | 791134 | 792620 | 794099 | 795572 | 797037 | 798497 | 18 |
| 3 | 45 | 785149 | 786661 | 788167 | 789666 | 791159 | 792644 | 794124 | 795596 | 797062 | 798521 | 17 |
| | | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 4 | 0 | 9.785174 | 9.786687 | 9.788192 | 9.789691 | 9.791184 | 9.792669 | 9.794148 | 9.795621 | 9.797086 | 9.798545 | 16 |
| 5 | 15 | 785199 | 786712 | 788217 | 789716 | 791209 | 792694 | 794173 | 795645 | 797111 | 798570 | 15 |
| 6 | 30 | 785225 | 786737 | 788242 | 789741 | 791233 | 792719 | 794197 | 795669 | 797135 | 798594 | 14 |
| 7 | 45 | 785250 | 786762 | 788267 | 789766 | 791258 | 792743 | 794222 | 795694 | 797159 | 798618 | 13 |
| | | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 8 | 0 | 9.785275 | 9.786787 | 9.788292 | 9.789791 | 9.791283 | 9.792768 | 9.794247 | 9.795718 | 9.797184 | 9.798642 | 12 |
| 9 | 15 | 785300 | 786812 | 788317 | 789816 | 791308 | 792793 | 794271 | 795743 | 797208 | 798667 | 11 |
| 0 | 30 | 785326 | 786837 | 788343 | 789841 | 791332 | 792817 | 794296 | 795767 | 797232 | 798691 | 10 |
| 1 | 45 | 785351 | 782862 | 788367 | 789866 | 791357 | 792842 | 794320 | 795792 | 797257 | 798715 | 9 |
| | | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 2 | 0 | 9.785376 | 9.786888 | 9.788393 | 9.789891 | 9.791382 | 9.792867 | 9.794345 | 9.795816 | 9.797281 | 9.798739 | 8 |
| 3 | 15 | 785401 | 786913 | 788418 | 789916 | 791407 | 792891 | 794369 | 795841 | 797305 | 798764 | 7 |
| 4 | 30 | 785427 | 786938 | 788443 | 789941 | 791432 | 792916 | 794394 | 795865 | 797330 | 798788 | 6 |
| 5 | 45 | 785452 | 786963 | 788468 | 789965 | 791456 | 792941 | 794419 | 795890 | 797354 | 798812 | 5 |
| | | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 6 | 0 | 9.785477 | 9.786989 | 9.788493 | 9.789990 | 9.791481 | 9.792966 | 9.794443 | 9.795914 | 9.797379 | 9.798836 | 4 |
| 7 | 15 | 785502 | 787013 | 788518 | 790015 | 791506 | 792980 | 794468 | 795939 | 797403 | 798861 | 3 |
| 8 | 30 | 785528 | 787038 | 788543 | 790040 | 791531 | 793015 | 794492 | 795963 | 797427 | 798885 | 2 |
| | | | | | | | | | | | | 1 |

| | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 100 deg. | | | | 101 deg. | | | | 102 deg. | |
| sec. | ′ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 9.768508 | 9.770094 | 9.771674 | 9.773247 | 9.774812 | 9.776371 | 9.777922 | 9.779467 | 9.781005 | 9.782536 |
| 1 | 15 768534 | 770121 | 771700 | 773273 | 774838 | 776397 | 777948 | 779493 | 781031 | 782562 |
| 2 | 30 768561 | 770147 | 771727 | 773299 | 774864 | 776423 | 777974 | 779519 | 781056 | 782587 |
| 3 | 45 768587 | 770174 | 771753 | 773325 | 774890 | 776448 | 778000 | 779544 | 781082 | 782613 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ |
| 4 | 0 9.768614 | 9.770200 | 9.771779 | 9.773351 | 9.774916 | 9.776474 | 9.778026 | 9.779570 | 9.781107 | 9.782638 |
| 5 | 15 768640 | 770226 | 771805 | 773377 | 774942 | 776500 | 778051 | 779596 | 781133 | 782663 |
| 6 | 30 768667 | 770253 | 771832 | 773403 | 774968 | 776526 | 778077 | 779621 | 781159 | 782689 |
| 7 | 45 768693 | 770279 | 771858 | 773429 | 774994 | 776552 | 778103 | 779647 | 781184 | 782715 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ |
| 8 | 0 9.768720 | 9.770305 | 9.771884 | 9.773456 | 9.775020 | 9.776578 | 9.778129 | 9.779673 | 9.781210 | 9.782740 |
| 9 | 15 768746 | 770332 | 771910 | 773482 | 775046 | 776604 | 778155 | 779698 | 781235 | 782765 |
| 10 | 30 768773 | 770358 | 771937 | 773508 | 775072 | 776629 | 778180 | 779724 | 781261 | 782791 |
| 11 | 45 768799 | 770385 | 771963 | 773534 | 775098 | 776656 | 778206 | 779750 | 781286 | 782816 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 9.768826 | 9.770411 | 9.771989 | 9.773560 | 9.775124 | 9.776682 | 9.778232 | 9.779775 | 9.781312 | 9.782842 |
| 13 | 15 768852 | 770437 | 772015 | 773586 | 775150 | 776707 | 778258 | 779801 | 781337 | 782867 |
| 14 | 30 768879 | 770464 | 772042 | 773612 | 775176 | 776733 | 778284 | 779827 | 781363 | 782893 |
| 15 | 45 768905 | 770490 | 772068 | 773639 | 775202 | 776759 | 778309 | 779852 | 781389 | 782919 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 9.768932 | 9.770516 | 9.772094 | 9.773665 | 9.775228 | 9.776785 | 9.778335 | 9.779878 | 9.781414 | 9.782944 |
| 17 | 15 768958 | 770543 | 772120 | 773691 | 775254 | 776811 | 778361 | 779904 | 781440 | 782969 |
| 18 | 30 768985 | 770569 | 772147 | 773717 | 775280 | 776837 | 778387 | 779929 | 781465 | 782994 |
| 19 | 45 769011 | 770595 | 772173 | 773743 | 775306 | 776863 | 778412 | 779955 | 781491 | 783020 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 9.769038 | 9.770622 | 9.772199 | 9.773769 | 9.775332 | 9.776889 | 9.778438 | 9.779981 | 9.781516 | 9.783045 |
| 21 | 15 769064 | 770648 | 772225 | 773795 | 775358 | 776915 | 778464 | 780006 | 781542 | 783071 |
| 22 | 30 769090 | 770674 | 772251 | 773821 | 775384 | 776940 | 778490 | 780032 | 781567 | 783096 |
| 23 | 45 769117 | 770701 | 772277 | 773847 | 775410 | 776966 | 778515 | 780057 | 781593 | 783121 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 9.769143 | 9.770727 | 9.772304 | 9.773874 | 9.775436 | 9.776992 | 9.778541 | 9.780083 | 9.781618 | 9.783147 |
| 25 | 15 769170 | 770753 | 772330 | 773900 | 775462 | 777018 | 778567 | 780109 | 781644 | 783173 |
| 26 | 30 769196 | 770780 | 772356 | 773926 | 775488 | 777044 | 778593 | 780135 | 781670 | 783199 |
| 27 | 45 769223 | 770806 | 772382 | 773952 | 775514 | 777070 | 778618 | 780160 | 781695 | 783224 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 9.769249 | 9.770832 | 9.772409 | 9.773978 | 9.775540 | 9.777096 | 9.778644 | 9.780186 | 9.781721 | 9.783248 |
| 29 | 15 769276 | 770859 | 772435 | 774004 | 775566 | 777122 | 778670 | 780211 | 781746 | 783274 |
| 30 | 30 769302 | 770885 | 772461 | 774030 | 775592 | 777147 | 778696 | 780237 | 781772 | 783299 |
| 31 | 45 769328 | 770911 | 772487 | 774056 | 775618 | 777173 | 778721 | 780263 | 781797 | 783325 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 9.769355 | 9.770938 | 9.772514 | 9.774082 | 9.775644 | 9.777199 | 9.778747 | 9.780288 | 9.781823 | 9.783350 |
| 33 | 15 769381 | 770964 | 772540 | 774108 | 775670 | 777225 | 778773 | 780314 | 781848 | 783377 |
| 34 | 30 769408 | 770990 | 772566 | 774135 | 775696 | 777251 | 778799 | 780340 | 781874 | 783401 |
| 35 | 45 769434 | 771017 | 772592 | 774161 | 775722 | 777277 | 778824 | 780365 | 781899 | 783426 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ |
| 36 | 0 9.769461 | 9.771043 | 9.772618 | 9.774187 | 9.775748 | 9.777303 | 9.778850 | 9.780391 | 9.781925 | 9.783452 |
| 37 | 15 769487 | 771069 | 772645 | 774213 | 775774 | 777328 | 778876 | 780416 | 781950 | 783477 |
| 38 | 30 769514 | 771096 | 772671 | 774239 | 775800 | 777354 | 778902 | 780442 | 781976 | 783503 |
| 39 | 45 769540 | 771122 | 772697 | 774265 | 775826 | 777380 | 778927 | 780468 | 782001 | 783528 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ |
| 40 | 0 9.769566 | 9.771148 | 9.772723 | 9.774291 | 9.775852 | 9.777406 | 9.778953 | 9.780493 | 9.782027 | 9.783553 |
| 41 | 15 769593 | 771174 | 772749 | 774317 | 775878 | 777432 | 778979 | 780519 | 782052 | 783579 |
| 42 | 30 769619 | 771201 | 772776 | 774343 | 775904 | 777458 | 779005 | 780545 | 782078 | 783604 |
| 43 | 45 769646 | 771227 | 772802 | 774369 | 775930 | 777483 | 779030 | 780570 | 782103 | 783629 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 9.769672 | 9.771253 | 9.772828 | 9.774395 | 9.775956 | 9.777509 | 9.779056 | 9.780596 | 9.782129 | 9.783655 |
| 45 | 15 769698 | 771280 | 772854 | 774421 | 775982 | 777535 | 779082 | 780621 | 782154 | 783680 |
| 46 | 30 769725 | 771306 | 772880 | 774447 | 776008 | 777561 | 779107 | 780647 | 782180 | 783706 |
| 47 | 45 769751 | 771332 | 772906 | 774473 | 776034 | 777587 | 779133 | 780672 | 782205 | 783731 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 9.769778 | 9.771359 | 9.772933 | 9.774500 | 9.776060 | 9.777613 | 9.779159 | 9.780698 | 9.782231 | 9.783756 |
| 49 | 15 769804 | 771385 | 772959 | 774526 | 776085 | 777638 | 779185 | 780724 | 782256 | 783782 |
| 50 | 30 769831 | 771411 | 772985 | 774551 | 776111 | 777664 | 779210 | 780749 | 782282 | 783807 |
| 51 | 45 769857 | 771437 | 773011 | 774578 | 776137 | 777690 | 779236 | 780775 | 782307 | 783832 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 9.769883 | 9.771464 | 9.773037 | 9.774604 | 9.776163 | 9.777716 | 9.779262 | 9.780801 | 9.782333 | 9.783858 |
| 53 | 15 769910 | 771490 | 773063 | 774630 | 776189 | 777742 | 779287 | 780826 | 782358 | 783883 |
| 54 | 30 769936 | 771516 | 773090 | 774656 | 776215 | 777768 | 779313 | 780852 | 782383 | 783908 |
| 55 | 45 769962 | 771543 | 773116 | 774682 | 776241 | 777793 | 779339 | 780877 | 782409 | 783934 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 9.769989 | 9.771569 | 9.773142 | 9.774708 | 9.776267 | 9.777819 | 9.779364 | 9.780903 | 9.782434 | 9.783959 |
| 57 | 15 770015 | 771595 | 773168 | 774734 | 776293 | 777845 | 779390 | 780928 | 782460 | 783984 |
| 58 | 30 770042 | 771621 | 773194 | 774760 | 776319 | 777871 | 779416 | 780954 | 782485 | 784010 |
| 59 | 45 770068 | 771648 | 773220 | 774786 | 776345 | 777897 | 779441 | 780980 | 782511 | 784035 |
| 60 | 60 9.770094 | 9.771674 | 9.773247 | 9.774812 | 9.776371 | 9.777922 | 9.779467 | 9.781005 | 9.782536 | 9.784061 |
| sec. | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 102 deg. | | 103 deg. | | | | 104 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.784061 | 9.785578 | 9.787089 | 9.788593 | 9.790090 | 9.791580 | 9.793064 | 9.794541 | 9.796012 | 9.797476 | 60 |
| 1 | 15 784096 | 785603 | 787114 | 788618 | 790115 | 791605 | 793089 | 794566 | 796036 | 797500 | 59 |
| 2 | 30 784111 | 785629 | 787139 | 788643 | 790140 | 791630 | 793114 | 794591 | 796061 | 797525 | 58 |
| 3 | 45 784137 | 785654 | 787164 | 788668 | 790165 | 791655 | 793138 | 794615 | 796085 | 797549 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.784162 | 9.785679 | 9.787189 | 9.788693 | 9.790189 | 9.791680 | 9.793163 | 9.794640 | 9.796110 | 9.797573 | 56 |
| 5 | 15 784187 | 785704 | 787214 | 788718 | 790214 | 791704 | 793188 | 794664 | 796134 | 797598 | 55 |
| 6 | 30 784213 | 785729 | 787239 | 788743 | 790239 | 791729 | 793212 | 794689 | 796159 | 797622 | 54 |
| 7 | 45 784238 | 785755 | 787264 | 788768 | 790264 | 791754 | 793237 | 794713 | 796183 | 797646 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.784263 | 9.785780 | 9.787290 | 9.788793 | 9.790289 | 9.791779 | 9.793262 | 9.794738 | 9.796208 | 9.797671 | 52 |
| 9 | 15 784289 | 785805 | 787315 | 788818 | 790314 | 791803 | 793286 | 794762 | 796232 | 797695 | 51 |
| 10 | 30 784314 | 785830 | 787340 | 788843 | 790339 | 791828 | 793311 | 794787 | 796256 | 797719 | 50 |
| 11 | 45 784339 | 785855 | 787365 | 788868 | 790364 | 791853 | 793336 | 794812 | 796281 | 797744 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.784365 | 9.785881 | 9.787390 | 9.788893 | 9.790389 | 9.791878 | 9.793360 | 9.794836 | 9.796305 | 797768 | 48 |
| 13 | 15 784390 | 785906 | 787415 | 788918 | 790413 | 791902 | 793385 | 794861 | 796330 | 797792 | 47 |
| 14 | 30 784415 | 785931 | 787440 | 788943 | 790438 | 791927 | 793410 | 794885 | 796354 | 797817 | 46 |
| 15 | 45 784440 | 785956 | 787465 | 788968 | 790463 | 791952 | 793434 | 794910 | 796379 | 797849 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.784466 | 9.785982 | 9.787490 | 9.788993 | 9.790488 | 9.791977 | 9.793459 | 9.794934 | 9.796403 | 9.797865 | 44 |
| 17 | 15 784491 | 786007 | 787515 | 789018 | 790513 | 792001 | 793483 | 794959 | 796427 | 797890 | 43 |
| 18 | 30 784517 | 786032 | 787541 | 789043 | 790538 | 792026 | 793508 | 794983 | 796452 | 797914 | 42 |
| 19 | 45 784542 | 786057 | 787566 | 789067 | 790563 | 792051 | 793533 | 795008 | 796476 | 797938 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.784567 | 9.786082 | 9.787591 | 9.789093 | 9.790588 | 9.792076 | 9.793557 | 9.795032 | 9.796501 | 9.797962 | 40 |
| 21 | 15 784592 | 786107 | 787616 | 789117 | 790612 | 792100 | 793582 | 795057 | 796525 | 797987 | 39 |
| 22 | 30 784618 | 786133 | 787641 | 789142 | 790637 | 792125 | 793607 | 795081 | 796550 | 798011 | 38 |
| 23 | 45 784643 | 786158 | 787666 | 789167 | 790662 | 792150 | 793631 | 795106 | 796574 | 798035 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.784668 | 9.786183 | 9.787691 | 9.789192 | 9.790687 | 9.792175 | 9.793656 | 9.795130 | 9.796598 | 9.798060 | 36 |
| 25 | 15 784694 | 786208 | 787716 | 789217 | 790712 | 792199 | 793681 | 795155 | 796623 | 798084 | 35 |
| 26 | 30 784719 | 786234 | 787741 | 789242 | 790737 | 792224 | 793705 | 795180 | 796647 | 798108 | 34 |
| 27 | 45 784744 | 786259 | 787766 | 789267 | 790761 | 792249 | 793730 | 795204 | 796672 | 798133 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.784770 | 9.786284 | 9.787791 | 9.789292 | 9.790786 | 9.792274 | 9.793754 | 9.795229 | 9.796696 | 9.798157 | 32 |
| 29 | 15 784795 | 786309 | 787816 | 789317 | 790811 | 792298 | 793779 | 795253 | 796720 | 798181 | 31 |
| 30 | 30 784820 | 786334 | 787842 | 789342 | 790836 | 792323 | 793804 | 795278 | 796745 | 798205 | 30 |
| 31 | 45 784845 | 786359 | 787867 | 789367 | 790861 | 792348 | 793828 | 795302 | 796769 | 798230 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.784871 | 9.786385 | 9.787892 | 9.789392 | 9.790886 | 9.792373 | 9.793853 | 9.795327 | 9.796794 | 9.798254 | 28 |
| 33 | 15 784896 | 786410 | 787917 | 789417 | 790911 | 792397 | 793878 | 795351 | 796818 | 798278 | 27 |
| 34 | 30 784921 | 786435 | 787942 | 789442 | 790935 | 792422 | 793902 | 795376 | 796842 | 798303 | 26 |
| 35 | 45 784946 | 786460 | 787967 | 789467 | 790960 | 792447 | 793927 | 795400 | 796867 | 798327 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.784972 | 9.786485 | 9.787992 | 9.789492 | 9.790985 | 9.792472 | 9.793951 | 9.795425 | 9.796891 | 9.798351 | 24 |
| 37 | 15 784997 | 786510 | 788017 | 789517 | 791010 | 792496 | 793976 | 795449 | 796916 | 798375 | 23 |
| 38 | 30 785022 | 786536 | 788042 | 789542 | 791035 | 792521 | 794001 | 795474 | 796940 | 798400 | 22 |
| 39 | 45 785048 | 786561 | 788067 | 789567 | 791059 | 792546 | 794025 | 795498 | 796964 | 798424 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.785073 | 9.786586 | 9.788092 | 9.789592 | 9.791084 | 9.792570 | 9.794050 | 9.795523 | 9.796989 | 9.798448 | 20 |
| 41 | 15 785098 | 786611 | 788117 | 789617 | 791109 | 792595 | 794074 | 795547 | 797013 | 798473 | 19 |
| 42 | 30 785124 | 786636 | 788142 | 789641 | 791134 | 792620 | 794099 | 795572 | 797037 | 798497 | 18 |
| 43 | 45 785149 | 786661 | 788167 | 789666 | 791159 | 792644 | 794124 | 795596 | 797062 | 798521 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.785174 | 9.786687 | 9.788192 | 9.789691 | 9.791184 | 9.792669 | 9.794148 | 9.795621 | 9.797086 | 9.798545 | 16 |
| 45 | 15 785199 | 786712 | 788217 | 789716 | 791209 | 792694 | 794173 | 795645 | 797111 | 798570 | 15 |
| 46 | 30 785225 | 786737 | 788242 | 789741 | 791233 | 792719 | 794197 | 795669 | 797135 | 798594 | 14 |
| 47 | 45 785250 | 786762 | 788267 | 789766 | 791258 | 792743 | 794222 | 795694 | 797159 | 798618 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.785275 | 9.786787 | 9.788292 | 9.789791 | 9.791283 | 9.792768 | 9.794247 | 9.795718 | 9.797184 | 9.798642 | 12 |
| 49 | 15 785300 | 786812 | 788317 | 789816 | 791308 | 792793 | 794271 | 795743 | 797208 | 798667 | 11 |
| 50 | 30 785326 | 786837 | 788343 | 789841 | 791332 | 792817 | 794296 | 795767 | 797232 | 798691 | 10 |
| 51 | 45 785351 | 782862 | 788367 | 789866 | 791357 | 792842 | 794320 | 795792 | 797257 | 798715 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.785376 | 9.786888 | 9.788393 | 9.789891 | 9.791382 | 9.792867 | 9.794345 | 9.795816 | 9.797281 | 9.798739 | 8 |
| 53 | 15 785401 | 786913 | 788418 | 789916 | 791407 | 792891 | 794369 | 795841 | 797305 | 798764 | 7 |
| 54 | 30 785427 | 786938 | 788443 | 789941 | 791432 | 792916 | 794394 | 795865 | 797330 | 798788 | 6 |
| 55 | 45 785452 | 786963 | 788468 | 789965 | 791456 | 792941 | 794419 | 795890 | 797354 | 798812 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.785477 | 9.786988 | 9.788493 | 9.789990 | 9.791481 | 9.792966 | 9.794443 | 9.795914 | 9.797379 | 9.798836 | 4 |
| 57 | 15 785502 | 787013 | 788518 | 790015 | 791506 | 792980 | 794468 | 795939 | 797403 | 798861 | 3 |
| 58 | 30 785528 | 787038 | 788543 | 790040 | 791531 | 793015 | 794492 | 795963 | 797427 | 798885 | 2 |
| 59 | 45 785553 | 787064 | 788568 | 790065 | 791556 | 793040 | 794517 | 795988 | 797452 | 798909 | 1 |
| 60 | 0 9.785578 | 9.787089 | 9.788593 | 9.790090 | 9.791580 | 9.793064 | 9.794541 | 9.796012 | 9.797476 | 9.798933 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| sec. | 105 deg. | | | | 106 deg. | | | | 107 deg. | | sec. |
| 0 | 0 0′ 9.798933 | 0 15′ 9.800384 | 0 30′ 9.801828 | 0 45′ 9.803266 | 1 0′ 9.804697 | 1 15′ 9.806122 | 1 30′ 9.807540 | 1 45′ 9.806952 | 2 0′ 9.810357 | 2 15′ 9.811756 | 60 |
| 1 | 15 798958 | 800408 | 801852 | 803290 | 804721 | 806146 | 807564 | 808975 | 810381 | 811780 | 59 |
| 2 | 30 798982 | 800432 | 801876 | 803314 | 804745 | 806169 | 807587 | 808999 | 810404 | 811803 | 58 |
| 3 | 45 799006 | 800456 | 801900 | 803338 | 804769 | 806193 | 807611 | 809022 | 810428 | 811826 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.799030 | 9.800481 | 9.801924 | 9.803362 | 9.804792 | 9.806217 | 9.807635 | 9.809046 | 9.810451 | 9.811849 | 56 |
| 5 | 15 799054 | 800505 | 801948 | 803386 | 804816 | 806240 | 807658 | 809069 | 810474 | 811873 | 55 |
| 6 | 30 799079 | 800529 | 801972 | 803409 | 804840 | 806264 | 807682 | 809093 | 810498 | 811896 | 54 |
| 7 | 45 799103 | 800553 | 801996 | 803433 | 804864 | 806288 | 807705 | 809116 | 810521 | 811919 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.799127 | 9.800577 | 9.802020 | 9.803457 | 9.804888 | 9.806311 | 9.807729 | 9.809140 | 9.810544 | 9.811943 | 52 |
| 9 | 15 799151 | 800601 | 802044 | 803481 | 804911 | 806335 | 807752 | 809163 | 810568 | 811966 | 51 |
| 10 | 30 799176 | 800625 | 802068 | 803505 | 804935 | 806359 | 807776 | 809187 | 810591 | 811989 | 50 |
| 11 | 45 799200 | 800649 | 802092 | 803529 | 804959 | 806382 | 807800 | 809210 | 810614 | 812012 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.799224 | 9.800673 | 9.802116 | 9.803553 | 9.804983 | 9.806406 | 9.807823 | 9.809234 | 9.810638 | 9.812035 | 48 |
| 13 | 15 799248 | 800698 | 802140 | 803577 | 805006 | 806430 | 807847 | 809257 | 810661 | 812059 | 47 |
| 14 | 30 799272 | 800722 | 802164 | 803601 | 805030 | 806453 | 807870 | 809281 | 810684 | 812082 | 46 |
| 15 | 45 799297 | 800746 | 802188 | 803624 | 805054 | 806477 | 807894 | 809304 | 810708 | 812105 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.799321 | 9.800770 | 9.802212 | 9.803648 | 9.805078 | 9.806501 | 9.807917 | 9.809327 | 9.810731 | 9.812128 | 44 |
| 17 | 15 799345 | 800794 | 802236 | 803672 | 805102 | 806524 | 807941 | 809351 | 810755 | 812152 | 43 |
| 18 | 30 799369 | 800818 | 802260 | 803696 | 805125 | 806548 | 807964 | 809374 | 810778 | 812175 | 42 |
| 19 | 45 799393 | 800842 | 802284 | 803720 | 805149 | 806572 | 807988 | 809398 | 810801 | 812198 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.799418 | 9.800866 | 9.802308 | 9.803744 | 9.805173 | 9.806595 | 9.808012 | 9.809421 | 9.810824 | 9.812221 | 40 |
| 21 | 15 799442 | 800890 | 802332 | 803768 | 805197 | 806619 | 808035 | 809445 | 810848 | 812245 | 39 |
| 22 | 30 799466 | 800914 | 802356 | 803792 | 805220 | 806643 | 808059 | 809468 | 810871 | 812268 | 38 |
| 23 | 45 799490 | 800938 | 802380 | 803815 | 805244 | 806666 | 808082 | 809491 | 810895 | 812291 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.799514 | 9.800963 | 9.802404 | 9.803839 | 9.805268 | 9.805690 | 9.808106 | 9.809515 | 9.810918 | 9.812314 | 36 |
| 25 | 15 799539 | 800987 | 802428 | 803863 | 805292 | 806714 | 808129 | 809538 | 810942 | 812337 | 35 |
| 26 | 30 799563 | 801011 | 802452 | 803887 | 805315 | 806737 | 808153 | 809562 | 810964 | 812361 | 34 |
| 27 | 45 799587 | 801035 | 802476 | 803911 | 805339 | 806761 | 808176 | 809585 | 810988 | 812384 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.799611 | 9.801059 | 9.802500 | 9.803935 | 9.805363 | 9.806785 | 9.808200 | 9.809609 | 9.811011 | 9.812407 | 32 |
| 29 | 15 799635 | 801083 | 802524 | 803959 | 805387 | 806808 | 808223 | 809632 | 811034 | 812430 | 31 |
| 30 | 30 799660 | 801107 | 802548 | 803982 | 805410 | 806832 | 808247 | 809656 | 811058 | 812454 | 30 |
| 31 | 45 799684 | 801131 | 802572 | 804006 | 805434 | 806856 | 808270 | 809679 | 811081 | 8 [illegible] | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.799708 | 9.801155 | 9.802596 | 9.804030 | 9.805458 | 9.806879 | 9.808294 | 9.809702 | 9.811104 | 9.812500 | 28 |
| 33 | 15 799732 | 801179 | 802620 | 804054 | 805482 | 806903 | 808317 | 809726 | 811128 | 812524 | 27 |
| 34 | 30 799756 | 801203 | 802644 | 804078 | 805505 | 806926 | 808341 | 809749 | 811151 | 812547 | 26 |
| 35 | 45 799780 | 801227 | 802668 | 804102 | 805529 | 806949 | 808365 | 809773 | 811174 | 812570 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.799805 | 9.801251 | 9.802692 | 9.804126 | 9.805553 | 9.806974 | 9.808388 | 9.809796 | 9.811198 | 9.812593 | 24 |
| 37 | 15 799829 | 801275 | 802716 | 804150 | 805577 | 806997 | 808412 | 809819 | 811221 | 812616 | 23 |
| 38 | 30 799853 | 801300 | 802740 | 804173 | 805600 | 807021 | 808435 | 809843 | 811244 | 812639 | 22 |
| 39 | 45 799877 | 801324 | 802764 | 804197 | 805624 | 807045 | 808459 | 809866 | 811267 | 812662 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.799901 | 9.801348 | 9.802788 | 9.804221 | 9.805648 | 9.807068 | 9.808482 | 9.809890 | 9.811291 | 9.812686 | 20 |
| 41 | 15 799925 | 801372 | 802811 | 804245 | 805672 | 807092 | 808506 | 809913 | 811314 | 812709 | 19 |
| 42 | 30 799950 | 801396 | 802835 | 804269 | 805695 | 807115 | 808529 | 809936 | 811337 | 812733 | 18 |
| 43 | 45 799974 | 801420 | 802859 | 804292 | 805719 | 807139 | 808553 | 809960 | 811361 | 812755 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.799998 | 9.801444 | 9.802883 | 9.804316 | 9.805743 | 9.807163 | 9.808576 | 9.809983 | 9.811384 | 9.812778 | 16 |
| 45 | 15 800022 | 801468 | 802907 | 804340 | 805766 | 807186 | 808600 | 810007 | 811407 | 812801 | 15 |
| 46 | 30 800046 | 801492 | 802931 | 804364 | 805790 | 807210 | 808623 | 810030 | 811431 | 812825 | 14 |
| 47 | 45 800070 | 801516 | 802955 | 804388 | 805814 | 807233 | 808647 | 810053 | 811454 | 812848 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.800094 | 9.801540 | 9.802979 | 9.804412 | 9.805838 | 9.807257 | 9.808670 | 9.810077 | 9.811477 | 9.812871 | 12 |
| 49 | 15 800119 | 801564 | 803003 | 804435 | 805861 | 807281 | 808694 | 810100 | 811500 | 812894 | 11 |
| 50 | 30 800143 | 801588 | 803027 | 804459 | 805885 | 807304 | 808717 | 810124 | 811524 | 812917 | 10 |
| 51 | 45 800167 | 801612 | 803051 | 804483 | 805909 | 807328 | 808741 | 810147 | 811547 | 812941 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.800191 | 9.801636 | 9.803075 | 9.804507 | 9.805932 | 9.807351 | 9.808764 | 9.810170 | 9.811570 | 9.812964 | 8 |
| 53 | 15 800215 | 801660 | 803099 | 804531 | 805956 | 807375 | 808788 | 810194 | 811594 | 812987 | 7 |
| 54 | 30 800239 | 801684 | 803123 | 804554 | 805980 | 807399 | 808811 | 810217 | 811617 | 813010 | 6 |
| 55 | 45 800263 | 801708 | 803147 | 804578 | 806003 | 807422 | 808835 | 810241 | 811640 | 81303 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.800288 | 9.801732 | 9.803170 | 9.804602 | 9.806027 | 9.807446 | 9.808858 | 9.810264 | 9.811663 | 9.813056 | 4 |
| 57 | 15 800312 | 801756 | 803194 | 804626 | 806051 | 807469 | 808882 | 810287 | 811687 | 813080 | 3 |
| 58 | 30 800336 | 801780 | 803218 | 804650 | 806075 | 807493 | 808905 | 810311 | 811710 | 813103 | 2 |
| 59 | 45 800360 | 801804 | 803242 | 804673 | 806098 | 807517 | 808929 | 810334 | 811733 | 813126 | 1 |
| 60 | 60 9.800384 | 9.801828 | 9.803266 | 9.804697 | 9.806122 | 9.807540 | 9.808952 | 9.810357 | 9.811756 | 9.813149 | 0 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m | sec. |

| sec. | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 107 deg. | | 108 deg. | | | | 109 deg. | | | | |
| | 30' | 45' | 0' | 15' | 30' | 45' | 0' | 15' | 30' | 45 | |
| 0 | 0 9.813149 | 9.814535 | 9.815915 | 9.817289 | 9.818656 | 9.820017 | 9.821372 | 9.822721 | 9.824063 | 9.825399 | 60 |
| 1 | 15 813172 | 814558 | 815938 | 817312 | 818679 | 820040 | 821394 | 822743 | 824085 | 825421 | 59 |
| 2 | 30 813195 | 814581 | 815961 | 817335 | 818702 | 820063 | 821417 | 822765 | 824108 | 825444 | 58 |
| 3 | 45 813218 | 814604 | 815984 | 817357 | 818724 | 820085 | 821440 | 822788 | 824130 | 825466 | 57 |
| | 31' | 46' | 1' | 16' | 31' | 46' | 1' | 16' | 31' | 46' | |
| 4 | 0 9.813242 | 9.814628 | 9.816007 | 9.817380 | 9.818747 | 9.820108 | 9.821462 | 9.822810 | 9.824152 | 9.825488 | 56 |
| 5 | 15 813265 | 814651 | 816030 | 817403 | 818770 | 820130 | 821485 | 822833 | 824174 | 825510 | 55 |
| 6 | 30 813288 | 814674 | 816053 | 817426 | 818793 | 820153 | 821507 | 822855 | 824197 | 825532 | 54 |
| 7 | 45 813311 | 814697 | 816076 | 817449 | 818815 | 820176 | 821530 | 822877 | 824219 | 825554 | 53 |
| | 32' | 47' | 2' | 17' | 32' | 47' | 2' | 17' | 32' | 47' | |
| 8 | 0 9.813334 | 9.814720 | 9.816099 | 9.817472 | 9.818838 | 9.820198 | 9.821552 | 9.822900 | 9.824241 | 9.825577 | 52 |
| 9 | 15 813357 | 814743 | 816122 | 817495 | 818861 | 820221 | 821575 | 822922 | 824264 | 825599 | 51 |
| 10 | 30 813381 | 814766 | 816145 | 817517 | 818884 | 820244 | 821597 | 822945 | 824286 | 825621 | 50 |
| 11 | 45 813404 | 814789 | 816168 | 817540 | 818906 | 820266 | 821620 | 822967 | 824308 | 825643 | 49 |
| | 33' | 48' | 3' | 18' | 33' | 48' | 3' | 18' | 33' | 48' | |
| 12 | 0 9.813427 | 9.814812 | 9.816191 | 9.817563 | 9.818929 | 9.820289 | 9.821642 | 9.822990 | 9.824331 | 9.825666 | 48 |
| 13 | 15 813450 | 814835 | 816214 | 817586 | 818952 | 820311 | 821665 | 823012 | 824353 | 825688 | 47 |
| 14 | 30 813473 | 814858 | 816236 | 817609 | 818974 | 820334 | 821687 | 823034 | 824375 | 825710 | 46 |
| 15 | 45 813496 | 814881 | 816259 | 817631 | 818997 | 820356 | 821710 | 823057 | 824397 | 825732 | 45 |
| | 34' | 49' | 4' | 19' | 34' | 49' | 4' | 19' | 34' | 49' | |
| 16 | 0 9.813519 | 9.814904 | 9.816282 | 9.817654 | 9.819020 | 9.820379 | 9.821732 | 9.823079 | 9.824420 | 9.825754 | 44 |
| 17 | 15 813542 | 814927 | 816305 | 817677 | 819042 | 820402 | 821755 | 823101 | 824442 | 825776 | 43 |
| 18 | 30 813566 | 814950 | 816328 | 817700 | 819065 | 820424 | 821777 | 823124 | 824464 | 825799 | 42 |
| 19 | 45 813589 | 814973 | 816351 | 817723 | 819088 | 820447 | 821800 | 823146 | 824487 | 825821 | 41 |
| | 35' | 50' | 5' | 20' | 35' | 50' | 5' | 20' | 35' | 50' | |
| 20 | 0 9.813612 | 9.814996 | 9.816374 | 9.817745 | 9.819111 | 9.820470 | 9.821822 | 9.823169 | 9.824509 | 9.825843 | 40 |
| 21 | 15 813635 | 815019 | 816397 | 817768 | 819133 | 820492 | 821845 | 823191 | 824531 | 825865 | 39 |
| 22 | 30 813658 | 815042 | 816420 | 817791 | 819156 | 820515 | 821867 | 823214 | 824554 | 825887 | 38 |
| 23 | 45 813681 | 815065 | 816443 | 817814 | 819179 | 820537 | 821890 | 823236 | 824576 | 825910 | 37 |
| | 36' | 51' | 6' | 21' | 36' | 51' | 6' | 21' | 36' | 51' | |
| 24 | 0 9.813704 | 9.815088 | 9.816465 | 9.817837 | 9.819201 | 9.820560 | 9.821912 | 9.823258 | 9.824598 | 9.825932 | 36 |
| 25 | 15 813727 | 815111 | 816488 | 817859 | 819224 | 820582 | 821935 | 823281 | 824620 | 825954 | 35 |
| 26 | 30 813751 | 815134 | 816511 | 817882 | 819247 | 820605 | 821957 | 823303 | 824643 | 825976 | 34 |
| 27 | 45 813774 | 815157 | 816534 | 817905 | 819270 | 820628 | 821980 | 823325 | 824665 | 825998 | 33 |
| | 37' | 52' | 7' | 22' | 37' | 52' | 7' | 22' | 37' | 52' | |
| 28 | 0 9.813797 | 9.815180 | 9.816557 | 9.817928 | 9.819292 | 9.820650 | 9.822002 | 9.823348 | 9.824687 | 9.826020 | 32 |
| 29 | 15 813820 | 815203 | 816580 | 817950 | 819315 | 820673 | 822025 | 823370 | 824710 | 826043 | 31 |
| 30 | 30 813843 | 815226 | 816603 | 817973 | 819338 | 820695 | 822047 | 823393 | 824732 | 826065 | 30 |
| 31 | 45 813866 | 815249 | 816626 | 817996 | 819360 | 820718 | 822070 | 823415 | 824754 | 826087 | 29 |
| | 38' | 53' | 8' | 23' | 38' | 53' | 8' | 23' | 38' | 53' | |
| 32 | 0 9.813889 | 9.815272 | 9.816649 | 9.818019 | 9.819383 | 9.820741 | 9.822092 | 9.823437 | 9.824776 | 9.826109 | 28 |
| 33 | 15 813912 | 815295 | 816671 | 818042 | 819405 | 820763 | 822115 | 823460 | 824799 | 826131 | 27 |
| 34 | 30 813935 | 815318 | 816694 | 818064 | 819428 | 820786 | 822137 | 823482 | 824821 | 826153 | 26 |
| 35 | 45 813958 | 815341 | 816717 | 818087 | 819451 | 820808 | 822159 | 823504 | 824843 | 826176 | 25 |
| | 39' | 54' | 9' | 24' | 39' | 54' | 9' | 24' | 39' | 54' | |
| 36 | 0 9.813982 | 9.815364 | 9.816740 | 9.818110 | 9.819474 | 9.820831 | 9.822182 | 9.823527 | 9.824865 | 9.826198 | 24 |
| 37 | 15 814005 | 815387 | 816763 | 818133 | 819496 | 820853 | 822204 | 823549 | 824888 | 826220 | 23 |
| 38 | 30 814028 | 815410 | 816786 | 818156 | 819519 | 820876 | 822227 | 823571 | 824909 | 826242 | 22 |
| 39 | 45 814051 | 815433 | 816809 | 818178 | 819542 | 820899 | 822249 | 823594 | 824932 | 826264 | 21 |
| | 40' | 55' | 10' | 25' | 40' | 55' | 10' | 25' | 40' | 58' | |
| 40 | 0 9.814074 | 9.815456 | 9.816832 | 9.818201 | 9.819564 | 9.820921 | 9.822272 | 9.823616 | 9.824954 | 9.826286 | 20 |
| 41 | 15 814097 | 815479 | 816855 | 818224 | 819587 | 820944 | 822294 | 823638 | 824977 | 826308 | 19 |
| 42 | 30 814120 | 815502 | 816877 | 818247 | 819609 | 820966 | 822317 | 823661 | 824999 | 826331 | 18 |
| 43 | 45 814143 | 815525 | 816900 | 818269 | 819632 | 820989 | 822339 | 823683 | 825021 | 826353 | 17 |
| | 41' | 56' | 11' | 26' | 41' | 56' | 11' | 26' | 41' | 56' | |
| 44 | 0 9.814166 | 9.815548 | 9.816923 | 9.818292 | 9.819655 | 9.821011 | 9.822362 | 9.823706 | 9.825043 | 9.826375 | 16 |
| 45 | 15 814189 | 815571 | 816946 | 818315 | 819678 | 821034 | 822384 | 823728 | 825066 | 826397 | 15 |
| 46 | 30 814212 | 815594 | 816969 | 818338 | 819700 | 821057 | 822407 | 823750 | 825088 | 826419 | 14 |
| 47 | 45 814235 | 815617 | 816992 | 818360 | 819723 | 821079 | 822429 | 823773 | 825110 | 826441 | 13 |
| | 42' | 57' | 12' | 27' | 42' | 57' | 12' | 27' | 42' | 57' | |
| 48 | 0 9.814259 | 9.815640 | 9.817015 | 9.818383 | 9.819746 | 9.821102 | 9.822451 | 9.823795 | 9.825132 | 9.826464 | 12 |
| 49 | 15 814282 | 815663 | 817037 | 818406 | 819768 | 821124 | 822474 | 823817 | 825155 | 826486 | 11 |
| 50 | 30 814305 | 815686 | 817060 | 818429 | 819791 | 821147 | 822496 | 823840 | 825177 | 826508 | 10 |
| 51 | 45 814328 | 815709 | 817083 | 818451 | 819813 | 821169 | 822519 | 823862 | 825199 | 826530 | 9 |
| | 43' | 58' | 13' | 28' | 43' | 58' | 13' | 28' | 43' | 58' | |
| 52 | 0 9.814351 | 9.815732 | 9.817106 | 9.818474 | 9.819836 | 9.821192 | 9.822541 | 9.823884 | 9.825221 | 9.826552 | 8 |
| 53 | 15 814374 | 815755 | 817129 | 818497 | 819859 | 821214 | 822564 | 823907 | 825243 | 826574 | 7 |
| 54 | 30 814397 | 815778 | 817152 | 818520 | 819881 | 821237 | 822586 | 823929 | 825266 | 826596 | 6 |
| 55 | 45 814420 | 815800 | 817175 | 818542 | 819904 | 821259 | 822608 | 823951 | 825288 | 826618 | 5 |
| | 44' | 59' | 14' | 29' | 44' | 59' | 14' | 29' | 44' | 59' | |
| 56 | 0 9.814443 | 9.815823 | 9.817198 | 9.818565 | 9.819927 | 9.821282 | 9.822631 | 9.823974 | 9.825310 | 9.826641 | 4 |
| 57 | 15 814466 | 815846 | 817221 | 818588 | 819949 | 821304 | 822653 | 823996 | 825332 | 826663 | 3 |
| 58 | 30 814489 | 815869 | 817243 | 818611 | 819972 | 821327 | 822676 | 824018 | 825355 | 826685 | 2 |
| 59 | 45 814512 | 815892 | 817266 | 818633 | 819995 | 821349 | 822698 | 824041 | 825377 | 826707 | 1 |
| 60 | 60 9.814535 | 9.815915 | 9.817289 | 9.818656 | 9.820017 | 9.821372 | 9.822721 | 9.824063 | 9.825399 | 9.826729 | 0 |
| sec. | 49m | 48m | 47m | 46m | 45m | 44m | 43m | 42m | 41m | 40m | sec. |

| sec. | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 110 deg. | | | | 111 deg. | | | | 112 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 9.826729 | 9.828053 | 9.829370 | 9.830682 | 9.831987 | 9.833287 | 9.834580 | 9.835867 | 9.837148 | 9.838424 | 60 |
| 1 | 15 826751 | 828075 | 829392 | 830704 | 832009 | 833308 | 834601 | 835889 | 837170 | 838445 | 59 |
| 2 | 30 826773 | 828097 | 829414 | 830726 | 832031 | 833330 | 834623 | 835910 | 837191 | 838466 | 58 |
| 3 | 45 826795 | 828119 | 829436 | 830747 | 832053 | 833352 | 834645 | 835931 | 837212 | 838487 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 9.826817 | 9.828141 | 9.829458 | 9.830769 | 9.832074 | 9.833373 | 9.834666 | 9.835953 | 9.837234 | 9.838508 | 56 |
| 5 | 15 826840 | 828163 | 829480 | 830791 | 832096 | 833395 | 834687 | 835974 | 837255 | 838530 | 55 |
| 6 | 30 826862 | 828185 | 829502 | 830813 | 832118 | 833416 | 834709 | 835996 | 837276 | 838551 | 54 |
| 7 | 45 826884 | 828207 | 829524 | 830835 | 832139 | 833438 | 834731 | 836017 | 837297 | 838572 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 9.826906 | 9.828229 | 9.829546 | 9.830856 | 9.832161 | 9.833460 | 9.834752 | 9.836038 | 9.837319 | 9.838593 | 52 |
| 9 | 15 826928 | 828251 | 829568 | 830878 | 832183 | 833481 | 834773 | 836060 | 837340 | 838614 | 51 |
| 10 | 30 826950 | 828273 | 829589 | 830900 | 832204 | 833503 | 834795 | 836081 | 837361 | 838636 | 50 |
| 11 | 45 826972 | 828295 | 829611 | 830922 | 832226 | 833524 | 834816 | 836103 | 837383 | 838657 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 9.826994 | 9.828317 | 9.829633 | 9.830944 | 9.832248 | 9.833546 | 9.834839 | 9.836124 | 9.837404 | 9.838678 | 48 |
| 13 | 15 827016 | 828339 | 829655 | 830965 | 832270 | 833567 | 834859 | 836145 | 837425 | 838699 | 47 |
| 14 | 30 827038 | 828361 | 829677 | 830987 | 832291 | 833589 | 834881 | 836167 | 837447 | 838720 | 46 |
| 15 | 45 827060 | 828383 | 829699 | 831009 | 832313 | 833611 | 834902 | 836188 | 837468 | 838741 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 9.827083 | 9.828405 | 9.829721 | 9.831031 | 9.832335 | 9.833632 | 9.834924 | 9.836209 | 9.837489 | 9.838763 | 44 |
| 17 | 15 827105 | 828427 | 829743 | 831052 | 832356 | 833654 | 834945 | 836231 | 837510 | 838784 | 43 |
| 18 | 30 827127 | 828449 | 829765 | 831074 | 832378 | 833675 | 834967 | 836252 | 837532 | 838805 | 42 |
| 19 | 45 827149 | 828471 | 829786 | 831096 | 832400 | 833697 | 834988 | 836274 | 837553 | 838826 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 9.827171 | 9.828493 | 9.829808 | 9.831118 | 9.832421 | 9.833719 | 9.835010 | 9.836295 | 9.837574 | 9.838847 | 40 |
| 21 | 15 827193 | 828515 | 829830 | 831140 | 832443 | 833740 | 835031 | 836316 | 837595 | 838868 | 39 |
| 22 | 30 827215 | 828537 | 829852 | 831161 | 832465 | 833762 | 835053 | 836338 | 837617 | 838890 | 38 |
| 23 | 45 827237 | 828559 | 829874 | 831183 | 832486 | 833783 | 835074 | 836359 | 837638 | 838911 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 9.827259 | 9.828581 | 9.829896 | 9.831205 | 9.832508 | 9.833805 | 9.835096 | 9.836380 | 9.837659 | 9.838932 | 36 |
| 25 | 15 827281 | 828603 | 829918 | 831227 | 832530 | 833826 | 835117 | 836402 | 837680 | 838953 | 35 |
| 26 | 30 827303 | 828625 | 829940 | 831248 | 832551 | 833848 | 835139 | 836423 | 837702 | 838975 | 34 |
| 27 | 45 827325 | 828646 | 829961 | 831270 | 832573 | 833869 | 835160 | 836444 | 837723 | 838995 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 9.827348 | 9.828668 | 9.829983 | 9.831292 | 9.832595 | 9.833891 | 9.835181 | 9.836466 | 9.837744 | 9.839017 | 32 |
| 29 | 15 827370 | 828690 | 830005 | 831314 | 832616 | 833913 | 835203 | 836487 | 837765 | 839038 | 31 |
| 30 | 30 827392 | 828712 | 830027 | 831335 | 832638 | 833934 | 835224 | 836509 | 837787 | 839059 | 30 |
| 31 | 45 827414 | 828734 | 830049 | 831357 | 832659 | 833956 | 835246 | 836530 | 837808 | 839080 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 9.827436 | 9.828756 | 9.830071 | 9.831379 | 9.832681 | 9.833977 | 9.835267 | 9.836551 | 9.837829 | 9.839101 | 28 |
| 33 | 15 827458 | 828778 | 830093 | 831401 | 832703 | 833999 | 835289 | 836573 | 837850 | 839122 | 27 |
| 34 | 30 827480 | 828800 | 830114 | 831422 | 832724 | 834020 | 835310 | 836594 | 837872 | 839144 | 26 |
| 35 | 45 827502 | 828822 | 830136 | 831444 | 832746 | 834042 | 835332 | 836615 | 837893 | 839165 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 9.827524 | 9.828844 | 9.830158 | 9.831466 | 9.832768 | 9.834063 | 9.835353 | 9.836637 | 9.837914 | 9.839186 | 24 |
| 37 | 15 827546 | 828866 | 830180 | 831488 | 832789 | 834085 | 835375 | 836658 | 837935 | 839207 | 23 |
| 38 | 30 827568 | 828888 | 830202 | 831509 | 832811 | 834107 | 835396 | 836679 | 837957 | 839228 | 22 |
| 39 | 45 827590 | 828910 | 830224 | 831531 | 832833 | 834128 | 835417 | 836701 | 837978 | 839249 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 9.827612 | 9.828932 | 9.830246 | 9.831553 | 9.832854 | 9.834150 | 9.835439 | 9 836722 | 9.837999 | 9.839270 | 20 |
| 41 | 15 827634 | 828954 | 830267 | 831575 | 832876 | 834171 | 835460 | 836743 | 838020 | 839291 | 19 |
| 42 | 30 827656 | 828976 | 830289 | 831596 | 832898 | 834193 | 835482 | 836765 | 838042 | 839313 | 18 |
| 43 | 45 827678 | 828998 | 830311 | 831618 | 832919 | 834214 | 835503 | 836786 | 838063 | 839334 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 9.827700 | 9.829020 | 9.830333 | 9.831640 | 9.832941 | 9.834236 | 9.835525 | 9.836807 | 9.838084 | 9.839355 | 16 |
| 45 | 15 827722 | 829042 | 830355 | 831662 | 832962 | 834257 | 835546 | 836829 | 838105 | 8 9376 | 15 |
| 46 | 30 827744 | 829064 | 830377 | 831683 | 832984 | 834279 | 835567 | 836850 | 838127 | 839397 | 14 |
| 47 | 45 827766 | 829085 | 830398 | 831705 | 833006 | 834300 | 835589 | 836871 | 838148 | 839419 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 9.827789 | 9.829107 | 9.830420 | 9.831727 | 9.833027 | 9.834322 | 9.835610 | 9.836893 | 9.838169 | 9.839439 | 12 |
| 49 | 15 827811 | 829129 | 830442 | 831749 | 833049 | 834343 | 835632 | 836914 | 838190 | 839461 | 11 |
| 50 | 30 827833 | 829151 | 830464 | 831770 | 833071 | 834365 | 835653 | 836935 | 838211 | 839482 | 10 |
| 51 | 45 827855 | 829173 | 830486 | 831792 | 833092 | 834386 | 835675 | 836957 | 838233 | 839503 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 9.827877 | 9.829195 | 9.830507 | 9.831814 | 9.833114 | 9.834408 | 9.835696 | 9.836978 | 9.838254 | 9.839524 | 8 |
| 53 | 15 827899 | 829217 | 830529 | 831836 | 833135 | 834429 | 835717 | 836999 | 838275 | 839545 | 7 |
| 54 | 30 827921 | 829239 | 830551 | 831857 | 833157 | 834451 | 835739 | 837021 | 838296 | 839566 | 6 |
| 55 | 45 827943 | 829261 | 830573 | 831879 | 833179 | 834472 | 835760 | 837042 | 838318 | 839587 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 9.827965 | 9.829283 | 9.830595 | 9.831901 | 9.833200 | 9.834494 | 9.835782 | 9.837063 | 9.838339 | 9.839608 | 4 |
| 57 | 15 827987 | 829305 | 830617 | 831922 | 833222 | 834515 | 835803 | 837084 | 838360 | 839629 | 3 |
| 58 | 30 828009 | 829327 | 830638 | 831944 | 833244 | 834537 | 835824 | 837106 | 838381 | 839651 | 2 |
| 59 | 45 828031 | 829349 | 830660 | 831966 | 833265 | 834558 | 835846 | 837127 | 838402 | 839672 | 1 |
| 60 | 60 9.828053 | 9.829370 | 9.830682 | 9.831987 | 9.833287 | 9.834580 | 9.835867 | 9.837148 | 9.838424 | 9.839693 | 0 |
| | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | |

| | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 112 deg. | | 113 deg. | | | | 114 deg. | | | | |
| sec. | | | | | | | | | | | sec. |
| | 30' | 45' | 0' | 15' | 30' | 45' | 0' | 15' | 30' | 45' | |
| 0 | 0 9.839693 | 9.840956 | 9.842213 | 9.843464 | 9.844710 | 9.845949 | 9.847183 | 9.848410 | 9.849632 | 9.850848 | 60 |
| 1 | 15 839714 | 840977 | 842234 | 843485 | 844731 | 845970 | 847203 | 848431 | 849653 | 850868 | 59 |
| 2 | 30 839735 | 840998 | 842255 | 843506 | 844751 | 845990 | 847224 | 848451 | 849673 | 850889 | 58 |
| 3 | 45 839756 | 841019 | 842276 | 843527 | 844772 | 846011 | 847244 | 848472 | 849693 | 850909 | 57 |
| | 31' | 46' | 1' | 16' | 31' | 46' | 1' | 16' | 31' | 46' | |
| 4 | 0 9.839777 | 9.841040 | 9.842297 | 9.843548 | 9.844793 | 9.846032 | 9.847265 | 9.848492 | 9.849714 | 9.850929 | 56 |
| 5 | 15 839798 | 841061 | 842318 | 843568 | 844813 | 846052 | 847285 | 848512 | 849734 | 850949 | 55 |
| 6 | 30 839819 | 841082 | 842339 | 843589 | 844834 | 846073 | 847306 | 848533 | 849754 | 850970 | 54 |
| 7 | 45 839840 | 841103 | 842359 | 843610 | 844855 | 846094 | 847326 | 848553 | 849774 | 850990 | 53 |
| | 32' | 47' | 2' | 17' | 32' | 47' | 2' | 17' | 32' | 47' | |
| 8 | 0 9.839862 | 9.841124 | 9.842380 | 9.843631 | 9.844875 | 9.846114 | 9.847347 | 9.848574 | 9.849795 | 9.851010 | 52 |
| 9 | 15 839883 | 841145 | 842401 | 843652 | 844896 | 846135 | 847367 | 848594 | 849815 | 851030 | 51 |
| 10 | 30 839904 | 841166 | 842422 | 843672 | 844917 | 846155 | 847388 | 848615 | 849835 | 851050 | 50 |
| 11 | 45 839925 | 841187 | 842443 | 843693 | 844938 | 846176 | 847408 | 848635 | 849856 | 851070 | 49 |
| | 33' | 48' | 3' | 18' | 33' | 48' | 3' | 18' | 33' | 48' | |
| 12 | 0 9.839946 | 9.841208 | 9.842464 | 9.843714 | 9.844958 | 9.846196 | 9.847429 | 9.848655 | 9.849876 | 9.851091 | 48 |
| 13 | 15 839967 | 841229 | 842485 | 843735 | 844979 | 846217 | 847449 | 848676 | 849896 | 851111 | 47 |
| 14 | 30 839988 | 841250 | 842506 | 843756 | 845000 | 846238 | 847470 | 848696 | 849917 | 851131 | 46 |
| 15 | 45 840009 | 841271 | 842527 | 843776 | 845020 | 846258 | 847490 | 848716 | 849937 | 851151 | 45 |
| | 34' | 49' | 4' | 19' | 34' | 49' | 4' | 19' | 34' | 49' | |
| 16 | 0 9.840030 | 9.841292 | 9.842547 | 9.843797 | 9.845041 | 9.846279 | 9.847511 | 9.848737 | 9.849957 | 9.851172 | 44 |
| 17 | 15 840051 | 841313 | 842568 | 843818 | 845062 | 846299 | 847531 | 848757 | 849977 | 851192 | 43 |
| 18 | 30 840072 | 841334 | 842589 | 843839 | 845082 | 846320 | 847552 | 848778 | 849998 | 851212 | 42 |
| 19 | 45 840093 | 841355 | 842610 | 843859 | 845103 | 846340 | 847572 | 848798 | 850018 | 851232 | 41 |
| | 35' | 50' | 5' | 20' | 35' | 50' | 5' | 20' | 35' | 50' | |
| 20 | 0 9.840114 | 9.841376 | 9.842631 | 9.843880 | 9.845124 | 9.846361 | 9.847593 | 9.848818 | 9.850038 | 9.851252 | 40 |
| 21 | 15 840136 | 841397 | 842652 | 843901 | 845144 | 846382 | 847613 | 848839 | 850058 | 851272 | 39 |
| 22 | 30 840157 | 841418 | 842673 | 843922 | 845165 | 846402 | 847634 | 848859 | 850079 | 851293 | 38 |
| 23 | 45 840178 | 841439 | 842694 | 843943 | 845186 | 846423 | 847654 | 848879 | 850099 | 851313 | 37 |
| | 36' | 51' | 6' | 21' | 36' | 51' | 6' | 21' | 36' | 51' | |
| 24 | 0 9.840199 | 9.841460 | 9.842714 | 9.843963 | 9.845206 | 9.846443 | 9.847675 | 9.848900 | 9.850119 | 9.851333 | 36 |
| 25 | 15 840220 | 841481 | 842735 | 843984 | 845227 | 846464 | 847695 | 848920 | 850140 | 851353 | 35 |
| 26 | 30 840241 | 841501 | 842756 | 844005 | 845248 | 846485 | 847716 | 848941 | 850160 | 851373 | 34 |
| 27 | 45 840262 | 841522 | 842777 | 844026 | 845268 | 846505 | 847736 | 848961 | 850180 | 851394 | 33 |
| | 37' | 52' | 7' | 22' | 37' | 52' | 7' | 22' | 37' | 52' | |
| 28 | 0 9.840283 | 9.841543 | 9.842798 | 9.844046 | 9.845289 | 9.846526 | 9.847756 | 9.848981 | 9.850200 | 9.851414 | 32 |
| 29 | 15 840304 | 841564 | 842819 | 844067 | 845310 | 846546 | 847777 | 849002 | 850221 | 851434 | 31 |
| 30 | 30 840325 | 841585 | 842840 | 844088 | 845330 | 846567 | 847797 | 849022 | 850241 | 851454 | 30 |
| 31 | 45 840346 | 841606 | 842860 | 844109 | 845351 | 846587 | 847818 | 849042 | 850261 | 851474 | 29 |
| | 38' | 53' | 8' | 23' | 38' | 53' | 8' | 23' | 38' | 53' | |
| 32 | 0 9.840367 | 9.841627 | 9.842881 | 9.844129 | 9.845372 | 9.846608 | 9.847838 | 9.849063 | 9.850282 | 9.851494 | 28 |
| 33 | 15 840388 | 841648 | 842902 | 844150 | 845392 | 846628 | 847859 | 849083 | 850302 | 851514 | 27 |
| 34 | 30 840409 | 841669 | 842923 | 844171 | 845413 | 846649 | 847879 | 849104 | 850322 | 851535 | 26 |
| 35 | 45 840430 | 841690 | 842944 | 844192 | 845434 | 846670 | 847900 | 849124 | 850342 | 851555 | 25 |
| | 39' | 54' | 9' | 24' | 39' | 54' | 9' | 24' | 39' | 54' | |
| 36 | 0 9.840451 | 9.841711 | 9.842965 | 9.844212 | 9.845454 | 9.846690 | 9.847920 | 9.849144 | 9.850363 | 9.851575 | 24 |
| 37 | 15 840472 | 841732 | 842986 | 844233 | 845475 | 846711 | 847941 | 849165 | 850383 | 851595 | 23 |
| 38 | 30 840493 | 841753 | 843006 | 844254 | 845495 | 846731 | 847961 | 849185 | 850403 | 851615 | 22 |
| 39 | 45 840515 | 841774 | 843027 | 844275 | 845516 | 846752 | 847981 | 849205 | 850423 | 851635 | 21 |
| | 40' | 55' | 10' | 25' | 40' | 55' | 10' | 25' | 40' | 55' | |
| 40 | 0 9.840536 | 9.841795 | 9.843048 | 9.844295 | 9.845537 | 9.846772 | 9.848002 | 9.849226 | 9.850444 | 9.851656 | 20 |
| 41 | 15 840557 | 841816 | 843069 | 844316 | 845557 | 846793 | 848022 | 849246 | 850464 | 851676 | 19 |
| 42 | 30 840578 | 841837 | 843090 | 844337 | 845578 | 846813 | 848043 | 849266 | 850484 | 851696 | 18 |
| 43 | 45 840599 | 841858 | 843111 | 844358 | 845599 | 846834 | 848063 | 849287 | 850504 | 851716 | 17 |
| | 41' | 56' | 11' | 26' | 41' | 56' | 11' | 26' | 41' | 56' | |
| 44 | 0 9.840620 | 9.841879 | 9.843131 | 9.844378 | 9.845619 | 9.846854 | 9.848084 | 9.849307 | 9.850525 | 9.851736 | 16 |
| 45 | 15 840641 | 841899 | 843152 | 844399 | 845640 | 846875 | 848104 | 849327 | 850545 | 851756 | 15 |
| 46 | 30 840662 | 841920 | 843173 | 844420 | 845661 | 846896 | 848125 | 849348 | 850565 | 851777 | 14 |
| 47 | 45 840683 | 841941 | 843194 | 844440 | 845681 | 846916 | 848145 | 849368 | 850585 | 851797 | 13 |
| | 42' | 57' | 12' | 27' | 42' | 57' | 12' | 27' | 42' | 57' | |
| 48 | 0 9.840704 | 9.841962 | 9.843215 | 9.844461 | 9.845702 | 9.846937 | 9.848165 | 9.849388 | 9.850606 | 9.851817 | 12 |
| 49 | 15 840725 | 841983 | 843236 | 844482 | 845722 | 846957 | 848186 | 849409 | 850626 | 851837 | 11 |
| 50 | 30 840746 | 842004 | 843256 | 844503 | 845743 | 846978 | 848206 | 849429 | 850646 | 851857 | 10 |
| 51 | 45 840767 | 842025 | 843277 | 844523 | 845764 | 846998 | 848227 | 849449 | 850666 | 851877 | 9 |
| | 43' | 58' | 13' | 28' | 43' | 58' | 13' | 28' | 43' | 58' | |
| 52 | 0 9.840788 | 9.842046 | 9.843298 | 9.844544 | 9.845784 | 9.847019 | 9.848247 | 9.849470 | 9.850686 | 9.851897 | 8 |
| 53 | 15 840809 | 842067 | 843319 | 844565 | 845805 | 847039 | 848268 | 849490 | 850707 | 851917 | 7 |
| 54 | 30 840830 | 842088 | 843340 | 844586 | 845826 | 847060 | 848288 | 849510 | 850727 | 851938 | 6 |
| 55 | 45 840851 | 842109 | 843360 | 844606 | 845846 | 847080 | 848308 | 849531 | 850747 | 851958 | 5 |
| | 44' | 59' | 14' | 29' | 44' | 59' | 14' | 29' | 44' | 59' | |
| 56 | 0 9.840872 | 9.842130 | 9.843381 | 9.844627 | 9.845867 | 9.847101 | 9.848329 | 9.849551 | 9.850767 | 9.851978 | 4 |
| 57 | 15 840893 | 842150 | 843402 | 844648 | 845887 | 847121 | 848349 | 849571 | 850788 | 851998 | 3 |
| 58 | 30 840914 | 842171 | 843423 | 844668 | 845908 | 847142 | 848370 | 849592 | 850808 | 852018 | 2 |
| 59 | 45 840935 | 842192 | 843444 | 844689 | 845929 | 847162 | 848390 | 849612 | 850828 | 852038 | 1 |
| 60 | 60 9.840956 | 9.842213 | 9.843464 | 9.844710 | 9.845949 | 9.847183 | 9.848410 | 9.849632 | 9.850848 | 9.852058 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| Sec. | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 115 deg. | | | | 116 deg. | | | | 117 deg. | |
| | ″ 0′ | 15′ | 30′ | 45′ | ° 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 9.852058 | 9.853263 | 9.854461 | 9.855654 | 9.856841 | 9.858022 | 9.859198 | 9.860367 | 9.861532 | 9.862690 |
| 1 | 15 852078 | 853283 | 854481 | 855674 | 856861 | 858042 | 859217 | 860387 | 861551 | 862709 |
| 2 | 30 852099 | 853303 | 854501 | 855694 | 856880 | 858061 | 859237 | 860406 | 861570 | 862727 |
| 3 | 45 852119 | 853323 | 854521 | 855713 | 856900 | 858081 | 859256 | 860426 | 861590 | 862748 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ |
| 4 | 0 9.852139 | 9.853343 | 9.854541 | 9.855733 | 9.856920 | 9.858101 | 9.859276 | 9.860445 | 9.861609 | 9.862767 |
| 5 | 15 852159 | 853363 | 854561 | 855753 | 856940 | 858120 | 859295 | 860465 | 861628 | 862786 |
| 6 | 30 852179 | 853383 | 854581 | 855773 | 856959 | 858140 | 859315 | 860484 | 861648 | 862805 |
| 7 | 45 852199 | 853403 | 854601 | 855793 | 856979 | 858160 | 859334 | 860503 | 861667 | 862825 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ |
| 8 | 0 9.852219 | 9.853423 | 9.854621 | 9.855813 | 9.856999 | 9.858179 | 9.859354 | 9.860523 | 9.861686 | 9.862844 |
| 9 | 15 852239 | 853443 | 854640 | 855832 | 857018 | 858199 | 859373 | 860542 | 861706 | 862863 |
| 10 | 30 852260 | 853463 | 854660 | 855852 | 857038 | 858219 | 859393 | 860562 | 861725 | 862882 |
| 11 | 45 852280 | 853483 | 854680 | 855872 | 857058 | 858238 | 859412 | 860581 | 861744 | 862901 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 9.852300 | 9.853503 | 9.854700 | 9.855892 | 9.857078 | 9.858258 | 9.859432 | 9.860601 | 9.861764 | 9.862921 |
| 13 | 15 852320 | 853523 | 854720 | 855912 | 857097 | 858278 | 859452 | 860620 | 861783 | 862940 |
| 14 | 30 852340 | 853543 | 854740 | 855931 | 857117 | 858297 | 859471 | 860640 | 861802 | 862959 |
| 15 | 45 852360 | 853563 | 854760 | 855951 | 857137 | 858317 | 859491 | 860659 | 861822 | 862978 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 9.852380 | 9.853583 | 9.854780 | 9.855971 | 9.857157 | 9.858336 | 9.859510 | 9.860678 | 9.861841 | 9.862997 |
| 17 | 15 852400 | 853603 | 854800 | 855991 | 857176 | 858356 | 859530 | 860698 | 861860 | 863017 |
| 18 | 30 852420 | 853623 | 854820 | 856011 | 857196 | 858375 | 859549 | 860717 | 861880 | 863036 |
| 19 | 45 852440 | 853643 | 854839 | 856030 | 857216 | 858395 | 859569 | 860737 | 861899 | 863056 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 9.852460 | 9.853663 | 9.854859 | 9.856050 | 9.857235 | 9.858415 | 9.859588 | 9.860756 | 9.861918 | 9.863075 |
| 21 | 15 852480 | 853683 | 854879 | 856070 | 857255 | 858434 | 859608 | 860775 | 861938 | 863094 |
| 22 | 30 852501 | 853703 | 854899 | 856090 | 857275 | 858454 | 859627 | 860795 | 861957 | 863113 |
| 23 | 45 852521 | 853723 | 854919 | 856110 | 857294 | 858474 | 859647 | 860814 | 861976 | 863132 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 9.852541 | 9.853743 | 9.854939 | 9.856129 | 9.857314 | 9.858493 | 9.859666 | 9.860834 | 9.861996 | 9.863151 |
| 25 | 15 852561 | 853763 | 854959 | 856149 | 857334 | 858513 | 859686 | 860853 | 862015 | 863171 |
| 26 | 30 852581 | 853783 | 854979 | 856169 | 857354 | 858532 | 859705 | 860873 | 862034 | 863190 |
| 27 | 45 852601 | 853803 | 854999 | 856189 | 857373 | 858552 | 859725 | 860892 | 862054 | 863209 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 9.852621 | 9.853823 | 9.855019 | 9.856209 | 9.857393 | 9.858571 | 9.859744 | 9.860911 | 9.862073 | 9.863229 |
| 29 | 15 852641 | 853843 | 855038 | 856228 | 857413 | 858591 | 859764 | 860931 | 862092 | 863248 |
| 30 | 30 852661 | 853863 | 855058 | 856248 | 857432 | 858611 | 859783 | 860950 | 862111 | 863267 |
| 31 | 45 852681 | 853883 | 855078 | 856268 | 857452 | 858630 | 859803 | 860970 | 862131 | 863287 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 9 852701 | 9.853903 | 9.855098 | 9.856288 | 9.857472 | 9.858650 | 9.859822 | 9.860989 | 9.862150 | 9.863306 |
| 33 | 15 852721 | 853923 | 855118 | 856307 | 857492 | 858669 | 859842 | 861008 | 862169 | 863325 |
| 34 | 30 852742 | 853943 | 855138 | 856327 | 857511 | 858689 | 859861 | 861028 | 862189 | 863344 |
| 35 | 45 852762 | 853962 | 855158 | 856347 | 857531 | 858709 | 859881 | 861047 | 862208 | 863363 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54 | 9′ | 24′ |
| 36 | 0 9.852782 | 9.853983 | 9.855178 | 9.856367 | 9.857550 | 9.858728 | 9.859900 | 9.861067 | 9.862227 | 9.863382 |
| 37 | 15 852802 | 854002 | 855197 | 856387 | 857570 | 858748 | 859920 | 861086 | 862246 | 863401 |
| 38 | 30 852822 | 854022 | 855217 | 856406 | 857590 | 858767 | 859939 | 861105 | 862266 | 863421 |
| 39 | 45 852842 | 854042 | 855237 | 856426 | 857609 | 858787 | 859959 | 861125 | 862285 | 863440 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 53′ | 10′ | 25′ |
| 40 | 0 9.852862 | 9.854062 | 9.855257 | 9.856446 | 9.857629 | 9.858807 | 9.859978 | 9.861144 | 9.862304 | 9.863459 |
| 41 | 15 852882 | 854082 | 855277 | 856466 | 857649 | 858826 | 859998 | 861163 | 862324 | 863478 |
| 42 | 30 852902 | 854102 | 855297 | 856485 | 857668 | 858846 | 860017 | 861183 | 862343 | 863497 |
| 43 | 45 852922 | 854122 | 855317 | 856505 | 857688 | 858865 | 860037 | 861202 | 862362 | 863517 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 9.852942 | 9.854142 | 9.855336 | 9.856525 | 9.857708 | 9.858885 | 9.860056 | 9.861222 | 9.862382 | 9.863536 |
| 45 | 15 852962 | 854162 | 855356 | 856545 | 857727 | 858904 | 860075 | 861241 | 862401 | 863555 |
| 46 | 30 852982 | 854182 | 855376 | 856565 | 857747 | 858924 | 860095 | 861260 | 862420 | 863574 |
| 47 | 45 853002 | 854202 | 855396 | 856584 | 857767 | 858943 | 860114 | 861280 | 862440 | 863593 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 9.853022 | 9.854222 | 9.855416 | 9.856604 | 9.857786 | 9.858963 | 9.860134 | 9.861299 | 9.862459 | 9.863613 |
| 49 | 15 853042 | 854242 | 855436 | 856624 | 857806 | 858983 | 860153 | 861318 | 862478 | 863632 |
| 50 | 30 853062 | 854262 | 855456 | 856644 | 857826 | 859002 | 860173 | 861338 | 862497 | 863651 |
| 51 | 45 853082 | 854282 | 855475 | 856663 | 857845 | 859022 | 860192 | 861357 | 862516 | 863670 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 9.853102 | 9.854302 | 9.855495 | 9.856683 | 9.857865 | 9.859041 | 9.860212 | 9.861377 | 9.862536 | 9.863689 |
| 53 | 15 853122 | 854322 | 855515 | 856703 | 857885 | 859061 | 860231 | 861396 | 862555 | 863709 |
| 54 | 30 853143 | 854342 | 855535 | 856723 | 857904 | 859080 | 860251 | 861415 | 862574 | 863728 |
| 55 | 45 853163 | 854362 | 855555 | 856742 | 857924 | 859100 | 860270 | 861435 | 862594 | 863747 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 9.853183 | 9.854382 | 9.855575 | 9.856762 | 9.857944 | 9.859120 | 9.860290 | 9.861454 | 9.862613 | 9.863766 |
| 57 | 15 853203 | 854401 | 855594 | 856782 | 857963 | 859139 | 860309 | 861473 | 862632 | 863785 |
| 58 | 30 853223 | 854421 | 855614 | 856801 | 857983 | 859159 | 860329 | 861493 | 862651 | 863804 |
| 59 | 45 853243 | 854441 | 855634 | 856821 | 858002 | 859178 | 860348 | 861512 | 862671 | 863823 |
| 60 | 60 9.853263 | 9.854461 | 9.855654 | 9.856841 | 9.858022 | 9.859198 | 9.860367 | 9.861532 | 9.862690 | 9.863843 |
| Sec. | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m |

| sec. | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 117 deg. | | 118 deg. | | | | 119 deg. | | | | |
| | ″ 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.863843 | 9.864990 | 9.866131 | 9.867267 | 9.868397 | 9.869522 | 9.870641 | 9.871754 | 9.872862 | 9.873964 | 60 |
| 1 | 15 863862 | 865008 | 866150 | 867286 | 868416 | 869540 | 870659 | 871773 | 872880 | 873983 | 59 |
| 2 | 30 863881 | 865028 | 866169 | 867305 | 868435 | 869559 | 870678 | 871791 | 872899 | 874001 | 58 |
| 3 | 45 863900 | 865047 | 866188 | 867324 | 868454 | 869578 | 870697 | 871810 | 872917 | 874019 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.863919 | 9.865066 | 9.866207 | 9.867342 | 9.868472 | 9.869597 | 9.870715 | 9.871828 | 9.872936 | 9.874038 | 56 |
| 5 | 15 863938 | 865085 | 866226 | 867361 | 868491 | 869615 | 870734 | 871847 | 872954 | 874056 | 55 |
| 6 | 30 863958 | 865104 | 866245 | 867380 | 868510 | 869634 | 870752 | 871865 | 872973 | 874074 | 54 |
| 7 | 45 863977 | 865123 | 866264 | 867399 | 868529 | 869653 | 870771 | 871884 | 872991 | 874093 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.863996 | 9.865142 | 9.866283 | 9.867418 | 9.868547 | 9.869671 | 9.870790 | 9.871902 | 9.873009 | 9.874111 | 52 |
| 9 | 15 864015 | 865161 | 866302 | 867437 | 868566 | 869690 | 870808 | 871921 | 873028 | 874129 | 51 |
| 10 | 30 864034 | 865180 | 866321 | 867456 | 868585 | 869709 | 870827 | 871939 | 873046 | 874148 | 50 |
| 11 | 45 864053 | 865199 | 866340 | 867475 | 868604 | 869727 | 870845 | 871958 | 873065 | 874166 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.864073 | 9.865218 | 9.866359 | 9.867493 | 9.868623 | 9.869746 | 9.870864 | 9.871976 | 9.873083 | 9.874184 | 48 |
| 13 | 15 864092 | 865237 | 866378 | 867512 | 868641 | 869765 | 870882 | 871995 | 873101 | 874203 | 47 |
| 14 | 30 864111 | 865257 | 866397 | 867531 | 868660 | 869783 | 870901 | 872013 | 873120 | 874221 | 46 |
| 15 | 45 864130 | 865276 | 866416 | 867550 | 868679 | 869802 | 870920 | 872032 | 873138 | 874239 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.864149 | 9.865295 | 9.866435 | 9.867569 | 9.868698 | 9.869821 | 9.870938 | 9.872050 | 9.873157 | 9.874257 | 44 |
| 17 | 15 864168 | 865314 | 866454 | 867588 | 868716 | 869839 | 870957 | 872069 | 873175 | 874276 | 43 |
| 18 | 30 864187 | 865333 | 866473 | 867607 | 868735 | 869858 | 870975 | 872087 | 873193 | 874294 | 42 |
| 19 | 45 864206 | 865352 | 866492 | 867625 | 868754 | 869877 | 870994 | 872106 | 873212 | 874312 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.864226 | 9.865371 | 9.866510 | 9.867644 | 9.868773 | 9.869895 | 9.871013 | 9.872124 | 9.873230 | 9.874331 | 40 |
| 21 | 15 864245 | 865390 | 866529 | 867663 | 868792 | 869914 | 871031 | 872143 | 873249 | 874349 | 39 |
| 22 | 30 864264 | 865409 | 866548 | 867682 | 868810 | 869933 | 871050 | 872161 | 873267 | 874367 | 38 |
| 23 | 45 864283 | 865428 | 866567 | 867701 | 868829 | 869951 | 871068 | 872180 | 873285 | 874386 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.864302 | 9.865447 | 9.866586 | 9.867720 | 9.868848 | 9.869970 | 9.871087 | 9.872198 | 9.873304 | 9.874404 | 36 |
| 25 | 15 864321 | 865466 | 866605 | 867739 | 868866 | 869989 | 871105 | 872216 | 873322 | 874422 | 35 |
| 26 | 30 864340 | 865485 | 866624 | 867757 | 868885 | 870007 | 871124 | 872235 | 873340 | 874440 | 34 |
| 27 | 45 864359 | 865504 | 866643 | 867776 | 868904 | 870026 | 871142 | 872253 | 873359 | 874459 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.864379 | 9.865523 | 9.866662 | 9.867795 | 9.868923 | 9.870045 | 9.871161 | 9.872272 | 9.873377 | 9.874477 | 32 |
| 29 | 15 864398 | 865542 | 866681 | 867814 | 868941 | 870063 | 871180 | 872290 | 873396 | 874495 | 31 |
| 30 | 30 864417 | 865561 | 866700 | 867833 | 868960 | 870082 | 871198 | 872309 | 873414 | 874514 | 30 |
| 31 | 45 864436 | 865580 | 866719 | 867852 | 868979 | 870100 | 871217 | 872327 | 873432 | 874532 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.864455 | 9.865599 | 9.866738 | 9.867870 | 9.868998 | 9.870119 | 9.871235 | 9.872346 | 9.873451 | 9.874550 | 28 |
| 33 | 15 864474 | 865618 | 866756 | 867889 | 869016 | 870138 | 871254 | 872364 | 873469 | 874568 | 27 |
| 34 | 30 864493 | 865637 | 866776 | 867908 | 869035 | 870157 | 871272 | 872383 | 873487 | 874587 | 26 |
| 35 | 45 864512 | 865656 | 866794 | 867927 | 869054 | 870176 | 871291 | 872401 | 873506 | 874605 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.864532 | 9.865675 | 9.866813 | 9.867946 | 9.869073 | 9.870194 | 9.871310 | 9.872420 | 9.873524 | 9.874623 | 24 |
| 37 | 15 864551 | 865694 | 866832 | 867965 | 869091 | 870212 | 871328 | 872438 | 873543 | 874641 | 23 |
| 38 | 30 864570 | 865713 | 866851 | 867983 | 869110 | 870231 | 871347 | 872457 | 873561 | 874660 | 22 |
| 39 | 45 864589 | 865732 | 866870 | 868002 | 869129 | 870250 | 871365 | 872475 | 873579 | 874678 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.864608 | 9.865751 | 9.866889 | 9.868021 | 9.869148 | 9.870268 | 9.871384 | 9.872493 | 9.873598 | 9.874696 | 20 |
| 41 | 15 864627 | 865770 | 866908 | 868040 | 869166 | 870287 | 871402 | 872512 | 873616 | 874714 | 19 |
| 42 | 30 864646 | 865789 | 866927 | 868059 | 869185 | 870306 | 871421 | 872530 | 873634 | 874733 | 18 |
| 43 | 45 864665 | 865808 | 866946 | 868078 | 869204 | 870324 | 871439 | 872549 | 873653 | 874751 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.864684 | 9.865827 | 9.866965 | 9.868096 | 9.869222 | 9.870343 | 9.871458 | 9.872567 | 9.873671 | 9.874769 | 16 |
| 45 | 15 864703 | 865846 | 866984 | 868115 | 869241 | 870362 | 871476 | 872586 | 873689 | 874788 | 15 |
| 46 | 30 864723 | 865865 | 867002 | 868134 | 869260 | 870380 | 871495 | 872604 | 873708 | 874806 | 14 |
| 47 | 45 864742 | 865884 | 867021 | 868153 | 869278 | 870399 | 871513 | 872623 | 873726 | 874824 | 13 |
| | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.864761 | 9.865903 | 9.867040 | 9.868172 | 9.869297 | 9.870417 | 9.871532 | 9.872641 | 9.873744 | 9.874842 | 12 |
| 49 | 15 864780 | 865922 | 867059 | 868190 | 869316 | 870436 | 871550 | 872660 | 873763 | 874860 | 11 |
| 50 | 30 864799 | 865941 | 867078 | 868209 | 869335 | 870455 | 871569 | 872678 | 873781 | 874879 | 10 |
| 51 | 45 864818 | 865960 | 867097 | 868228 | 869354 | 870473 | 871588 | 872696 | 873799 | 874897 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.864837 | 9.865979 | 9.867116 | 9.868247 | 9.869372 | 9.870492 | 9.871606 | 9.872715 | 9.873818 | 9.874915 | 8 |
| 53 | 15 864856 | 865998 | 867135 | 868266 | 869391 | 870510 | 871624 | 872733 | 873836 | 874934 | 7 |
| 54 | 30 864875 | 866017 | 867154 | 868284 | 869410 | 870529 | 871643 | 872752 | 873854 | 874952 | 6 |
| 55 | 45 864894 | 866036 | 867172 | 868303 | 869428 | 870548 | 871662 | 872770 | 873873 | 874970 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.864913 | 9.866055 | 9.867191 | 9.868322 | 9.869447 | 9.870566 | 9.871680 | 9.872788 | 9.873891 | 9.874988 | 4 |
| 57 | 15 864932 | 866074 | 867210 | 868341 | 869466 | 870585 | 871699 | 872807 | 873909 | 875007 | 3 |
| 58 | 30 864952 | 866093 | 867229 | 868360 | 869484 | 870604 | 871717 | 872825 | 873928 | 875025 | 2 |
| 59 | 45 864971 | 866112 | 867248 | 868378 | 869503 | 870622 | 871736 | 872844 | 873946 | 875043 | 1 |
| 60 | 0 9.864990 | 9.866131 | 9.867267 | 9.868397 | 9.869522 | 9.870641 | 9.871754 | 9.872862 | 9.873964 | 9.875061 | 0 |
| sec. | 9m | 8m | 7m | 6m | 5m | 4m | 3m | 2m | 1m | 0m | sec. |

| sec. | 0m | 1m | 2m | 3m | 4m | 5m | 6m | 7m | 8m | 9m |
|---|---|---|---|---|---|---|---|---|---|---|
| | 120 deg. | | | | 121 deg. | | | | 122 deg. | |
| | ″ 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ |
| 0 | 0 9.875061 | 9.876153 | 9.877238 | 9.878319 | 9.879394 | 9.880463 | 9.881527 | 9.882585 | 9.883639 | 9.884686 |
| 1 | 15 875079 | 876171 | 877256 | 878337 | 879411 | 880481 | 881545 | 882603 | 883656 | 884704 |
| 2 | 30 875098 | 876189 | 877274 | 878355 | 879429 | 880498 | 881562 | 882621 | 883674 | 884721 |
| 3 | 45 875116 | 876207 | 877292 | 878373 | 879447 | 880516 | 881580 | 882638 | 883691 | 884738 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ |
| 4 | 0 9.875134 | 9.876225 | 9.877311 | 9.878391 | 9.879465 | 9.880534 | 9.881598 | 9.882656 | 9.883709 | 9.884756 |
| 5 | 15 875152 | 876243 | 877329 | 878408 | 879483 | 880552 | 881615 | 882673 | 883726 | 884773 |
| 6 | 30 875171 | 876261 | 877347 | 878426 | 879501 | 880570 | 881633 | 882691 | 883744 | 884791 |
| 7 | 45 875189 | 876280 | 877365 | 878444 | 879519 | 880587 | 881651 | 882709 | 883761 | 884808 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ |
| 8 | 0 9.875207 | 9.876298 | 9.877383 | 9.878462 | 9.879536 | 9.880605 | 9.881668 | 9.882726 | 9.883779 | 9.884826 |
| 9 | 15 875225 | 876316 | 877401 | 878480 | 879554 | 880623 | 881686 | 882744 | 883796 | 884843 |
| 10 | 30 875244 | 876334 | 877419 | 878498 | 879572 | 880641 | 881704 | 882761 | 883814 | 884861 |
| 11 | 45 875262 | 876352 | 877437 | 878516 | 879590 | 880658 | 881721 | 882779 | 883831 | 884878 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ |
| 12 | 0 9.875280 | 9.876370 | 9.877455 | 9.878534 | 9.879608 | 9.880676 | 9.881739 | 9.882796 | 9.883848 | 9.884895 |
| 13 | 15 875298 | 876388 | 877473 | 878552 | 879626 | 880694 | 881757 | 882814 | 883866 | 884912 |
| 14 | 30 875316 | 876406 | 877491 | 878570 | 879644 | 880711 | 881774 | 882832 | 883883 | 884930 |
| 15 | 45 875335 | 876425 | 877509 | 878588 | 879661 | 880729 | 881792 | 882849 | 883901 | 884947 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ |
| 16 | 0 9.875353 | 9.876443 | 9.877527 | 9.878606 | 9.879679 | 9.880747 | 9.881810 | 9.882867 | 9.883918 | 9.884965 |
| 17 | 15 875371 | 876461 | 877545 | 878624 | 879697 | 880765 | 881827 | 882885 | 883936 | 884982 |
| 18 | 30 875389 | 876479 | 877563 | 878642 | 879715 | 880783 | 881845 | 882902 | 883953 | 884999 |
| 19 | 45 875407 | 876497 | 877581 | 878660 | 879733 | 880800 | 881863 | 882919 | 883971 | 885017 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ |
| 20 | 0 9.875426 | 9.876515 | 9.877599 | 9.878678 | 9.879751 | 9.880818 | 9.881880 | 9.882937 | 9.883988 | 9.885034 |
| 21 | 15 875444 | 876533 | 877617 | 878696 | 879768 | 880836 | 881898 | 882955 | 884006 | 885052 |
| 22 | 30 875462 | 876551 | 877635 | 878713 | 879786 | 880854 | 881916 | 882972 | 884023 | 885069 |
| 23 | 45 875480 | 876569 | 877653 | 878731 | 879804 | 880871 | 881933 | 882990 | 884041 | 885086 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ |
| 24 | 0 9.875498 | 9.876588 | 9.877671 | 9.878749 | 9.879822 | 9.880889 | 9.881951 | 9.883007 | 9.884058 | 9.885104 |
| 25 | 15 875517 | 876606 | 877689 | 878767 | 879840 | 880907 | 881969 | 883025 | 884076 | 885121 |
| 26 | 30 875535 | 876624 | 877707 | 878785 | 879858 | 880925 | 881986 | 883042 | 884093 | 885138 |
| 27 | 45 875553 | 876642 | 877725 | 878803 | 879875 | 880942 | 882004 | 883060 | 884111 | 885156 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ |
| 28 | 0 9.875571 | 9.876660 | 9.877743 | 9.878821 | 9.879893 | 9.880960 | 9.882022 | 9.883078 | 9.884128 | 9.885173 |
| 29 | 15 875589 | 876678 | 877761 | 878839 | 879911 | 880978 | 882039 | 883095 | 884146 | 885191 |
| 30 | 30 875608 | 876696 | 877779 | 878857 | 879929 | 880996 | 882057 | 883113 | 884163 | 885208 |
| 31 | 45 875626 | 876714 | 877797 | 878875 | 879947 | 881014 | 882074 | 883130 | 884180 | 885225 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ |
| 32 | 0 9.875644 | 9.876732 | 9.877815 | 9.878893 | 9.879965 | 9.881031 | 9.882092 | 9.883148 | 9.884198 | 9.885243 |
| 33 | 15 875662 | 876750 | 877833 | 878911 | 879982 | 881049 | 882110 | 883165 | 884216 | 885260 |
| 34 | 30 875680 | 876769 | 877851 | 878928 | 880000 | 881067 | 882127 | 883183 | 884233 | 885278 |
| 35 | 45 875698 | 876787 | 877869 | 878946 | 880018 | 881084 | 882145 | 883200 | 884250 | 885295 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ |
| 36 | 0 9.875717 | 9.876805 | 9.877887 | 9.878964 | 9.880036 | 9.881102 | 9.882163 | 9.883218 | 9.884268 | 9.885313 |
| 37 | 15 875735 | 876823 | 877905 | 878982 | 880054 | 881120 | 882180 | 883235 | 884285 | 885330 |
| 38 | 30 875753 | 876841 | 877923 | 879000 | 880071 | 881137 | 882198 | 883253 | 884303 | 885347 |
| 39 | 45 875771 | 876859 | 877941 | 879018 | 880089 | 881155 | 882216 | 883271 | 884320 | 885364 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ |
| 40 | 0 9.875789 | 9.876877 | 9.877959 | 9.879036 | 9.880107 | 9.881173 | 9.882233 | 9.883288 | 9.884338 | 9.885382 |
| 41 | 15 875808 | 876895 | 877977 | 879054 | 880125 | 881191 | 882251 | 883306 | 884355 | 885399 |
| 42 | 30 875826 | 876913 | 877995 | 879072 | 880143 | 881208 | 882268 | 883323 | 884372 | 885416 |
| 43 | 45 875844 | 876931 | 878013 | 879090 | 880160 | 881226 | 882286 | 883341 | 884390 | 885434 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ |
| 44 | 0 9.875862 | 9.876949 | 9.878031 | 9.879107 | 9.880178 | 9.881244 | 9.882303 | 9.883358 | 9.884407 | 9.885451 |
| 45 | 15 875880 | 876967 | 878049 | 879125 | 880196 | 881261 | 882321 | 883376 | 884425 | 885469 |
| 46 | 30 875898 | 876986 | 878067 | 879143 | 880214 | 881279 | 882339 | 883393 | 884442 | 885486 |
| 47 | 45 875917 | 877004 | 878085 | 879161 | 880232 | 881297 | 882357 | 883411 | 884460 | 885503 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ |
| 48 | 0 9.875935 | 9.877022 | 9.878103 | 9.879179 | 9.880250 | 9.881315 | 9.882374 | 9.883428 | 9.884477 | 9.885520 |
| 49 | 15 875953 | 877040 | 878121 | 879197 | 880267 | 881332 | 882392 | 883446 | 884495 | 885538 |
| 50 | 30 875971 | 877058 | 878139 | 879215 | 880285 | 881350 | 882409 | 883463 | 884512 | 885555 |
| 51 | 45 875989 | 877076 | 878157 | 879233 | 880303 | 881368 | 882427 | 883481 | 884529 | 885572 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ |
| 52 | 0 9.876007 | 9.877094 | 9.878175 | 9.879251 | 9.880321 | 9.881385 | 9.882445 | 9.883498 | 9.884547 | 9.885590 |
| 53 | 15 876026 | 877112 | 878193 | 879268 | 880338 | 881403 | 882462 | 883516 | 884564 | 885607 |
| 54 | 30 876044 | 877130 | 878211 | 879286 | 880356 | 881421 | 882480 | 883533 | 884582 | 885625 |
| 55 | 45 876062 | 877148 | 878229 | 879304 | 880374 | 881438 | 882497 | 883551 | 884599 | 885642 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ |
| 56 | 0 9.876080 | 9.877166 | 9.878247 | 9.879322 | 9.880392 | 9.881456 | 9.882515 | 9.883568 | 9.884617 | 9.885659 |
| 57 | 15 876098 | 877184 | 878265 | 879340 | 880410 | 881474 | 882533 | 883586 | 884634 | 885676 |
| 58 | 30 876116 | 877202 | 878283 | 879358 | 880427 | 881492 | 882550 | 883604 | 884651 | 885694 |
| 59 | 45 876134 | 877220 | 878301 | 879376 | 880445 | 881509 | 882568 | 883621 | 884669 | 885711 |
| 60 | 60 9.876153 | 9.877238 | 9.878319 | 9.879394 | 9.880463 | 9.881527 | 9.882585 | 9.883639 | 9.884686 | 9.885728 |
| sec. | 59m | 58m | 57m | 56m | 55m | 54m | 53m | 52m | 51m | 50m |

| | 10m | 11m | 12m | 13m | 14m | 15m | 16m | 17m | 18m | 19m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 122 deg. | | 123 deg. | | | | 124 deg. | | | | |
| sec. | | | | | | | | | | | sec. |
| | | 30′ 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 | 9.885729 9.886765 | 9.887797 | 9.888823 | 9.889844 | 9.890860 | 9.891870 | 9.892875 | 9.893874 | 9.894869 | 60 |
| 1 | 15 | 885746 886783 | 887814 | 888840 | 889861 | 890876 | 891887 | 892891 | 893891 | 894885 | 59 |
| 2 | 30 | 885763 886800 | 887831 | 888857 | 889878 | 890893 | 891903 | 892908 | 893908 | 894902 | 58 |
| 3 | 45 | 885780 886817 | 887848 | 888874 | 889895 | 890910 | 891920 | 892925 | 893924 | 894918 | 57 |
| | | 31′ 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 | 9.885798 9.886834 | 9.887866 | 9.888891 | 9.889912 | 9.890927 | 9.891937 | 9.892942 | 9.893941 | 9.894935 | 56 |
| 5 | 15 | 885815 886852 | 887883 | 888908 | 889929 | 890944 | 891954 | 892958 | 893957 | 894951 | 55 |
| 6 | 30 | 885832 886869 | 887900 | 888926 | 889946 | 890961 | 891971 | 892975 | 893974 | 894968 | 54 |
| 7 | 45 | 885850 886886 | 887917 | 888943 | 889963 | 890978 | 891987 | 892992 | 893991 | 894984 | 53 |
| | | 32′ 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 | 9.885867 9.886903 | 9.887934 | 9.888960 | 9.889980 | 9.890995 | 9.892004 | 9.893008 | 9.894007 | 9.895001 | 52 |
| 9 | 15 | 885884 886920 | 887951 | 888977 | 889997 | 891011 | 892021 | 893025 | 894024 | 895017 | 51 |
| 10 | 30 | 885902 886938 | 887968 | 888994 | 890014 | 891028 | 892038 | 893042 | 894040 | 895034 | 50 |
| 11 | 45 | 885919 886955 | 887985 | 889011 | 890031 | 891045 | 892054 | 893058 | 894057 | 895050 | 49 |
| | | 33′ 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 | 9.885936 9.886972 | 9.888003 | 9.889028 | 9.890048 | 9.891062 | 9.892071 | 9.893075 | 9.894074 | 9.895067 | 48 |
| 13 | 15 | 885954 886989 | 888020 | 889045 | 890065 | 891079 | 892088 | 893092 | 894090 | 895083 | 47 |
| 14 | 30 | 885971 887007 | 888037 | 889062 | 890082 | 891096 | 892105 | 893108 | 894107 | 895100 | 46 |
| 15 | 45 | 885988 887024 | 888054 | 889079 | 890098 | 891113 | 892121 | 893125 | 894123 | 895116 | 45 |
| | | 34′ 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 | 9.886006 9.887041 | 9.888071 | 9.889096 | 9.890115 | 9.891130 | 9.892138 | 9.893142 | 9.894140 | 9.895133 | 44 |
| 17 | 15 | 886023 887058 | 888088 | 889113 | 890132 | 891146 | 892155 | 893158 | 894157 | 895149 | 43 |
| 18 | 30 | 886040 887075 | 888105 | 889130 | 890149 | 891163 | 892172 | 893175 | 894173 | 895166 | 42 |
| 19 | 45 | 886058 887093 | 888122 | 889147 | 890166 | 891180 | 892189 | 893192 | 894190 | 895182 | 41 |
| | | 35′ 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 | 9.886075 9.887110 | 9.888140 | 9.889164 | 9.890183 | 9.891197 | 9.892205 | 9.893209 | 9.894206 | 9.895199 | 40 |
| 21 | 15 | 886092 887127 | 888157 | 889181 | 890200 | 891214 | 892222 | 893225 | 894223 | 895215 | 39 |
| 22 | 30 | 886109 887144 | 888174 | 889198 | 890217 | 891231 | 892239 | 893242 | 894240 | 895232 | 38 |
| 23 | 45 | 886127 887161 | 888191 | 889215 | 890234 | 891247 | 892256 | 893259 | 894256 | 895248 | 37 |
| | | 36′ 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 | 9.886144 9.887179 | 9.888208 | 9.889232 | 9.890251 | 9.891264 | 9.892272 | 9.893275 | 9.894273 | 9.895265 | 36 |
| 25 | 15 | 886161 887196 | 888225 | 889249 | 890268 | 891281 | 892289 | 893292 | 894289 | 895281 | 35 |
| 26 | 30 | 886179 887213 | 888242 | 889266 | 890285 | 891298 | 892306 | 893309 | 894306 | 895298 | 34 |
| 27 | 45 | 886196 887230 | 888259 | 889283 | 890302 | 891315 | 892323 | 893325 | 894322 | 895314 | 33 |
| | | 37′ 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 | 9.886213 9.887248 | 9.888277 | 9.889300 | 9.890319 | 9.891332 | 9.892339 | 9.893342 | 9.894339 | 9.895331 | 32 |
| 29 | 15 | 886230 887265 | 888294 | 889317 | 890336 | 891348 | 892356 | 893359 | 894356 | 895347 | 31 |
| 30 | 30 | 886248 887282 | 888311 | 889334 | 890353 | 891365 | 892373 | 893375 | 894372 | 895364 | 30 |
| 31 | 45 | 886265 887299 | 888328 | 889351 | 890369 | 891382 | 892390 | 893392 | 894389 | 895380 | 29 |
| | | 38′ 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 | 9.886282 9.887316 | 9.888345 | 9.889368 | 9.890386 | 9.891399 | 9.892406 | 9.893409 | 9.894405 | 9.895397 | 28 |
| 33 | 15 | 886299 887333 | 888362 | 889385 | 890403 | 891416 | 892423 | 893425 | 894422 | 895414 | 27 |
| 34 | 30 | 886317 887351 | 888379 | 889402 | 890420 | 891433 | 892440 | 893442 | 894439 | 895430 | 26 |
| 35 | 45 | 886334 887368 | 888396 | 889419 | 890437 | 891449 | 892457 | 893458 | 894455 | 895446 | 25 |
| | | 39′ 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 | 9.886351 9.887385 | 9.888413 | 9.889436 | 9.890454 | 9.891466 | 9.892473 | 9.893475 | 9.894472 | 9.895463 | 24 |
| 37 | 15 | 886369 887402 | 888430 | 889453 | 890471 | 891483 | 892490 | 893492 | 894488 | 895479 | 23 |
| 38 | 30 | 886386 887419 | 888448 | 889470 | 890488 | 891500 | 892507 | 893508 | 894505 | 895496 | 22 |
| 39 | 45 | 886403 887437 | 888465 | 889487 | 890505 | 891517 | 892524 | 893525 | 894521 | 895512 | 21 |
| | | 40′ 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 | 9.886420 9.887454 | 9.888482 | 9.889504 | 9.890522 | 9.891534 | 9.892540 | 9.893542 | 9.894538 | 9.895529 | 20 |
| 41 | 15 | 886438 887471 | 888499 | 889521 | 890539 | 891550 | 892557 | 893559 | 894554 | 895545 | 19 |
| 42 | 30 | 886455 887488 | 888516 | 889538 | 890556 | 891567 | 892574 | 893575 | 894571 | 895562 | 18 |
| 43 | 45 | 886472 887505 | 888533 | 889555 | 890572 | 891584 | 892591 | 893592 | 894587 | 895578 | 17 |
| | | 41′ 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 | 9.886489 9.887522 | 9.888550 | 9.889572 | 9.890589 | 9.891601 | 9.892607 | 9.893608 | 9.894604 | 9.895595 | 16 |
| 45 | 15 | 886507 887540 | 888567 | 889589 | 890606 | 891618 | 892624 | 893625 | 894621 | 895611 | 15 |
| 46 | 30 | 886524 887557 | 888584 | 889606 | 890623 | 891635 | 892641 | 893642 | 894637 | 895628 | 14 |
| 47 | 45 | 886541 887574 | 888601 | 889623 | 890640 | 891651 | 892657 | 893658 | 894654 | 895644 | 13 |
| | | 42′ 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 | 9.886558 9.887591 | 9.888618 | 9.889640 | 9.890657 | 9.891668 | 9.892674 | 9.893675 | 9.894670 | 9.895660 | 12 |
| 49 | 15 | 886576 887608 | 888635 | 889657 | 890674 | 891685 | 892691 | 893691 | 894687 | 895677 | 11 |
| 50 | 30 | 886593 887625 | 888653 | 889674 | 890691 | 891702 | 892708 | 893708 | 894703 | 895693 | 10 |
| 51 | 45 | 886610 887643 | 888670 | 889691 | 890708 | 891719 | 892724 | 893725 | 894720 | 895710 | 9 |
| | | 43′ 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 | 9.886628 9.887660 | 9.888687 | 9.889708 | 9.890725 | 9.891735 | 9.892741 | 9.893741 | 9.894736 | 9.895726 | 8 |
| 53 | 15 | 886645 887677 | 888704 | 889725 | 890741 | 891752 | 892758 | 893758 | 894753 | 895743 | 7 |
| 54 | 30 | 886662 887694 | 888721 | 889742 | 890758 | 891769 | 892775 | 893775 | 894770 | 895759 | 6 |
| 55 | 45 | 886679 887711 | 888738 | 889759 | 890775 | 891786 | 892791 | 893791 | 894786 | 895776 | 5 |
| | | 44′ 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 | 9.886696 9.887728 | 9.888755 | 9.889776 | 9.890792 | 9.891803 | 9.892808 | 9.893808 | 9.894803 | 9.895792 | 4 |
| 57 | 15 | 886714 887746 | 888772 | 889793 | 890809 | 891819 | 892825 | 893824 | 894819 | 895808 | 3 |
| 58 | 30 | 886731 887763 | 888789 | 889810 | 890826 | 891836 | 892841 | 893841 | 894836 | 895825 | 2 |
| 59 | 45 | 886748 887780 | 888806 | 889827 | 890843 | 891853 | 892858 | 893858 | 894852 | 895841 | 1 |
| 60 | 60 | 9.886765 9.887797 | 9.888823 | 9.889844 | 9.890860 | 9.891870 | 9.892875 | 9.893874 | 9.894869 | 9.895858 | 0 |

| sec. | | 20m | 21m | 22m | 23m | 24m | 25m | 26m | 27m | 28m | 29m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 125 deg. | | | | 126 deg. | | | | 127 deg. | | |
| | ′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 0 | 9.895858 | 9.896842 | 9.897820 | 9.898794 | 9.899762 | 9.900725 | 9.901682 | 9.902635 | 9.903582 | 9.904525 | 60 |
| 1 | 15 | 895874 | 896858 | 897836 | 898810 | 899778 | 900741 | 901698 | 902651 | 903598 | 904540 | 59 |
| 2 | 30 | 895891 | 896874 | 897853 | 898826 | 899794 | 900757 | 901714 | 902667 | 903614 | 904556 | 58 |
| 3 | 45 | 895907 | 896891 | 897869 | 898842 | 899810 | 900773 | 901730 | 902682 | 903630 | 904572 | 57 |
| | | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 0 | 9.895924 | 9.896907 | 9.897885 | 9.898858 | 9.899826 | 9.900789 | 9.901746 | 9.902698 | 9.903645 | 9.904587 | 56 |
| 5 | 15 | 895940 | 896923 | 897901 | 898874 | 899842 | 900805 | 901762 | 902714 | 903661 | 904603 | 55 |
| 6 | 30 | 895956 | 896940 | 897918 | 898891 | 899858 | 900821 | 901778 | 902730 | 903677 | 904619 | 54 |
| 7 | 45 | 895973 | 896956 | 897934 | 898907 | 899874 | 900837 | 901794 | 902746 | 903693 | 904634 | 53 |
| | | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 0 | 9.895989 | 9.896972 | 9.897950 | 9.898923 | 9.899890 | 9.900853 | 9.901810 | 9.902762 | 9.903708 | 9.904650 | 52 |
| 9 | 15 | 896006 | 896989 | 897967 | 898939 | 899906 | 900869 | 901826 | 902778 | 903724 | 904665 | 51 |
| 10 | 30 | 896022 | 897005 | 897983 | 898956 | 899923 | 900885 | 901842 | 902793 | 903740 | 904681 | 50 |
| 11 | 45 | 896039 | 897021 | 897999 | 898971 | 899939 | 900901 | 901857 | 902809 | 903755 | 904697 | 49 |
| | | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 0 | 9.896055 | 9.897038 | 9.898015 | 9.898988 | 9.899955 | 9.900917 | 9.901873 | 9.902825 | 9.903771 | 9.904712 | 48 |
| 13 | 15 | 896071 | 897054 | 898032 | 899004 | 899971 | 900933 | 901889 | 902841 | 903787 | 904728 | 47 |
| 14 | 30 | 896088 | 897070 | 898048 | 899020 | 899987 | 900949 | 901905 | 902857 | 903803 | 904744 | 46 |
| 15 | 45 | 896104 | 897087 | 898064 | 899036 | 900003 | 900965 | 901921 | 902872 | 903818 | 904760 | 45 |
| | | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 0 | 9.896121 | 9.897103 | 9.898080 | 9.899052 | 9.900019 | 9.900981 | 9.901937 | 9.902888 | 9.903834 | 9.904775 | 44 |
| 17 | 15 | 896137 | 897119 | 898097 | 899068 | 900035 | 900997 | 901953 | 902904 | 903850 | 904791 | 43 |
| 18 | 30 | 896154 | 897136 | 898113 | 899085 | 900051 | 901013 | 901969 | 902920 | 903866 | 904806 | 42 |
| 19 | 45 | 896170 | 897152 | 898129 | 899101 | 900067 | 901028 | 901985 | 902935 | 903881 | 904822 | 41 |
| | | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 0 | 9.896186 | 9.897168 | 9.898145 | 9.899117 | 9.900083 | 9.901045 | 9.902001 | 9.902951 | 9.903897 | 9.904838 | 40 |
| 21 | 15 | 896203 | 897185 | 898161 | 899133 | 900099 | 901060 | 902016 | 902967 | 903913 | 904853 | 39 |
| 22 | 30 | 896219 | 897201 | 898178 | 899149 | 900115 | 901076 | 902032 | 902983 | 903928 | 904869 | 38 |
| 23 | 45 | 896236 | 897217 | 898194 | 899165 | 900131 | 901092 | 902048 | 902999 | 903944 | 904884 | 37 |
| | | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 0 | 9.896252 | 9.897234 | 9.898210 | 9.899182 | 9.900148 | 9.901108 | 9.902064 | 9.903015 | 9.903960 | 9.904900 | 36 |
| 25 | 15 | 896268 | 897250 | 898226 | 899198 | 900164 | 901124 | 902080 | 903030 | 903976 | 904916 | 35 |
| 26 | 30 | 896285 | 897266 | 898243 | 899214 | 900180 | 901140 | 902096 | 903046 | 903991 | 904931 | 34 |
| 27 | 45 | 896301 | 897283 | 898259 | 899230 | 900196 | 901156 | 902112 | 903062 | 904007 | 904947 | 33 |
| | | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 0 | 9.896318 | 9.897299 | 9.898275 | 9.899246 | 9.900212 | 9.901172 | 9.902128 | 9.903078 | 9.904023 | 9.904963 | 32 |
| 29 | 15 | 896334 | 897316 | 898291 | 899262 | 900228 | 901188 | 902144 | 903094 | 904038 | 904978 | 31 |
| 30 | 30 | 896350 | 897332 | 898308 | 899278 | 900244 | 901204 | 902159 | 903109 | 904054 | 904994 | 30 |
| 31 | 45 | 896367 | 897348 | 898324 | 899294 | 900260 | 901220 | 902175 | 903125 | 904070 | 905009 | 29 |
| | | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 0 | 9.896383 | 9.897364 | 9.898340 | 9.899311 | 9.900276 | 9.901236 | 9.902191 | 9.903141 | 9.904086 | 9.905025 | 28 |
| 33 | 15 | 896400 | 897380 | 898356 | 899327 | 900292 | 901252 | 902207 | 903157 | 904101 | 905041 | 27 |
| 34 | 30 | 896416 | 897397 | 898372 | 899343 | 900308 | 901268 | 902223 | 903172 | 904117 | 905056 | 26 |
| 35 | 45 | 896432 | 897413 | 898389 | 899359 | 900324 | 901284 | 902239 | 903188 | 904133 | 905072 | 25 |
| | | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 0 | 9.896449 | 9.897429 | 9.898405 | 9.899375 | 9.900340 | 9.901300 | 9.902255 | 9.903204 | 9.904148 | 9.905087 | 24 |
| 37 | 15 | 896465 | 897446 | 898421 | 899391 | 900356 | 901316 | 902270 | 903220 | 904164 | 905103 | 23 |
| 38 | 30 | 896482 | 897462 | 898437 | 899407 | 900372 | 901332 | 902286 | 903236 | 904180 | 905119 | 22 |
| 39 | 45 | 896498 | 897478 | 898453 | 899423 | 900388 | 901348 | 902302 | 903251 | 904195 | 905134 | 21 |
| | | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 0 | 9.896514 | 9.897495 | 9.898470 | 9.899440 | 9.900404 | 9.901364 | 9.902318 | 9.903267 | 9.904211 | 9.905150 | 20 |
| 41 | 15 | 896531 | 897511 | 898486 | 899456 | 900420 | 901380 | 902334 | 903283 | 904227 | 905165 | 19 |
| 42 | 30 | 896547 | 897527 | 898502 | 899472 | 900436 | 901396 | 902350 | 903299 | 904242 | 905181 | 18 |
| 43 | 45 | 896563 | 897543 | 898518 | 899488 | 900452 | 901412 | 902366 | 903314 | 904258 | 905197 | 17 |
| | | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 0 | 9.896580 | 9.897560 | 9.898535 | 9.899504 | 9.900468 | 9.901428 | 9.902382 | 9.903330 | 9.904274 | 9.905212 | 16 |
| 45 | 15 | 896596 | 897576 | 898551 | 899520 | 900484 | 901443 | 902398 | 903346 | 904289 | 905228 | 15 |
| 46 | 30 | 896613 | 897592 | 898567 | 899536 | 900500 | 901459 | 902413 | 903362 | 904305 | 905243 | 14 |
| 47 | 45 | 896629 | 897609 | 898583 | 899552 | 900516 | 901475 | 902429 | 903378 | 904321 | 905259 | 13 |
| | | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 0 | 9.896645 | 9.897625 | 9.898599 | 9.899569 | 9.900532 | 9.901491 | 9.902445 | 9.903393 | 9.904337 | 9.905275 | 12 |
| 49 | 15 | 896662 | 897641 | 898615 | 899585 | 900548 | 901507 | 902461 | 903409 | 904352 | 905290 | 11 |
| 50 | 30 | 896678 | 897658 | 898632 | 899601 | 900565 | 901523 | 902477 | 903425 | 904368 | 905306 | 10 |
| 51 | 45 | 896694 | 897674 | 898648 | 899617 | 900581 | 901539 | 902492 | 903441 | 904384 | 905321 | 9 |
| | | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 0 | 9.896711 | 9.897690 | 9.898664 | 9.899633 | 9.900597 | 9.901555 | 9.902508 | 9.903456 | 9.904399 | 9.905337 | 8 |
| 53 | 15 | 896727 | 897706 | 898680 | 899649 | 900613 | 901571 | 902524 | 903472 | 904415 | 905353 | 7 |
| 54 | 30 | 896744 | 897723 | 898697 | 899665 | 900629 | 901587 | 902540 | 903488 | 904431 | 905368 | 6 |
| 55 | 45 | 896760 | 897739 | 898713 | 899681 | 900645 | 901603 | 902556 | 903504 | 904446 | 905384 | 5 |
| | | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 0 | 9.896776 | 9.897755 | 9.898729 | 9.899697 | 9.900661 | 9.901619 | 9.902572 | 9.903519 | 9.904462 | 9.905399 | 4 |
| 57 | 15 | 896793 | 897771 | 898745 | 899713 | 900677 | 901635 | 902587 | 903535 | 904478 | 905414 | 3 |
| 58 | 30 | 896809 | 897788 | 898761 | 899730 | 900693 | 901651 | 902603 | 903551 | 904493 | 905430 | 2 |
| 59 | 45 | 896825 | 897804 | 898777 | 899746 | 900709 | 901666 | 902619 | 903567 | 904509 | 905446 | 1 |
| 60 | 60 | 9.896842 | 9.897820 | 9.898794 | 9.899762 | 9.900725 | 9.901682 | 9.902635 | 9.903582 | 9.904525 | 9.905462 | 0 |
| sec. | | 39m | 38m | 37m | 36m | 35m | 34m | 33m | 32m | 31m | 30m | sec. |

| sec. | 30m | 31m | 32m | 33m | 34m | 35m | 36m | 37m | 38m | 39m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 127 deg. | | 128 deg. | | | | 129 deg. | | | | |
| | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | |
| 0 | 0 9.905462 | 9.906394 | 9.907320 | 9.908242 | 9.909159 | 9.910070 | 9.910976 | 9.911878 | 9.912774 | 9.913665 | 60 |
| 1 | 15 905477 | 906409 | 907336 | 908257 | 909174 | 910085 | 910992 | 911893 | 912789 | 913680 | 59 |
| 2 | 30 905493 | 906425 | 907351 | 908273 | 909189 | 910100 | 911007 | 911908 | 912804 | 913695 | 58 |
| 3 | 45 905508 | 906440 | 907367 | 908288 | 909204 | 910116 | 911022 | 911923 | 912819 | 913710 | 57 |
| | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 9.905524 | 9.906456 | 9.907382 | 9.908303 | 9.909220 | 9.910131 | 9.911037 | 9.911938 | 9.912834 | 9.913725 | 56 |
| 5 | 15 905539 | 906471 | 907397 | 908319 | 909235 | 910146 | 911052 | 911953 | 912849 | 913739 | 55 |
| 6 | 30 905555 | 906486 | 907413 | 908334 | 909250 | 910161 | 911067 | 911968 | 912863 | 913754 | 54 |
| 7 | 45 905571 | 906502 | 907428 | 908349 | 909265 | 910176 | 911082 | 911983 | 912878 | 913769 | 53 |
| | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 9.905586 | 9.906517 | 9.907444 | 9.908365 | 9.909280 | 9.910191 | 9.911097 | 9.911998 | 9.912893 | 9.913784 | 52 |
| 9 | 15 905602 | 906533 | 907459 | 908380 | 909296 | 910206 | 911112 | 912013 | 912908 | 913798 | 51 |
| 10 | 30 905617 | 906548 | 907474 | 908395 | 909311 | 910222 | 911127 | 912028 | 912923 | 913813 | 50 |
| 11 | 45 905633 | 906564 | 907490 | 908410 | 909326 | 910237 | 911142 | 912043 | 912938 | 913828 | 49 |
| | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 9.905648 | 9.906579 | 9.907505 | 9.908426 | 9.909341 | 9.910252 | 9.911157 | 9.912057 | 9.912953 | 9.913843 | 48 |
| 13 | 15 905664 | 906595 | 907520 | 908441 | 909357 | 910267 | 911172 | 912072 | 912968 | 913858 | 47 |
| 14 | 30 905680 | 906610 | 907536 | 908456 | 909372 | 910282 | 911187 | 912087 | 912982 | 913872 | 46 |
| 15 | 45 905695 | 906626 | 907551 | 908472 | 909387 | 910297 | 911202 | 912102 | 912997 | 913887 | 45 |
| | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 9.905711 | 9.906641 | 9.907567 | 9.908487 | 9.909402 | 9.910312 | 9.911217 | 9.912117 | 9.913012 | 9.913902 | 44 |
| 17 | 15 905726 | 906657 | 907582 | 908502 | 909417 | 910327 | 911232 | 912132 | 913027 | 913917 | 43 |
| 18 | 30 905742 | 906672 | 907597 | 908518 | 909433 | 910343 | 911247 | 912147 | 913042 | 913932 | 42 |
| 19 | 45 905757 | 906688 | 907613 | 908533 | 909448 | 910358 | 911262 | 912162 | 913057 | 913946 | 41 |
| | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 9.905773 | 9.906703 | 9.907628 | 9.908548 | 9.909463 | 9.910373 | 9.911277 | 9.912177 | 9.913072 | 9.913961 | 40 |
| 21 | 15 905788 | 906719 | 907644 | 908563 | 909478 | 910388 | 911293 | 912192 | 913087 | 913976 | 39 |
| 22 | 30 905804 | 906734 | 907659 | 908579 | 909493 | 910403 | 911308 | 912207 | 913101 | 913991 | 38 |
| 23 | 45 905819 | 906749 | 907674 | 908594 | 909509 | 910418 | 911323 | 912222 | 913116 | 914006 | 37 |
| | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 9.905835 | 9.906765 | 9.907690 | 9.908609 | 9.909524 | 9.910433 | 9.911338 | 9.912237 | 9.913131 | 9.914020 | 36 |
| 25 | 15 905851 | 906780 | 907705 | 908625 | 909539 | 910448 | 911353 | 912252 | 913146 | 914035 | 35 |
| 26 | 30 905866 | 906796 | 907720 | 908640 | 909554 | 910463 | 911368 | 912267 | 913161 | 914050 | 34 |
| 27 | 45 905882 | 906811 | 907736 | 908655 | 909569 | 910479 | 911383 | 912282 | 913176 | 914065 | 33 |
| | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 9.905897 | 9.906827 | 9.907751 | 9.908670 | 9.909585 | 9.910494 | 9.911398 | 9.912297 | 9.913191 | 9.914079 | 32 |
| 29 | 15 905913 | 906842 | 907766 | 908686 | 909600 | 910509 | 911413 | 912312 | 913206 | 914094 | 31 |
| 30 | 30 905928 | 906858 | 907782 | 908701 | 909615 | 910524 | 911428 | 912327 | 913220 | 914109 | 30 |
| 31 | 45 905944 | 906873 | 907797 | 908716 | 909630 | 910539 | 911443 | 912342 | 913235 | 914124 | 29 |
| | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 9.905959 | 9.906889 | 9.907813 | 9.908732 | 9.909645 | 9.910554 | 9.911458 | 9.912356 | 9.913250 | 9.914139 | 28 |
| 33 | 15 905975 | 906904 | 907828 | 909747 | 909661 | 910569 | 911473 | 912371 | 913265 | 914153 | 27 |
| 34 | 30 905990 | 906919 | 907843 | 908762 | 909676 | 910584 | 911488 | 912386 | 913280 | 914168 | 26 |
| 35 | 45 906006 | 906935 | 907859 | 908777 | 909691 | 910599 | 911503 | 912401 | 913295 | 914183 | 25 |
| | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 9.906021 | 9.906950 | 9.907874 | 9.908793 | 9.909706 | 9.910615 | 9.911518 | 9.912416 | 9.913309 | 9.914198 | 24 |
| 37 | 15 906037 | 906966 | 907889 | 908808 | 909721 | 910630 | 911533 | 912431 | 913324 | 914212 | 23 |
| 38 | 30 906052 | 906981 | 907905 | 908823 | 909736 | 910645 | 911548 | 912446 | 913339 | 914227 | 22 |
| 39 | 45 906068 | 906997 | 907920 | 908838 | 909752 | 910660 | 911563 | 912461 | 913354 | 914242 | 21 |
| | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 9.906084 | 9.907012 | 9.907935 | 9.908854 | 9.909767 | 9.910675 | 9.911578 | 9.912476 | 9.913369 | 9.914257 | 20 |
| 41 | 15 906099 | 907027 | 907951 | 908869 | 909782 | 910690 | 911593 | 912491 | 913384 | 914271 | 19 |
| 42 | 30 906115 | 907043 | 907966 | 908884 | 909797 | 910705 | 911608 | 912506 | 913398 | 914286 | 18 |
| 43 | 45 906130 | 907058 | 907981 | 908899 | 909812 | 910720 | 911623 | 912521 | 913413 | 914301 | 17 |
| | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 9.906146 | 9.907074 | 9.907997 | 9.908915 | 9.909828 | 9.910735 | 9.911638 | 9.912536 | 9.913428 | 9.914316 | 16 |
| 45 | 15 906161 | 907089 | 908012 | 908930 | 909843 | 910750 | 911653 | 912550 | 913443 | 914330 | 15 |
| 46 | 30 906177 | 907105 | 908027 | 908945 | 909858 | 910765 | 911668 | 912565 | 913458 | 914345 | 14 |
| 47 | 45 906192 | 907120 | 908043 | 908960 | 909873 | 910781 | 911683 | 912580 | 913473 | 914360 | 13 |
| | 43′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 9.906208 | 9.907135 | 9.908058 | 9.908976 | 9.909888 | 9.910796 | 9.911698 | 9.912595 | 9.913487 | 9.914375 | 12 |
| 49 | 15 906223 | 907151 | 908073 | 908991 | 909903 | 910811 | 911713 | 912610 | 913502 | 914389 | 11 |
| 50 | 30 906239 | 907166 | 908089 | 909006 | 909919 | 910826 | 911728 | 912625 | 913517 | 914404 | 10 |
| 51 | 45 906254 | 907182 | 908104 | 909021 | 909934 | 910841 | 911743 | 912640 | 913532 | 914419 | 9 |
| | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 9.906270 | 9.907197 | 9.908119 | 9.909037 | 9.909949 | 9.910856 | 9.911758 | 9.912655 | 9.913547 | 9.914434 | 8 |
| 53 | 15 906285 | 907212 | 908135 | 909052 | 909964 | 910871 | 911773 | 912670 | 913562 | 914448 | 7 |
| 54 | 30 906301 | 907228 | 908150 | 909067 | 909979 | 910886 | 911788 | 912685 | 913576 | 914463 | 6 |
| 55 | 45 906316 | 907243 | 908165 | 909082 | 909994 | 910901 | 911803 | 912700 | 913591 | 914478 | 5 |
| | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 9.906332 | 9.907259 | 9.908181 | 9.909098 | 9.910009 | 9.910916 | 9.911818 | 9.912714 | 9.913606 | 9.914493 | 4 |
| 57 | 15 906347 | 907274 | 908196 | 909113 | 910025 | 910931 | 911833 | 912729 | 913621 | 914507 | 3 |
| 58 | 30 906363 | 907290 | 908211 | 909128 | 910040 | 910946 | 911848 | 912744 | 913636 | 914522 | 2 |
| 59 | 45 906378 | 907305 | 908227 | 909143 | 910055 | 910961 | 911863 | 912759 | 913650 | 914537 | 1 |
| 60 | 60 9.906394 | 9.907320 | 9.908242 | 9.909159 | 9.910070 | 9.910976 | 9.911878 | 9.912774 | 9.913665 | 9.914551 | 0 |
| sec. | 29m | 28m | 27m | 26m | 25m | 24m | 23m | 22m | 21m | 20m | sec. |

| sec. | 40m | 41m | 42m | 43m | 44m | 45m | 46m | 47m | 48m | 49m | sec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 130 deg. | | | | 131 deg. | | | | 132 deg. | | |
| | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | |
| 0 | 9.914551 | 9.915433 | 9.916309 | 9.917180 | 9.918046 | 9.918907 | 9.919763 | 9.920614 | 9.921460 | 9.922302 | 60 |
| 1 | 914556 | 915447 | 916323 | 917194 | 918060 | 918921 | 919778 | 920628 | 921474 | 922315 | 59 |
| 2 | 914581 | 915462 | 916338 | 917209 | 918075 | 918936 | 919791 | 920642 | 921488 | 922329 | 58 |
| 3 | 914596 | 915476 | 916352 | 917223 | 918089 | 918950 | 919806 | 920657 | 921502 | 922343 | 57 |
| | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | |
| 4 | 9.914610 | 9.915491 | 9.916367 | 9.917238 | 9.918103 | 9.918964 | 9.919820 | 9.920671 | 9.921517 | 9.922357 | 56 |
| 5 | 914625 | 915506 | 916381 | 917252 | 918118 | 918978 | 919834 | 920685 | 921531 | 922371 | 55 |
| 6 | 914640 | 915520 | 916396 | 917267 | 918132 | 918993 | 919848 | 920699 | 921545 | 922385 | 54 |
| 7 | 914654 | 915535 | 916411 | 917281 | 918146 | 919007 | 919863 | 920713 | 921559 | 922399 | 53 |
| | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | |
| 8 | 9.914669 | 9.915550 | 9.916425 | 9.917295 | 9.918161 | 9.919021 | 9.919877 | 9.920727 | 9.921573 | 9.922413 | 52 |
| 9 | 914684 | 915564 | 916440 | 917310 | 918175 | 919036 | 919891 | 920741 | 921587 | 922427 | 51 |
| 10 | 914699 | 915579 | 916454 | 917324 | 918190 | 919050 | 919905 | 920756 | 921601 | 922441 | 50 |
| 11 | 914713 | 915594 | 916469 | 917339 | 918204 | 919064 | 919919 | 920770 | 921615 | 922455 | 49 |
| | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | |
| 12 | 9.914728 | 9.915608 | 9.916483 | 9.917353 | 9.918218 | 9.919079 | 9.919934 | 9.920784 | 9.921629 | 9.922470 | 48 |
| 13 | 914743 | 915623 | 916498 | 917368 | 918233 | 919093 | 919948 | 920798 | 921643 | 922484 | 47 |
| 14 | 914757 | 915637 | 916512 | 917382 | 918247 | 919107 | 919962 | 920812 | 921657 | 922497 | 46 |
| 15 | 914772 | 915652 | 916527 | 917397 | 918262 | 919121 | 919976 | 920826 | 921671 | 922511 | 45 |
| | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | |
| 16 | 9.914787 | 9.915667 | 9.916541 | 9.917411 | 9.918276 | 9.919136 | 9.919990 | 9.920840 | 9.921685 | 9.922525 | 44 |
| 17 | 914802 | 915681 | 916556 | 917426 | 918290 | 919150 | 920005 | 920854 | 921699 | 922539 | 43 |
| 18 | 914816 | 915696 | 916570 | 917440 | 918305 | 919164 | 920019 | 920869 | 921713 | 922553 | 42 |
| 19 | 914831 | 915710 | 916585 | 917454 | 918319 | 919179 | 920033 | 920883 | 921727 | 922567 | 41 |
| | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | |
| 20 | 9.914846 | 9.915725 | 9.916600 | 9.917469 | 9.918333 | 9.919193 | 9.920047 | 9.920897 | 9.921741 | 9.922581 | 40 |
| 21 | 914860 | 915740 | 916614 | 917483 | 918348 | 919207 | 920061 | 920911 | 921755 | 922595 | 39 |
| 22 | 914875 | 915754 | 916629 | 917498 | 918362 | 919221 | 920076 | 920925 | 921769 | 922609 | 38 |
| 23 | 914889 | 915769 | 916643 | 917512 | 918376 | 919236 | 920090 | 920939 | 921783 | 922623 | 37 |
| | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | |
| 24 | 9.914904 | 9.915784 | 9.916658 | 9.917527 | 9.918391 | 9.919250 | 9.920104 | 9.920953 | 9.921797 | 9.922637 | 36 |
| 25 | 914919 | 915798 | 916672 | 917541 | 918405 | 919264 | 920118 | 920967 | 921811 | 922651 | 35 |
| 26 | 914934 | 915813 | 916687 | 917556 | 918420 | 919279 | 920132 | 920981 | 921825 | 922665 | 34 |
| 27 | 914949 | 915827 | 916701 | 917570 | 918434 | 919293 | 920147 | 920995 | 921839 | 922678 | 33 |
| | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | |
| 28 | 9.914963 | 9.915842 | 9.916716 | 9.917585 | 9.918448 | 9.919307 | 9.920161 | 9.921010 | 9.921854 | 9.922693 | 32 |
| 29 | 914978 | 915857 | 916730 | 917599 | 918463 | 919321 | 920175 | 921024 | 921867 | 922706 | 31 |
| 30 | 914993 | 915871 | 916745 | 917613 | 918477 | 919336 | 920189 | 921038 | 921882 | 922720 | 30 |
| 31 | 915007 | 915886 | 916759 | 917628 | 918491 | 919350 | 920203 | 921052 | 921896 | 922734 | 29 |
| | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | |
| 32 | 9.915022 | 9.915900 | 9.916774 | 9.917642 | 9.918506 | 9.919364 | 9.920218 | 9.921066 | 9.921910 | 9.922748 | 28 |
| 33 | 915037 | 915915 | 916788 | 917657 | 918520 | 919378 | 920232 | 921080 | 921924 | 922762 | 27 |
| 34 | 915051 | 915930 | 916803 | 917671 | 918534 | 919393 | 920246 | 921094 | 921938 | 922776 | 26 |
| 35 | 915066 | 915944 | 916817 | 917686 | 918549 | 919407 | 920260 | 921108 | 921952 | 922790 | 25 |
| | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | |
| 36 | 9.915081 | 9.915959 | 9.916832 | 9.917700 | 9.918563 | 9.919421 | 9.920274 | 9.921122 | 9.921966 | 9.922804 | 24 |
| 37 | 915095 | 915973 | 916846 | 917714 | 918577 | 919435 | 920288 | 921136 | 921980 | 922818 | 23 |
| 38 | 915110 | 915988 | 916861 | 917729 | 918592 | 919450 | 920303 | 921151 | 921994 | 922832 | 22 |
| 39 | 915125 | 916003 | 916875 | 917743 | 918606 | 919464 | 920317 | 921165 | 922008 | 922846 | 21 |
| | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | |
| 40 | 9.915139 | 9.916017 | 9.916890 | 9.917758 | 9.918620 | 9.919478 | 9.920331 | 9.921179 | 9.922022 | 9.922860 | 20 |
| 41 | 915154 | 916032 | 916904 | 917772 | 918635 | 919492 | 920345 | 921193 | 922036 | 922873 | 19 |
| 42 | 915169 | 916046 | 916919 | 917787 | 918649 | 919507 | 920359 | 921207 | 922050 | 922887 | 18 |
| 43 | 915183 | 916061 | 916933 | 917801 | 918663 | 919521 | 920373 | 921221 | 922064 | 922901 | 17 |
| | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | |
| 44 | 9.915198 | 9.916076 | 9.916948 | 9.917815 | 9.918678 | 9.919535 | 9.920388 | 9.921235 | 9.922078 | 9.922915 | 16 |
| 45 | 915213 | 916090 | 916962 | 917830 | 918692 | 919549 | 920402 | 921249 | 922092 | 922929 | 15 |
| 46 | 915227 | 916105 | 916977 | 917844 | 918706 | 919564 | 920416 | 921263 | 922106 | 922943 | 14 |
| 47 | 915242 | 916119 | 916991 | 917859 | 918720 | 919578 | 920430 | 921277 | 922120 | 922957 | 13 |
| | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | |
| 48 | 9.915257 | 9.916134 | 9.917006 | 9.917873 | 9.918735 | 9.919592 | 9.920444 | 9.921291 | 9.922134 | 9.922971 | 12 |
| 49 | 915271 | 916148 | 917020 | 917887 | 918749 | 919606 | 920458 | 921306 | 922148 | 922985 | 11 |
| 50 | 915286 | 916163 | 917035 | 917902 | 918764 | 919621 | 920473 | 921320 | 922162 | 922999 | 10 |
| 51 | 915301 | 916178 | 917049 | 917916 | 918778 | 919635 | 920487 | 921334 | 922176 | 923013 | 9 |
| | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | |
| 52 | 9.915315 | 9.916192 | 9.917064 | 9.917931 | 9.918792 | 9.919649 | 9.920501 | 9.921348 | 9.922190 | 9.923027 | 8 |
| 53 | 915330 | 916207 | 917078 | 917945 | 918807 | 919663 | 920515 | 921362 | 922204 | 923040 | 7 |
| 54 | 915345 | 916221 | 917093 | 917959 | 918821 | 919678 | 920529 | 921376 | 922218 | 923054 | 6 |
| 55 | 915359 | 916236 | 917107 | 917974 | 918835 | 919692 | 920543 | 921390 | 922232 | 923068 | 5 |
| | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | |
| 56 | 9.915374 | 9.916250 | 9.917122 | 9.917988 | 9.918850 | 9.919706 | 9.920558 | 9.921404 | 9.922246 | 9.923082 | 4 |
| 57 | 915389 | 916265 | 917136 | 918003 | 918864 | 919720 | 920572 | 921418 | 922260 | 923096 | 3 |
| 58 | 915403 | 916280 | 917151 | 918017 | 918878 | 919735 | 920586 | 921432 | 922274 | 923110 | 2 |
| 59 | 915418 | 916294 | 917165 | 918031 | 918893 | 919749 | 920600 | 921446 | 922287 | 923124 | 1 |
| 60 | 9.915433 | 9.916309 | 9.917180 | 9.918046 | 9.918907 | 9.919763 | 9.920614 | 9.921460 | 9.922302 | 9.923138 | 0 |
| sec. | 19m | 18m | 17m | 16m | 15m | 14m | 13m | 12m | 11m | 10m | sec. |

| | 50m | 51m | 52m | 53m | 54m | 55m | 56m | 57m | 58m | 59m | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 132 deg. | | 133 deg. | | | | 134 deg. | | | | |
| sec. | ′ | 30′ 45′ | 0′ | 15′ | 30′ | 45′ | 0′ | 15′ | 30′ | 45′ | sec. |
| 0 | 0 | 9.923138 9.923969 | 9.924796 | 9.925617 | 9.926434 | 9.927245 | 9.928052 | 9.928854 | 9.929651 | 9.930443 | 60 |
| 1 | 15 | 923152 923983 | 924809 | 925631 | 926447 | 927259 | 928065 | 928867 | 929664 | 930456 | 59 |
| 2 | 30 | 923166 923997 | 924823 | 925644 | 926461 | 927272 | 928079 | 928881 | 929678 | 930470 | 58 |
| 3 | 45 | 923179 924011 | 924837 | 925658 | 926474 | 927286 | 928092 | 928894 | 929691 | 930483 | 57 |
| | | 31′ 46′ | 1′ | 16′ | 31′ | 46′ | 1′ | 16′ | 31′ | 46′ | |
| 4 | 0 | 9.923193 9.924024 | 9.924850 | 9.925672 | 9.926488 | 9.927299 | 9.928106 | 9.928907 | 9.929704 | 9.930496 | 56 |
| 5 | 15 | 923207 924038 | 924864 | 925685 | 926501 | 927313 | 928119 | 928921 | 929717 | 930509 | 55 |
| 6 | 30 | 923221 924052 | 924878 | 925699 | 926515 | 927326 | 928133 | 928934 | 929731 | 930522 | 54 |
| 7 | 45 | 923235 924066 | 924892 | 925713 | 926529 | 927340 | 928146 | 928947 | 929744 | 930535 | 53 |
| | | 32′ 47′ | 2′ | 17′ | 32′ | 47′ | 2′ | 17′ | 32′ | 47′ | |
| 8 | 0 | 9.923249 9.924080 | 9.924905 | 9.925726 | 9.926542 | 9.927353 | 9.928159 | 9.928961 | 9.929757 | 9.930549 | 52 |
| 9 | 15 | 923263 924094 | 924919 | 925740 | 926556 | 927367 | 928173 | 928974 | 929770 | 930562 | 51 |
| 10 | 30 | 923277 924107 | 924933 | 925754 | 926569 | 927380 | 928186 | 928987 | 929784 | 930575 | 50 |
| 11 | 45 | 923291 924121 | 924946 | 925767 | 926583 | 927394 | 928199 | 929000 | 929797 | 930588 | 49 |
| | | 33′ 48′ | 3′ | 18′ | 33′ | 48′ | 3′ | 18′ | 33′ | 48′ | |
| 12 | 0 | 9.923304 9.924135 | 9.924960 | 9.925781 | 9.926596 | 9.927407 | 9.928213 | 9.929014 | 9.929810 | 9.930601 | 48 |
| 13 | 15 | 923318 924149 | 924974 | 925794 | 926610 | 927420 | 928226 | 929027 | 929823 | 930614 | 47 |
| 14 | 30 | 923332 924162 | 924988 | 925808 | 926623 | 927434 | 928240 | 929041 | 929836 | 930627 | 46 |
| 15 | 45 | 923346 924176 | 925001 | 925822 | 926637 | 927447 | 928253 | 929054 | 929850 | 930641 | 45 |
| | | 34′ 49′ | 4′ | 19′ | 34′ | 49′ | 4′ | 19′ | 34′ | 49′ | |
| 16 | 0 | 9.923360 9.924190 | 9.925015 | 9.925835 | 9.926651 | 9.927461 | 9.928266 | 9.929067 | 9.929863 | 9.930654 | 44 |
| 17 | 15 | 923374 924204 | 925029 | 925849 | 926664 | 927474 | 928280 | 929080 | 929876 | 930667 | 43 |
| 18 | 30 | 923388 924218 | 925043 | 925863 | 926678 | 927488 | 928293 | 929094 | 929889 | 930680 | 42 |
| 19 | 45 | 923402 924231 | 925056 | 925876 | 926681 | 927501 | 928307 | 929107 | 929902 | 930693 | 41 |
| | | 35′ 50′ | 5′ | 20′ | 35′ | 50′ | 5′ | 20′ | 35′ | 50′ | |
| 20 | 0 | 9.923415 9.924245 | 9.925070 | 9.925890 | 9.926705 | 9.927515 | 9.928320 | 9.929120 | 9.929916 | 9.930706 | 40 |
| 21 | 15 | 923429 924259 | 925084 | 925903 | 926718 | 927528 | 928333 | 929134 | 929929 | 930719 | 39 |
| 22 | 30 | 923443 924273 | 925097 | 925917 | 926732 | 927542 | 928347 | 929147 | 929942 | 930733 | 38 |
| 23 | 45 | 923457 924286 | 925111 | 925931 | 926745 | 927555 | 928360 | 929160 | 929955 | 930746 | 37 |
| | | 36′ 51′ | 6′ | 21′ | 36′ | 51′ | 6′ | 21′ | 36′ | 51′ | |
| 24 | 0 | 9.923471 9.924300 | 9.925125 | 9.925944 | 9.926759 | 9.927569 | 9.928374 | 9.929174 | 9.929969 | 9.930759 | 36 |
| 25 | 15 | 923485 924314 | 925138 | 925958 | 926772 | 927582 | 928387 | 929187 | 929982 | 930772 | 35 |
| 26 | 30 | 923499 924328 | 925152 | 925972 | 926786 | 927596 | 928400 | 929200 | 929995 | 930785 | 34 |
| 27 | 45 | 923512 924342 | 925166 | 925985 | 926799 | 927609 | 928413 | 929213 | 930008 | 930798 | 33 |
| | | 37′ 52′ | 7′ | 22′ | 37′ | 52′ | 7′ | 22′ | 37′ | 52′ | |
| 28 | 0 | 9.923526 9.924355 | 9.925180 | 9.925999 | 9.926813 | 9.927622 | 9.928427 | 9.929227 | 9.930021 | 9.930811 | 32 |
| 29 | 15 | 923540 924369 | 925193 | 926012 | 926826 | 927636 | 928440 | 929240 | 930035 | 930824 | 31 |
| 30 | 30 | 923554 924383 | 925207 | 926026 | 926840 | 927649 | 928454 | 929253 | 930048 | 930838 | 30 |
| 31 | 45 | 923568 924397 | 925221 | 926039 | 926854 | 927663 | 928467 | 929266 | 930061 | 930851 | 29 |
| | | 38′ 53′ | 8′ | 23′ | 38′ | 53′ | 8′ | 23′ | 38′ | 53′ | |
| 32 | 0 | 9.923582 9.924411 | 9.925234 | 9.926053 | 9.926867 | 9.927676 | 9.928480 | 9.929280 | 9.930074 | 9.930864 | 28 |
| 33 | 15 | 923596 924424 | 925248 | 926067 | 926881 | 927690 | 928494 | 929293 | 930087 | 930877 | 27 |
| 34 | 30 | 923610 924438 | 925262 | 926080 | 926894 | 927703 | 928507 | 929306 | 930101 | 930890 | 26 |
| 35 | 45 | 923623 924452 | 925275 | 926094 | 926908 | 927716 | 928520 | 929320 | 930114 | 930903 | 25 |
| | | 39′ 54′ | 9′ | 24′ | 39′ | 54′ | 9′ | 24′ | 39′ | 54′ | |
| 36 | 0 | 9.923637 9.924466 | 9.925289 | 9.926108 | 9.926921 | 9.927730 | 9.928534 | 9.929333 | 9.930127 | 9.930916 | 24 |
| 37 | 15 | 923651 924479 | 925303 | 926121 | 926935 | 927743 | 928547 | 929346 | 930140 | 930929 | 23 |
| 38 | 30 | 923665 924493 | 925316 | 926135 | 926948 | 927757 | 928561 | 929359 | 930153 | 930943 | 22 |
| 39 | 45 | 923679 924507 | 925333 | 926148 | 926962 | 927770 | 928574 | 929373 | 930167 | 930956 | 21 |
| | | 40′ 55′ | 10′ | 25′ | 40′ | 55′ | 10′ | 25′ | 40′ | 55′ | |
| 40 | 0 | 9.923693 9.924521 | 9.925344 | 9.926162 | 9.926975 | 9.927784 | 9.928587 | 9.929386 | 9.930180 | 9.930969 | 20 |
| 41 | 15 | 923706 924534 | 925357 | 926176 | 926989 | 927797 | 928601 | 929399 | 930193 | 930983 | 19 |
| 42 | 30 | 923720 924548 | 925371 | 926189 | 927002 | 927811 | 928614 | 929413 | 930206 | 930995 | 18 |
| 43 | 45 | 923734 924562 | 925385 | 926203 | 927016 | 927824 | 928627 | 929426 | 930219 | 931009 | 17 |
| | | 41′ 56′ | 11′ | 26′ | 41′ | 56′ | 11′ | 26′ | 41′ | 56′ | |
| 44 | 0 | 9.923748 9.924576 | 9.925398 | 9.926216 | 9.927029 | 9.927837 | 9.928641 | 9.929439 | 9.930233 | 9.931021 | 16 |
| 45 | 15 | 923762 924589 | 925412 | 926230 | 927043 | 927851 | 928654 | 929452 | 930246 | 931035 | 15 |
| 46 | 30 | 923776 924603 | 925426 | 926244 | 927056 | 927864 | 928667 | 929466 | 930259 | 931047 | 14 |
| 47 | 45 | 923789 924617 | 925439 | 926257 | 927070 | 927878 | 928681 | 929479 | 930272 | 931061 | 13 |
| | | 42′ 57′ | 12′ | 27′ | 42′ | 57′ | 12′ | 27′ | 42′ | 57′ | |
| 48 | 0 | 9.923803 9.924631 | 9.925453 | 9.926271 | 9.927083 | 9.927891 | 9.928694 | 9.929492 | 9.930285 | 9.931074 | 12 |
| 49 | 15 | 923817 924644 | 925467 | 926284 | 927097 | 927905 | 928707 | 929505 | 930298 | 931088 | 11 |
| 50 | 30 | 923831 924658 | 925480 | 926298 | 927110 | 927918 | 928721 | 929519 | 930312 | 931100 | 10 |
| 51 | 45 | 923845 924672 | 925494 | 926311 | 927124 | 927931 | 928734 | 929532 | 930325 | 931114 | 9 |
| | | 43′ 58′ | 13′ | 28′ | 43′ | 58′ | 13′ | 28′ | 43′ | 58′ | |
| 52 | 0 | 9.923859 9.924686 | 9.925508 | 9.926325 | 9.927137 | 9.927945 | 9.928747 | 9.929544 | 9.930338 | 9.931126 | 8 |
| 53 | 15 | 923872 924699 | 925521 | 926339 | 927151 | 927958 | 928761 | 929559 | 930351 | 931140 | 7 |
| 54 | 30 | 923886 924713 | 925535 | 926352 | 927164 | 927972 | 928774 | 929572 | 930364 | 931152 | 6 |
| 55 | 45 | 923900 924727 | 925549 | 926366 | 927178 | 927985 | 928787 | 929585 | 930377 | 931166 | 5 |
| | | 44′ 59′ | 14′ | 29′ | 44′ | 59′ | 14′ | 29′ | 44′ | 59′ | |
| 56 | 0 | 9.923914 9.924741 | 9.925562 | 9.926379 | 9.927191 | 9.927999 | 9.928801 | 9.929598 | 9.930391 | 9.931178 | 4 |
| 57 | 15 | 923928 924754 | 925576 | 926393 | 927205 | 928012 | 928814 | 929612 | 930404 | 931192 | 3 |
| 58 | 30 | 923942 924768 | 925590 | 926407 | 927218 | 928025 | 928827 | 929625 | 930417 | 931205 | 2 |
| 59 | 45 | 923955 924782 | 925603 | 926420 | 927232 | 928039 | 928841 | 929639 | 930430 | 931219 | 1 |
| 60 | 0 | 9.923969 9.924796 | 9.925617 | 9.926434 | 9.927245 | 9.928052 | 9.928854 | 9.929651 | 9.930443 | 9.931231 | 0 |

| Time. | Arc. | $9^h\ 0^m$ | $9^h\ 4^m$ | $9^h\ 8^m$ | $9^h\ 12^m$ | $9^h\ 16^m$ | $9^h\ 20^m$ | $9^h\ 24^m$ | $9^h\ 28^m$ | $9^h\ 32^m$ | Arc. | Time. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| m s | | 135° | 136° | 137° | 138° | 139° | 140° | 141° | 142° | 143° | | s m |
| 0 0 | 0 | 9.931231 | 9.934332 | 9.937356 | 9.940303 | 9.943175 | 9.945972 | 9.948693 | 9.951340 | 9.953913 | 60 | 0 4 |
| 0 4 | 1 | 931283 | 934383 | 937406 | 940352 | 943223 | 946018 | 948738 | 951384 | 953955 | 59 | 56 3 |
| 0 8 | 2 | 931335 | 934434 | 937455 | 940400 | 943270 | 946064 | 948783 | 951427 | 953998 | 58 | 52 3 |
| 0 12 | 3 | 931388 | 934485 | 937505 | 940449 | 943317 | 946109 | 948827 | 951471 | 954040 | 57 | 48 3 |
| 0 16 | 4 | 9.931440 | 9.934536 | 9.937555 | 9.940497 | 9.943364 | 9.946155 | 9.948872 | 9.951514 | 9.954082 | 56 | 44 3 |
| 0 20 | 5 | 931492 | 934587 | 937604 | 940546 | 943411 | 946201 | 948917 | 951557 | 954124 | 55 | 40 3 |
| 0 24 | 6 | 931544 | 934638 | 937654 | 940594 | 943458 | 946247 | 948961 | 951601 | 954166 | 54 | 36 3 |
| 0 28 | 7 | 931596 | 934688 | 937704 | 940642 | 943505 | 946293 | 949006 | 951644 | 954209 | 53 | 32 3 |
| 0 32 | 8 | 9.931649 | 9.934739 | 9.937753 | 9.940691 | 9.943552 | 9.946339 | 9.949050 | 9.951687 | 9.954251 | 52 | 28 3 |
| 0 36 | 9 | 931701 | 934790 | 937803 | 940739 | 943600 | 946385 | 949095 | 951731 | 954293 | 51 | 24 3 |
| 0 40 | 10 | 931753 | 934841 | 937852 | 940787 | 943647 | 946430 | 949139 | 951774 | 954335 | 50 | 20 3 |
| 0 44 | 11 | 931805 | 934892 | 937902 | 940836 | 943694 | 946476 | 949184 | 951817 | 954377 | 49 | 16 3 |
| 0 48 | 12 | 9.931857 | 9.934943 | 9.937951 | 9.940884 | 9.943741 | 9.946522 | 9.949228 | 9.951861 | 9.954419 | 48 | 12 3 |
| 0 52 | 13 | 931909 | 934993 | 938001 | 940932 | 943788 | 946568 | 949273 | 951904 | 954461 | 47 | 8 3 |
| 0 56 | 14 | 931961 | 935044 | 938050 | 940980 | 943834 | 946613 | 949317 | 951947 | 954503 | 46 | 4 3 |
| 1 0 | 15 | 932013 | 935095 | 938100 | 941029 | 943881 | 946659 | 949362 | 951990 | 954545 | 45 | 0 3 |
| 1 4 | 16 | 9.932065 | 9.935146 | 9.938150 | 9.941077 | 9.943928 | 9.946705 | 9.949406 | 9.952033 | 9.954587 | 44 | 56 2 |
| 1 8 | 17 | 932117 | 935196 | 938199 | 941125 | 943975 | 946750 | 949451 | 952077 | 954629 | 43 | 52 2 |
| 1 12 | 18 | 932169 | 935247 | 938248 | 941173 | 944022 | 946796 | 949495 | 952120 | 954671 | 42 | 48 2 |
| 1 16 | 19 | 932221 | 935298 | 938297 | 941221 | 944069 | 946842 | 949539 | 952163 | 954713 | 41 | 44 2 |
| 1 20 | 20 | 9.932273 | 9.935348 | 9.938347 | 9.941269 | 9.944116 | 9.946887 | 9.949584 | 9.952206 | 9.954754 | 40 | 40 2 |
| 1 24 | 21 | 932325 | 935399 | 938396 | 941317 | 944163 | 946933 | 949628 | 952249 | 954796 | 39 | 36 2 |
| 1 28 | 22 | 932377 | 935449 | 938445 | 941365 | 944209 | 946978 | 949672 | 952292 | 954838 | 38 | 32 2 |
| 1 32 | 23 | 932429 | 935500 | 938495 | 941413 | 944256 | 947024 | 949717 | 952335 | 954880 | 37 | 28 2 |
| 1 36 | 24 | 9.932480 | 9.935551 | 9.938544 | 9.941461 | 9.944303 | 9.947069 | 9.949761 | 9.952378 | 9.954922 | 36 | 24 2 |
| 1 40 | 25 | 932532 | 935601 | 938593 | 941509 | 944350 | 947115 | 949805 | 952421 | 954964 | 35 | 20 2 |
| 1 44 | 26 | 932584 | 935652 | 938642 | 941557 | 944396 | 947160 | 949849 | 952464 | 955005 | 34 | 16 2 |
| 1 48 | 27 | 932636 | 935702 | 938692 | 941605 | 944443 | 947206 | 949893 | 952507 | 955047 | 33 | 12 2 |
| 1 52 | 28 | 9.932687 | 9.935753 | 9.938741 | 9.941653 | 9.944490 | 9.947251 | 9.949938 | 9.952550 | 9.955089 | 32 | 8 2 |
| 1 56 | 29 | 932739 | 935803 | 938790 | 941701 | 944536 | 947296 | 949982 | 952593 | 955130 | 31 | 4 2 |
| 2 0 | 30 | 932791 | 935853 | 938839 | 941749 | 944583 | 947342 | 950026 | 952636 | 955172 | 30 | 0 2 |
| 2 4 | 31 | 932843 | 935904 | 938888 | 941797 | 944629 | 947387 | 950070 | 952679 | 955214 | 29 | 56 1 |
| 2 8 | 32 | 9.932894 | 9.935954 | 9.938937 | 9.941845 | 9.944676 | 9.947432 | 9.950114 | 9.952722 | 9.955255 | 28 | 52 1 |
| 2 12 | 33 | 932946 | 936004 | 938986 | 941892 | 944723 | 947478 | 950158 | 952764 | 955297 | 27 | 48 1 |
| 2 16 | 34 | 932997 | 936055 | 939035 | 941940 | 944769 | 947523 | 950202 | 952807 | 955339 | 26 | 44 1 |
| 2 20 | 35 | 933049 | 936105 | 939085 | 941988 | 944816 | 947568 | 950246 | 952850 | 955380 | 25 | 40 1 |
| 2 24 | 36 | 9.933101 | 9.936155 | 9.939134 | 9.942036 | 9.944862 | 9.947613 | 9.950290 | 9.952893 | 9.955422 | 24 | 36 1 |
| 2 28 | 37 | 933152 | 936206 | 939183 | 942083 | 944909 | 947659 | 950334 | 952936 | 955463 | 23 | 32 1 |
| 2 32 | 38 | 933204 | 936256 | 939232 | 942131 | 944955 | 947704 | 950378 | 952978 | 955504 | 22 | 28 1 |
| 2 36 | 39 | 933255 | 936306 | 939280 | 942179 | 945001 | 947749 | 950422 | 953021 | 955546 | 21 | 24 1 |
| 2 40 | 40 | 9.933307 | 9.936356 | 9.939329 | 9.942226 | 9.945048 | 9.947794 | 9.950466 | 9.953064 | 9.955588 | 20 | 20 1 |
| 2 44 | 41 | 933358 | 936406 | 939378 | 942274 | 945094 | 947839 | 950510 | 953106 | 955629 | 19 | 16 1 |
| 2 48 | 42 | 933410 | 936457 | 939427 | 942322 | 945141 | 947884 | 950554 | 953149 | 955671 | 18 | 12 1 |
| 2 52 | 43 | 933461 | 936507 | 939476 | 942369 | 945187 | 947930 | 950598 | 953192 | 955712 | 17 | 8 1 |
| 2 56 | 44 | 9.933512 | 9.936557 | 9.939525 | 9.942417 | 9.945233 | 9.947975 | 9.950642 | 9.953234 | 9.955753 | 16 | 4 1 |
| 3 0 | 45 | 933564 | 936607 | 939574 | 942464 | 945280 | 948020 | 950685 | 953277 | 955795 | 15 | 0 1 |
| 3 4 | 46 | 933615 | 936657 | 939622 | 942512 | 945326 | 948065 | 950729 | 953319 | 955836 | 14 | 56 0 |
| 3 8 | 47 | 933666 | 936707 | 939671 | 942559 | 945372 | 948110 | 950773 | 953362 | 955877 | 13 | 52 0 |
| 3 12 | 48 | 9.933718 | 9.936757 | 9.939720 | 9.942607 | 9.945418 | 9.948155 | 9.950817 | 9.953404 | 9.955919 | 12 | 48 0 |
| 3 16 | 49 | 933769 | 936807 | 939769 | 942654 | 945465 | 948200 | 950860 | 953447 | 955960 | 11 | 44 0 |
| 3 20 | 50 | 933820 | 936857 | 939817 | 942702 | 945511 | 948245 | 950904 | 953489 | 956001 | 10 | 40 0 |
| 3 24 | 51 | 933871 | 936907 | 939866 | 942749 | 945557 | 948290 | 950948 | 953532 | 956042 | 9 | 36 0 |
| 3 28 | 52 | 9.933923 | 9.936957 | 9.939915 | 9.942797 | 9.945603 | 9.948335 | 9.950991 | 9.953574 | 9.956084 | 8 | 32 0 |
| 3 32 | 53 | 933974 | 937007 | 939964 | 942844 | 945649 | 948379 | 951035 | 953617 | 956125 | 7 | 28 0 |
| 3 36 | 54 | 934025 | 937057 | 940012 | 942891 | 945695 | 948424 | 951079 | 953659 | 956166 | 6 | 24 0 |
| 3 40 | 55 | 934076 | 937107 | 940061 | 942939 | 945741 | 948469 | 951122 | 953702 | 956207 | 5 | 20 0 |
| 3 44 | 56 | 9.934127 | 9.937157 | 9.940109 | 9.942986 | 9.945788 | 9.948514 | 9.951166 | 9.953744 | 9.956248 | 4 | 16 0 |
| 3 48 | 57 | 934179 | 937206 | 940158 | 943033 | 945834 | 948559 | 951210 | 953786 | 956289 | 3 | 12 0 |
| 3 52 | 58 | 934230 | 937256 | 940206 | 943081 | 945880 | 948604 | 951253 | 953829 | 956331 | 2 | 8 0 |
| 3 56 | 59 | 934281 | 937306 | 940255 | 943128 | 945926 | 948648 | 951297 | 953871 | 956372 | 1 | 4 0 |
| 4 0 | 60 | 9.934332 | 9.937356 | 9.940303 | 9.943175 | 9.945972 | 9.948693 | 9.951340 | 9.953913 | 9.956413 | 0 | 0 0 |
| m s | | | | | | | | | | | | s m |
| Time. | Arc. | 224° | 223° | 222° | 221° | 220° | 219° | 218° | 217° | 216° | Arc. | Time. |
| | | $14^h\ 56^m$ | $14^h\ 52^m$ | $14^h\ 48^m$ | $14^h\ 44^m$ | $14^h\ 40^m$ | $14^h\ 36^m$ | $14^h\ 32^m$ | $14^h\ 28^m$ | $14^h\ 24^m$ | | |

| Time. | | Arc. | 9h 36m | 9h 40m | 9h 44m | 9h 48m | 9h 52m | 9h 56m | 10h 0m | 10h 4m | 10h 8m | Arc. | Time. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| m | s | ′ | 144° | 145° | 146° | 147° | 148° | 149° | 150° | 151° | 152° | | s m |
| 0 | 0 | 0 | 9.956413 | 9.958839 | 9.961193 | 9.963474 | 9.965683 | 9.967821 | 9.969887 | 9.971883 | 9.973808 | 60 | 0 4 |
| 0 | 4 | 1 | 956454 | 958879 | 961231 | 963511 | 965719 | 967856 | 969921 | 971916 | 973840 | 59 | 56 3 |
| 0 | 8 | 2 | 956495 | 958919 | 961270 | 963549 | 965756 | 967891 | 969955 | 971948 | 973871 | 58 | 52 3 |
| 0 | 12 | 3 | 956536 | 958958 | 961308 | 963586 | 965792 | 967926 | 969989 | 971981 | 973903 | 57 | 48 3 |
| 0 | 16 | 4 | 9.956577 | 9.958998 | 9.961347 | 9.963623 | 9.965828 | 9.967961 | 9.970023 | 9.972014 | 9.973934 | 56 | 44 3 |
| 0 | 20 | 5 | 956618 | 959038 | 961385 | 963661 | 965864 | 967996 | 970057 | 972046 | 973965 | 55 | 40 3 |
| 0 | 24 | 6 | 956659 | 959078 | 961424 | 963698 | 965900 | 968031 | 970090 | 972079 | 973997 | 54 | 36 3 |
| 0 | 28 | 7 | 956699 | 959117 | 961463 | 963735 | 965936 | 968066 | 970124 | 972111 | 974028 | 53 | 32 3 |
| 0 | 32 | 8 | 9.956740 | 9.959157 | 9.961501 | 9.963773 | 9.965972 | 9.968101 | 9.970158 | 9.972144 | 9.974060 | 52 | 28 3 |
| 0 | 36 | 9 | 956781 | 959197 | 961539 | 963810 | 966008 | 968136 | 970191 | 972176 | 974091 | 51 | 24 3 |
| 0 | 40 | 10 | 956822 | 959236 | 961578 | 963847 | 966045 | 968170 | 970225 | 972209 | 974122 | 50 | 20 3 |
| 0 | 44 | 11 | 956863 | 959276 | 961616 | 963884 | 966081 | 968205 | 970259 | 972241 | 974154 | 49 | 16 3 |
| 0 | 48 | 12 | 9.956904 | 9.959316 | 9.961655 | 9.963922 | 9.966117 | 9.968240 | 9.970292 | 9.972274 | 9.974185 | 48 | 12 3 |
| 0 | 52 | 13 | 956945 | 959355 | 961693 | 963959 | 966153 | 968275 | 970326 | 972306 | 974216 | 47 | 8 3 |
| 0 | 56 | 14 | 956985 | 959395 | 961731 | 963996 | 966188 | 968310 | 970360 | 972339 | 974247 | 46 | 4 3 |
| 1 | 0 | 15 | 957026 | 959434 | 961770 | 964033 | 966224 | 968344 | 970393 | 972371 | 974279 | 45 | 0 3 |
| 1 | 4 | 16 | 9.957067 | 9.959474 | 9.961808 | 9.964070 | 9.966260 | 9.968379 | 9.970427 | 9.972403 | 9.974310 | 44 | 56 2 |
| 1 | 8 | 17 | 957108 | 959513 | 961846 | 964107 | 966296 | 968414 | 970460 | 972436 | 974341 | 43 | 52 2 |
| 1 | 12 | 18 | 957148 | 959553 | 961885 | 964144 | 966332 | 968448 | 970493 | 972468 | 974372 | 42 | 48 2 |
| 1 | 16 | 19 | 957189 | 959592 | 961923 | 964181 | 966368 | 968483 | 970527 | 972500 | 974403 | 41 | 44 2 |
| 1 | 20 | 20 | 9.957230 | 9.959632 | 9.961961 | 9.964218 | 9.966404 | 9.968518 | 9.970561 | 9.972533 | 9.974434 | 40 | 40 2 |
| 1 | 24 | 21 | 957270 | 959671 | 961999 | 964255 | 966440 | 968552 | 970594 | 972565 | 974465 | 39 | 36 2 |
| 1 | 28 | 22 | 957311 | 959710 | 962037 | 964292 | 966475 | 968587 | 970628 | 972597 | 974496 | 38 | 32 2 |
| 1 | 32 | 23 | 957351 | 959750 | 962076 | 964329 | 966511 | 968622 | 970661 | 972629 | 974528 | 37 | 28 2 |
| 1 | 36 | 24 | 9.957392 | 9.959789 | 9.962114 | 9.964366 | 9.966547 | 9.968656 | 9.970694 | 9.972662 | 9.974559 | 36 | 24 2 |
| 1 | 40 | 25 | 957432 | 959828 | 962152 | 964403 | 966583 | 968691 | 970728 | 972694 | 974590 | 35 | 20 2 |
| 1 | 44 | 26 | 957473 | 959868 | 962190 | 964440 | 966618 | 968725 | 970761 | 972726 | 974621 | 34 | 16 2 |
| 1 | 48 | 27 | 957514 | 959907 | 962228 | 964477 | 966654 | 968760 | 970794 | 972758 | 974652 | 33 | 12 2 |
| 1 | 52 | 28 | 9.957554 | 9.959946 | 9.962266 | 9.964514 | 9.966690 | 9.968794 | 9.970828 | 9.972790 | 9.974683 | 32 | 8 2 |
| 1 | 56 | 29 | 957594 | 959986 | 962304 | 964551 | 966725 | 968829 | 970861 | 972822 | 974713 | 31 | 4 2 |
| 2 | 0 | 30 | 957635 | 960025 | 962342 | 964588 | 966761 | 968863 | 970894 | 972855 | 974744 | 30 | 0 2 |
| 2 | 4 | 31 | 957675 | 960064 | 962380 | 964624 | 966797 | 968898 | 970927 | 972887 | 974775 | 29 | 56 1 |
| 2 | 8 | 32 | 9.957716 | 9.960103 | 9.962418 | 9.964661 | 9.966832 | 9.968932 | 9.970961 | 9.972919 | 9.974806 | 28 | 52 1 |
| 2 | 12 | 33 | 957756 | 960142 | 962456 | 964698 | 966868 | 968966 | 970994 | 972951 | 974837 | 27 | 48 1 |
| 2 | 16 | 34 | 957797 | 960182 | 962494 | 964735 | 966903 | 969001 | 971027 | 972983 | 974868 | 26 | 44 1 |
| 2 | 20 | 35 | 957837 | 960221 | 962532 | 964771 | 966939 | 969035 | 971060 | 973015 | 974899 | 25 | 40 1 |
| 2 | 24 | 36 | 9.957877 | 9.960260 | 9.962570 | 9.964808 | 9.966974 | 9.969069 | 9.971093 | 9.973047 | 9.974930 | 24 | 36 1 |
| 2 | 28 | 37 | 957918 | 960299 | 962608 | 964845 | 967010 | 969104 | 971127 | 973079 | 974960 | 23 | 32 1 |
| 2 | 32 | 38 | 957958 | 960338 | 962646 | 964882 | 967045 | 969138 | 971160 | 973111 | 974991 | 22 | 28 1 |
| 2 | 36 | 39 | 957998 | 960377 | 962684 | 964918 | 967081 | 969172 | 971193 | 973142 | 975022 | 21 | 24 1 |
| 2 | 40 | 40 | 9.958038 | 9.960416 | 9.962722 | 9.964955 | 9.967116 | 9.969207 | 9.971226 | 9.973174 | 9.975053 | 20 | 20 1 |
| 2 | 44 | 41 | 958079 | 960455 | 962759 | 964991 | 967152 | 969241 | 971259 | 973206 | 975083 | 19 | 16 1 |
| 2 | 48 | 42 | 958119 | 960494 | 962797 | 965028 | 967187 | 969275 | 971292 | 973238 | 975114 | 18 | 12 1 |
| 2 | 52 | 43 | 958159 | 960533 | 962835 | 965065 | 967223 | 969309 | 971325 | 973270 | 975145 | 17 | 8 1 |
| 2 | 56 | 44 | 9.958199 | 9.960572 | 9.962873 | 9.965101 | 9.967258 | 9.969343 | 9.971358 | 9.973302 | 9.975175 | 16 | 4 1 |
| 3 | 0 | 45 | 958239 | 960611 | 962910 | 965138 | 967293 | 969378 | 971391 | 973334 | 975206 | 15 | 0 1 |
| 3 | 4 | 46 | 958279 | 960650 | 962948 | 965174 | 967329 | 969412 | 971424 | 973365 | 975237 | 14 | 56 0 |
| 3 | 8 | 47 | 958319 | 960689 | 962986 | 965211 | 967364 | 969446 | 971457 | 973397 | 975267 | 13 | 52 0 |
| 3 | 12 | 48 | 9.958360 | 9.960728 | 9.963023 | 9.965247 | 9.967399 | 9.969480 | 9.971490 | 9.973429 | 9.975298 | 12 | 48 0 |
| 3 | 16 | 49 | 958400 | 960767 | 963061 | 965284 | 967434 | 969514 | 971523 | 973461 | 975328 | 11 | 44 0 |
| 3 | 20 | 50 | 958440 | 960805 | 963099 | 965320 | 967470 | 969548 | 971555 | 973492 | 975359 | 10 | 40 0 |
| 3 | 24 | 51 | 958480 | 960844 | 963136 | 965356 | 967505 | 969582 | 971588 | 973524 | 975389 | 9 | 36 0 |
| 3 | 28 | 52 | 9.958520 | 9.960883 | 9.963174 | 9.965393 | 9.967540 | 9.969616 | 9.971621 | 9.973556 | 9.975420 | 8 | 32 0 |
| 3 | 32 | 53 | 958560 | 960922 | 963211 | 965429 | 967575 | 969650 | 971654 | 973587 | 975450 | 7 | 28 0 |
| 3 | 36 | 54 | 958600 | 960961 | 963249 | 965466 | 967610 | 969684 | 971687 | 973619 | 975481 | 6 | 24 0 |
| 3 | 40 | 55 | 958640 | 960999 | 963287 | 965502 | 967646 | 969718 | 971720 | 973651 | 975511 | 5 | 20 0 |
| 3 | 44 | 56 | 9.958680 | 9.961038 | 9.963324 | 9.965538 | 9.967681 | 9.969752 | 9.971752 | 9.973682 | 9.975542 | 4 | 16 0 |
| 3 | 48 | 57 | 958719 | 961077 | 963362 | 965575 | 967716 | 969786 | 971785 | 973714 | 975572 | 3 | 12 0 |
| 3 | 52 | 58 | 958759 | 961115 | 963399 | 965611 | 967751 | 969820 | 971818 | 973745 | 975602 | 2 | 8 0 |
| 3 | 56 | 59 | 958799 | 961154 | 963436 | 965647 | 967786 | 969854 | 971851 | 973777 | 975633 | 1 | 4 0 |
| 4 | 0 | 60 | 9.958839 | 9.961193 | 9.963474 | 9.965683 | 9.967821 | 9.969887 | 9.971883 | 9.973808 | 9.975663 | 0 | 0 0 |
| m | s | | | | | | | | | | | | s m |
| Time. | | Arc. | 215° | 214° | 213° | 212° | 211° | 210° | 209° | 208° | 207° | Arc. | Time. |
| | | | 14h 20m | 14h 16m | 14h 12m | 14h 8m | 14h 4m | 14h 0m | 13h 56m | 13h 52m | 13h 48m | | |

| Time. | Arc. | 10h 12m | 10h 16m | 10h 20m | 10h 24m | 10h 28m | 10h 32m | 10h 36m | 10h 40m | 10h 44m | Arc. | Time. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| m s | ′ | 153° | 154° | 155° | 156° | 157° | 158° | 159° | 160° | 161° | ′ | m s |
| 0 0 | 0 | 9.975663 | 9.977448 | 9.979163 | 9.980809 | 9.982385 | 9.983893 | 9.985332 | 9.986703 | 9.988005 | 60 | 0 4 |
| 0 4 | 1 | 975693 | 977477 | 979191 | 980836 | 982411 | 983918 | 985356 | 986725 | 988027 | 59 | 56 3 |
| 0 8 | 2 | 975724 | 977506 | 979219 | 980862 | 982437 | 983942 | 985379 | 986747 | 988048 | 58 | 52 3 |
| 0 12 | 3 | 975754 | 977535 | 979247 | 980889 | 982462 | 983967 | 985402 | 986770 | 988069 | 57 | 48 3 |
| 0 16 | 4 | 9.975784 | 9.977564 | 9.979275 | 9.980916 | 9.982488 | 9.983991 | 9.985426 | 9.986792 | 9.988090 | 56 | 44 3 |
| 0 20 | 5 | 975814 | 977593 | 979303 | 980943 | 982514 | 984016 | 985449 | 986814 | 988111 | 55 | 40 3 |
| 0 24 | 6 | 975845 | 977623 | 979331 | 980970 | 982539 | 984040 | 985472 | 986836 | 988132 | 54 | 36 3 |
| 0 28 | 7 | 975875 | 977652 | 979359 | 980996 | 982565 | 984065 | 985496 | 986858 | 988153 | 53 | 32 3 |
| 0 32 | 8 | 9.975905 | 9.977681 | 9.979386 | 9.981023 | 9.982590 | 9.984089 | 9.985519 | 9.986881 | 9.988174 | 52 | 28 3 |
| 0 36 | 9 | 975935 | 977710 | 979414 | 981050 | 982616 | 984113 | 985542 | 986903 | 988195 | 51 | 24 3 |
| 0 40 | 10 | 975965 | 977739 | 979442 | 981076 | 982641 | 984138 | 985565 | 986925 | 988216 | 50 | 20 3 |
| 0 44 | 11 | 975995 | 977768 | 979470 | 981103 | 982667 | 984162 | 985589 | 986947 | 988237 | 49 | 16 3 |
| 0 48 | 12 | 9.976026 | 9.977796 | 9.979498 | 9.981130 | 9.982692 | 9.984186 | 9.985612 | 9.986969 | 9.988258 | 48 | 12 3 |
| 0 52 | 13 | 976056 | 977825 | 979525 | 981156 | 982718 | 984211 | 985635 | 986991 | 988279 | 47 | 8 3 |
| 0 56 | 14 | 976086 | 977854 | 979553 | 981183 | 982743 | 984235 | 985658 | 987013 | 988300 | 46 | 4 3 |
| 1 0 | 15 | 976116 | 977883 | 979581 | 981209 | 982769 | 984259 | 985681 | 987035 | 988320 | 45 | 0 3 |
| 1 4 | 16 | 9.976146 | 9.977912 | 9.979609 | 9.981236 | 9.982794 | 9.984284 | 9.985704 | 9.987057 | 9.988341 | 44 | 56 2 |
| 1 8 | 17 | 976176 | 977941 | 979636 | 981263 | 982820 | 984308 | 985728 | 987079 | 988362 | 43 | 52 2 |
| 1 12 | 18 | 976206 | 977970 | 979664 | 981289 | 982845 | 984332 | 985751 | 987101 | 988383 | 42 | 48 2 |
| 1 16 | 19 | 976236 | 977999 | 979692 | 981316 | 982870 | 984356 | 985774 | 987123 | 988404 | 41 | 44 2 |
| 1 20 | 20 | 9.976266 | 9.978027 | 9.979719 | 9.981342 | 9.982896 | 9.984380 | 9.985797 | 9.987145 | 9.988424 | 40 | 40 2 |
| 1 24 | 21 | 976296 | 978056 | 979747 | 981368 | 982921 | 984405 | 985820 | 987167 | 988445 | 39 | 36 2 |
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| 1 32 | 23 | 976355 | 978114 | 979802 | 981421 | 982972 | 984453 | 985866 | 987210 | 988487 | 37 | 28 2 |
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| 1 52 | 28 | 9.976505 | 9.978257 | 9.979940 | 9.981553 | 9.983098 | 9.984573 | 9.985980 | 9.987319 | 9.988590 | 32 | 8 2 |
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| 2 0 | 30 | 976564 | 978314 | 979995 | 981606 | 983148 | 984621 | 986026 | 987363 | 988631 | 30 | 0 2 |
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| 2 16 | 34 | 976683 | 978428 | 980104 | 981711 | 983248 | 984717 | 986117 | 987449 | 988713 | 26 | 44 1 |
| 2 20 | 35 | 976713 | 978457 | 980131 | 981737 | 983273 | 984741 | 986140 | 987471 | 988734 | 25 | 40 1 |
| 2 24 | 36 | 9.976742 | 9.978485 | 9.980159 | 9.981763 | 9.983298 | 9.984765 | 9.986163 | 9.987493 | 9.988754 | 24 | 36 1 |
| 2 28 | 37 | 976772 | 978514 | 980186 | 981789 | 983323 | 984789 | 986186 | 987514 | 988775 | 23 | 32 1 |
| 2 32 | 38 | 976802 | 978542 | 980213 | 981815 | 983348 | 984813 | 986208 | 987536 | 988795 | 22 | 28 1 |
| 2 36 | 39 | 976831 | 978571 | 980241 | 981841 | 983373 | 984836 | 986231 | 987557 | 988816 | 21 | 24 1 |
| 2 40 | 40 | 9.976861 | 9.978599 | 9.980268 | 9.981868 | 9.983398 | 9.984860 | 9.986254 | 9.987579 | 9.988836 | 20 | 20 1 |
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| 2 52 | 43 | 976950 | 978684 | 980350 | 981946 | 983473 | 984931 | 986321 | 987643 | 988897 | 17 | 8 1 |
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| 3 16 | 49 | 977126 | 978854 | 980512 | 982102 | 983622 | 985074 | 986457 | 987772 | 989019 | 11 | 44 0 |
| 3 20 | 50 | 977155 | 978882 | 980539 | 982127 | 983647 | 985097 | 986479 | 987793 | 989039 | 10 | 40 0 |
| 3 24 | 51 | 977185 | 978910 | 980566 | 982153 | 983671 | 985121 | 986502 | 987814 | 989059 | 9 | 36 0 |
| 3 28 | 52 | 9.977214 | 9.978938 | 9.980593 | 9.982179 | 9.983696 | 9.985144 | 9.986524 | 9.987836 | 9.989079 | 8 | 32 0 |
| 3 32 | 53 | 977243 | 978967 | 980620 | 982205 | 983721 | 985168 | 986547 | 987857 | 989099 | 7 | 28 0 |
| 3 36 | 54 | 977273 | 978995 | 980647 | 982231 | 983745 | 985191 | 986569 | 987878 | 989119 | 6 | 24 0 |
| 3 40 | 55 | 977302 | 979023 | 980674 | 982257 | 983770 | 985215 | 986591 | 987899 | 989140 | 5 | 20 0 |
| 3 44 | 56 | 9.977331 | 9.979051 | 9.980701 | 9.982282 | 9.983795 | 9.985238 | 9.986614 | 9.987921 | 9.989160 | 4 | 16 0 |
| 3 48 | 57 | 977360 | 979079 | 980728 | 982308 | 983819 | 985262 | 986636 | 987942 | 989180 | 3 | 12 0 |
| 3 52 | 58 | 977389 | 979107 | 980755 | 982334 | 983844 | 985285 | 986658 | 987963 | 989200 | 2 | 8 0 |
| 3 56 | 59 | 977419 | 979135 | 980781 | 982360 | 983869 | 985309 | 986681 | 987984 | 989220 | 1 | 4 0 |
| 4 0 | 60 | 9.977448 | 9.979163 | 9.980809 | 9.982385 | 9.983893 | 9.985332 | 9.986703 | 9.988005 | 9.989240 | 0 | 0 0 |
| m s Time. | Arc. ′ | 206° | 205° | 204° | 203° | 202° | 201° | 200° | 199° | 198° | Arc. ′ | s m Time. |
| | | 13h 44m | 13h 40m | 13h 36m | 13h 32m | 13h 28m | 13h 24m | 13h 20m | 13h 16m | 13h 12m | | |

| Time | Arc. | $10^h\,48^m$ | $10^h\,52^m$ | $10^h\,56^m$ | $11^h\,0^m$ | $11^h\,4^m$ | $11^h\,8^m$ | $11^h\,12^m$ | $11^h\,16^m$ | $11^h\,20^m$ | Arc. | Time. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 162° | 163° | 164° | 165° | 166° | 167° | 168° | 169° | 170° | | |
| m s | | | | | | | | | | | | s m |
| 0 0 | 0 | 9.989240 | 9.990407 | 9.991506 | 9.992537 | 9.993501 | 9.994399 | 9.995229 | 9.995992 | 9.996688 | 60 | 0 4 |
| 0 4 | 1 | 989260 | 990425 | 991523 | 992554 | 993517 | 994413 | 995242 | 996004 | 996699 | 59 | 56 3 |
| 0 8 | 2 | 989280 | 990444 | 991541 | 992570 | 993532 | 994427 | 995255 | 996016 | 996711 | 58 | 52 3 |
| 0 12 | 3 | 989300 | 990463 | 991559 | 992587 | 993548 | 994442 | 995268 | 996028 | 996722 | 57 | 48 3 |
| 0 16 | 4 | 9.989320 | 9.990482 | 9.991576 | 9.992604 | 9.993563 | 9.994456 | 9.995282 | 9.996040 | 9.996733 | 56 | 44 3 |
| 0 20 | 5 | 989340 | 990501 | 991594 | 992620 | 993578 | 994470 | 995295 | 996053 | 996743 | 55 | 40 3 |
| 0 24 | 6 | 989360 | 990519 | 991612 | 992637 | 993594 | 994485 | 995308 | 996065 | 996754 | 54 | 36 3 |
| 0 28 | 7 | 989379 | 990538 | 991629 | 992653 | 993610 | 994499 | 995321 | 996077 | 996765 | 53 | 32 3 |
| 0 32 | 8 | 9.989399 | 9.990557 | 9.991647 | 9.992670 | 9.993625 | 9.994513 | 9.995334 | 9.996089 | 9.996776 | 52 | 28 3 |
| 0 36 | 9 | 989419 | 990576 | 991665 | 992686 | 993640 | 994527 | 995347 | 996101 | 996787 | 51 | 24 3 |
| 0 40 | 10 | 989439 | 990594 | 991682 | 992703 | 993656 | 994542 | 995361 | 996113 | 996798 | 50 | 20 3 |
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| 0 48 | 12 | 9.989479 | 9.990632 | 9.991717 | 9.992735 | 9.993686 | 9.994570 | 9.995387 | 9.996137 | 9.996820 | 48 | 12 3 |
| 0 52 | 13 | 989498 | 990650 | 991735 | 992752 | 993701 | 994584 | 995400 | 996149 | 996831 | 47 | 8 3 |
| 0 56 | 14 | 989518 | 990669 | 991752 | 992768 | 993717 | 994598 | 995413 | 996160 | 996841 | 46 | 4 3 |
| 1 0 | 15 | 989538 | 990688 | 991770 | 992785 | 993732 | 994612 | 995426 | 996172 | 996852 | 45 | 0 3 |
| 1 4 | 16 | 9.989558 | 9.990706 | 9.991787 | 9.992801 | 9.993747 | 9.994626 | 9 995439 | 9.996184 | 9.996863 | 44 | 56 2 |
| 1 8 | 17 | 989577 | 990725 | 991805 | 992817 | 993762 | 994641 | 995452 | 996196 | 996874 | 43 | 52 2 |
| 1 12 | 18 | 989597 | 990743 | 991822 | 992833 | 993778 | 994655 | 995465 | 996208 | 996884 | 42 | 48 2 |
| 1 16 | 19 | 989617 | 990762 | 991840 | 992850 | 993793 | 994669 | 995478 | 996220 | 996895 | 41 | 44 2 |
| 1 20 | 20 | 9.989636 | 9.990780 | 9.991857 | 9.992866 | 9.993808 | 9.994683 | 9.995491 | 9.996232 | 9.996906 | 40 | 40 2 |
| 1 24 | 21 | 989656 | 990800 | 991874 | 992882 | 993823 | 994697 | 995503 | 996243 | 996916 | 39 | 36 2 |
| 1 28 | 22 | 989675 | 990817 | 991892 | 992899 | 993838 | 994711 | 995516 | 996255 | 996927 | 38 | 32 2 |
| 1 32 | 23 | 989695 | 990836 | 991909 | 992915 | 993853 | 994725 | 995529 | 996267 | 996938 | 37 | 28 2 |
| 1 36 | 24 | 9.989715 | 9.990854 | 9.991926 | 9.992931 | 9.993868 | 9.994739 | 9.995542 | 9.996279 | 9.996948 | 36 | 24 2 |
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| 1 52 | 28 | 9.989793 | 9.990928 | 9.991995 | 9.992995 | 9.993928 | 9.994794 | 9.995593 | 9.996325 | 9.996991 | 32 | 8 2 |
| 1 56 | 29 | 989812 | 990946 | 992013 | 993012 | 993943 | 994808 | 995606 | 996337 | 997001 | 31 | 4 2 |
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| 2 8 | 32 | 9.989870 | 9.991001 | 9.992064 | 9.993060 | 9.993988 | 9.994850 | 9.995644 | 9.996372 | 9.997033 | 28 | 52 1 |
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| 2 16 | 34 | 989909 | 991038 | 992098 | 993092 | 994018 | 994877 | 995669 | 996395 | 997054 | 26 | 44 1 |
| 2 20 | 35 | 989929 | 991056 | 992115 | 993108 | 994033 | 994891 | 995682 | 996406 | 997064 | 25 | 40 1 |
| 2 24 | 36 | 9.989948 | 9.991074 | 9.992133 | 9.993124 | 9.994048 | 9.994905 | 9.995695 | 9.996418 | 9.997074 | 24 | 36 1 |
| 2 28 | 37 | 989967 | 991092 | 992150 | 993140 | 994063 | 994918 | 995707 | 996429 | 997085 | 23 | 32 1 |
| 2 32 | 38 | 989987 | 991110 | 992167 | 993156 | 994077 | 994932 | 995720 | 996441 | 997095 | 22 | 28 1 |
| 2 36 | 39 | 990006 | 991129 | 992184 | 993172 | 994092 | 994946 | 995732 | 996452 | 997105 | 21 | 24 1 |
| 2 40 | 40 | 9.990025 | 9.991147 | 9.992201 | 9.993187 | 9.994107 | 9.994959 | 9.995745 | 9.996464 | 9.997116 | 20 | 20 1 |
| 2 44 | 41 | 990044 | 991165 | 992218 | 993203 | 994122 | 994973 | 995757 | 996475 | 997126 | 19 | 16 1 |
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| 2 52 | 43 | 990083 | 991201 | 992252 | 993235 | 994151 | 995000 | 995782 | 996498 | 997147 | 17 | 8 1 |
| 2 56 | 44 | 9.990102 | 9.991219 | 9.992269 | 9.993251 | 9.994166 | 9.995014 | 9.995795 | 9.996509 | 9.997157 | 16 | 4 1 |
| 3 0 | 45 | 990121 | 991237 | 992286 | 993267 | 994181 | 995027 | 995807 | 996521 | 997167 | 15 | 0 1 |
| 3 4 | 46 | 990140 | 991255 | 992302 | 993282 | 994195 | 995041 | 995820 | 996532 | 997177 | 14 | 56 0 |
| 3 8 | 47 | 990159 | 991273 | 992319 | 993293 | 994210 | 995055 | 995832 | 996543 | 997187 | 13 | 52 0 |
| 3 12 | 48 | 9.990179 | 9.991291 | 9.992336 | 9.993314 | 9.994224 | 9.995068 | 9.995845 | 9.996554 | 9.997198 | 12 | 48 0 |
| 3 16 | 49 | 990198 | 991309 | 992353 | 993330 | 994239 | 995082 | 995857 | 996566 | 997208 | 11 | 44 0 |
| 3 20 | 50 | 990217 | 991327 | 992370 | 993345 | 994254 | 995095 | 995869 | 996577 | 997218 | 10 | 40 0 |
| 3 24 | 51 | 990236 | 991345 | 992387 | 993361 | 994268 | 995108 | 995882 | 996588 | 997228 | 9 | 36 0 |
| 3 28 | 52 | 9.990255 | 9.991363 | 9.992403 | 9.993377 | 9.994283 | 9.995122 | 9.995894 | 9.996599 | 9.997238 | 8 | 32 0 |
| 3 32 | 53 | 990274 | 991381 | 992420 | 993392 | 994297 | 995135 | 995906 | 996611 | 997248 | 7 | 28 0 |
| 3 36 | 54 | 990294 | 991399 | 992437 | 993408 | 994312 | 995149 | 995919 | 996622 | 997258 | 6 | 24 0 |
| 3 40 | 55 | 990312 | 991417 | 992454 | 993424 | 994326 | 995162 | 995931 | 996633 | 997268 | 5 | 20 0 |
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| 3 48 | 57 | 990350 | 991452 | 992487 | 993455 | 994355 | 995189 | 995955 | 996655 | 997288 | 3 | 12 0 |
| 3 52 | 58 | 990369 | 991470 | 992504 | 993470 | 994370 | 995202 | 995968 | 996666 | 997298 | 2 | 8 0 |
| 3 56 | 59 | 990388 | 991488 | 992520 | 993486 | 994384 | 995215 | 995980 | 996677 | 997308 | 1 | 4 0 |
| 4 0 | 60 | 9.990407 | 9.991506 | 9.992537 | 9.993501 | 9.994399 | 9.995229 | 9.995992 | 9.996688 | 9.997318 | 0 | 0 0 |
| m s | | | | | | | | | | | | s m |
| Time. | Arc. | 197° | 196° | 195° | 194° | 193° | 192° | 191° | 190° | 189° | Arc. | Time. |
| | | $13^h\,8^m$ | $13^h\,4^m$ | $13^h\,0^m$ | $12^h\,56^m$ | $12^h\,52^m$ | $12^h\,48^m$ | $12^h\,44^m$ | $12^h\,40^m$ | $12^h\,36^m$ | | |

| Time | Arc. | 11h 24m 171° | 11h 28m 172° | 11h 32m 173° | 11h 36m 174° | 11h 40m 175° | 11h 44m 176° | 11h 48m 177° | 11h 52m 178° | 11h 56m 179° | Arc. | Time |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| m s | | | | | | | | | | | | s m |
| 0 0 | 0 | 9.997318 | 9.997882 | 9.998378 | 9.998809 | 9.999173 | 9.999471 | 9.999702 | 9.999868 | 9.999967 | 60 | 0 4 |
| 0 4 | 1 | 997328 | 997890 | 998386 | 998815 | 999178 | 999475 | 999706 | 999870 | 999968 | 59 | 56 3 |
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| 0 12 | 3 | 997348 | 997908 | 998401 | 998829 | 999189 | 999484 | 999712 | 999874 | 999970 | 57 | 48 3 |
| 0 16 | 4 | 9.997358 | 9.997917 | 9.998409 | 9.998835 | 9.999195 | 9.999488 | 9.999715 | 9.999876 | 9.999971 | 56 | 44 3 |
| 0 20 | 5 | 997368 | 997926 | 998417 | 998842 | 999200 | 999493 | 999719 | 999878 | 999972 | 55 | 40 3 |
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| 0 56 | 14 | 997456 | 998003 | 998484 | 998900 | 999248 | 999531 | 999747 | 999897 | 999981 | 46 | 4 3 |
| 1 0 | 15 | 997465 | 998012 | 998492 | 998906 | 999254 | 999535 | 999750 | 999899 | 999981 | 45 | 0 3 |
| 1 4 | 16 | 9·997475 | 9.998021 | 9.998500 | 9.998912 | 9.999259 | 9.999539 | 9.999753 | 9.999901 | 9.999982 | 44 | 56 2 |
| 1 8 | 17 | 997485 | 998029 | 998507 | 998919 | 999264 | 999543 | 999756 | 999903 | 999983 | 43 | 52 2 |
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| 1 20 | 20 | 9.997513 | 9.998055 | 9.998529 | 9.998938 | 9.999280 | 9.999555 | 9.999765 | 9.999908 | 9.999985 | 40 | 40 2 |
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| 2 32 | 38 | 997683 | 998204 | 998659 | 999047 | 999369 | 999625 | 999814 | 999938 | 999996 | 22 | 28 1 |
| 2 36 | 39 | 997692 | 998212 | 998666 | 999053 | 999374 | 999629 | 999817 | 999940 | 999996 | 21 | 24 1 |
| 2 40 | 40 | 9.997701 | 9.998220 | 9.998673 | 9.999059 | 9.999379 | 9.999632 | 9.999820 | 9.999941 | 9.999996 | 20 | 20 1 |
| 2 44 | 41 | 997710 | 998228 | 998680 | 999065 | 999384 | 999636 | 999822 | 999943 | 999997 | 19 | 16 1 |
| 2 48 | 42 | 997720 | 998236 | 998687 | 999071 | 999388 | 999640 | 999825 | 999944 | 999997 | 18 | 12 1 |
| 2 52 | 43 | 997729 | 998244 | 998694 | 999076 | 999393 | 999643 | 999828 | 999946 | 999997 | 17 | 8 1 |
| 2 56 | 44 | 9.997738 | 9.998252 | 9.998701 | 9.999082 | 9.999398 | 9.999647 | 9.999830 | 9.999947 | 9.999998 | 16 | 4 1 |
| 3 0 | 45 | 997747 | 998260 | 998707 | 999088 | 999402 | 999651 | 999832 | 999948 | 999998 | 15 | 0 1 |
| 3 4 | 46 | 997756 | 998268 | 998714 | 999094 | 999407 | 999654 | 999835 | 999950 | 999998 | 14 | 56 0 |
| 3 8 | 47 | 997765 | 998276 | 998721 | 999100 | 999412 | 999658 | 999837 | 999951 | 999998 | 13 | 52 0 |
| 3 12 | 48 | 9.997774 | 9.998284 | 9.998728 | 9.999105 | 9.999416 | 9.999661 | 9.999840 | 9.999952 | 9.999999 | 12 | 48 0 |
| 3 16 | 49 | 997783 | 998292 | 998735 | 999111 | 999421 | 999665 | 999842 | 999954 | 999999 | 11 | 44 0 |
| 3 20 | 50 | 997792 | 998300 | 998742 | 999116 | 999426 | 999668 | 999845 | 999955 | 999999 | 10 | 40 0 |
| 3 24 | 51 | 997801 | 998308 | 998748 | 999123 | 999430 | 999672 | 999847 | 999956 | 999999 | 9 | 36 0 |
| 3 28 | 52 | 9.997810 | 9.998316 | 9.998755 | 9.999128 | 9.999434 | 9.999675 | 9.999849 | 9.999958 | 9.999999 | 8 | 32 0 |
| 3 32 | 53 | 997819 | 998324 | 998762 | 999134 | 999439 | 999679 | 999852 | 999959 | 10.000000 | 7 | 28 0 |
| 3 36 | 54 | 997828 | 998332 | 998769 | 999139 | 999444 | 999682 | 999854 | 999960 | 10.000000 | 6 | 24 0 |
| 3 40 | 55 | 997837 | 998340 | 998775 | 999145 | 999448 | 999686 | 999856 | 999961 | 10.000000 | 5 | 20 0 |
| 3 44 | 56 | 9.997846 | 9.998347 | 9.998782 | 9.999151 | 9.999453 | 9.999689 | 9.999859 | 9.999962 | 10.000000 | 4 | 16 0 |
| 3 48 | 57 | 997855 | 998355 | 998789 | 999156 | 999457 | 999692 | 999861 | 999964 | 10.000000 | 3 | 12 0 |
| 3 52 | 58 | 997864 | 998363 | 998796 | 999162 | 999462 | 999696 | 999863 | 999965 | 10.000000 | 2 | 8 0 |
| 3 56 | 59 | 997873 | 998371 | 998802 | 999167 | 999466 | 999699 | 999865 | 999966 | 10.000000 | 1 | 4 0 |
| 4 0 | 60 | 9.997882 | 9.998378 | 9.998809 | 9.999173 | 9.999471 | 9.999702 | 9.999868 | 9.999967 | 10.000000 | 0 | 0 0 |
| m s | | | | | | | | | | | | m |
| Time. | Arc. | 188° | 187° | 186° | 185° | 184° | 183° | 182° | 181° | 180° | Arc. | Time. |
| | | 12h 32m | 12h 28m | 12h 24m | 12h 20m | 12h 16m | 12h 12m | 12h 8m | 12h 4m | 12h 0m | | |

## TO FIND COLOGARITHMS OF NUMBERS.

TAKE out the logarithm from the table of logarithms, and subtract it (characteristic as well as mantissa) from 10 in the following manner: subtract every figure from 9, proceeding from left to right, to the last significant figure, which subtract from 10. Cast out as many tens in characteristic of result as there have been cologarithms used.

Thus, to find log. 5806 − log. 4814 + log. 8192 − log. 612, using addition only:—

| | | |
|---|---|---|
| log. | 5806 . . . . . | 3·724767 |
| colog. | 4814 . . . . . | 6·317494 |
| log. | 8192 . . . . . | 3·913390 |
| colog. | 612 . . . . . | 7·213249 |
| | log. 14·76 . . . . . | 1·168900 |

N.B. The cologarithm may thus be taken *by sight* from a table of logarithms, by persons accustomed to the use of tables, as easily as the logarithm itself, and with greater security from material error, than from a table of cologarithms. The rule for finding the characteristic of the cologarithm differing from the rule by which the characteristic of the logarithm is found, some considerable probability of serious error is involved in the use of tables of cologarithms.

In the case of negative characteristics, their subtraction from 9 being apparently an addition, it is often as well to cast out the 10 from the cologarithm at once before proceeding to sum.

Thus, to find log. 53·06 − log. ·04814 + log. 8·192 − log. ·00612:—

| | | | |
|---|---|---|---|
| log. | 53·06 | = . . . | 1·724767 |
| colog. | ·04814 | = . . . | ×1·317494 |
| log. | 8·192 | = . . . | 0·913390 |
| colog. | ·00612 | = . . . | ×2·213249 |
| | | | 6·168900 |

[*To face Table of Logarithms of Numbers*, p. 217.

## Log$^{a}$. of numbers from *one* to a *thousand*. (u.)

| No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | .000000 | 73 | .863323 | 145 | .161368 | 217 | .336460 | 289 | .460898 | 361 | .557507 | 433 | .636485 |
| 2 | .301030 | 74 | .869232 | 146 | .164353 | 218 | .338457 | 290 | .462398 | 362 | .558709 | 434 | .637490 |
| 3 | .477121 | 75 | .875061 | 147 | .167317 | 219 | 340444 | 291 | .463893 | 363 | .559907 | 435 | .638489 |
| 4 | .602060 | 76 | .880814 | 148 | .170262 | 220 | 342423 | 292 | .465383 | 364 | .561101 | 436 | .639486 |
| 5 | .698970 | 77 | .886491 | 149 | .173186 | 221 | .344392 | 293 | .466868 | 365 | .562293 | 437 | .640481 |
| 6 | .778151 | 78 | .892095 | 150 | .176091 | 222 | .346353 | 294 | .468347 | 366 | .563481 | 438 | .641474 |
| 7 | .845098 | 79 | .897627 | 151 | .178977 | 223 | .348305 | 295 | .469822 | 367 | .564666 | 439 | .642465 |
| 8 | .903090 | 80 | .903090 | 152 | .181844 | 224 | .350248 | 296 | .471292 | 368 | .565848 | 440 | .643453 |
| 9 | .954243 | 81 | .908485 | 153 | .184691 | 225 | .352183 | 297 | .472756 | 369 | .567026 | 441 | .644439 |
| 10 | .000000 | 82 | .913814 | 154 | .187521 | 226 | .354108 | 298 | .474216 | 370 | .568202 | 442 | .645422 |
| 11 | .041393 | 83 | .919078 | 155 | .190332 | 227 | .356026 | 299 | .475671 | 371 | .569374 | 443 | .646404 |
| 12 | .079181 | 84 | .924279 | 156 | .193125 | 228 | .357935 | 300 | .477121 | 372 | .570543 | 444 | .647383 |
| 13 | .113943 | 85 | .929419 | 157 | .195900 | 229 | .359835 | 301 | .478567 | 373 | .571709 | 445 | .648360 |
| 14 | .146128 | 86 | 934498 | 158 | .198657 | 230 | .361728 | 302 | .480007 | 374 | .572872 | 446 | .649335 |
| 15 | .176091 | 87 | .939519 | 159 | .201397 | 231 | .363612 | 303 | .481443 | 375 | .574031 | 447 | .650308 |
| 16 | .204120 | 88 | .944483 | 160 | .204120 | 232 | .365488 | 304 | .482874 | 376 | .575188 | 448 | .651278 |
| 17 | .230449 | 89 | .949390 | 161 | .206826 | 233 | .367356 | 305 | .484300 | 377 | .576341 | 449 | .652246 |
| 18 | .255273 | 90 | .954243 | 162 | .209515 | 234 | .369216 | 306 | .485721 | 378 | .577492 | 450 | .653213 |
| 19 | .278754 | 91 | .959041 | 163 | .212188 | 235 | .371068 | 307 | .487138 | 379 | .578639 | 451 | .654177 |
| 20 | .301030 | 92 | .963788 | 164 | .214844 | 236 | .372912 | 308 | .488551 | 380 | .579784 | 452 | .655138 |
| 21 | .322219 | 93 | .968483 | 165 | .217484 | 237 | .374748 | 309 | .489958 | 381 | .580925 | 453 | .656098 |
| 22 | .342423 | 94 | .973128 | 166 | .220108 | 238 | .376577 | 310 | .491362 | 382 | .582063 | 454 | .657056 |
| 23 | .361728 | 95 | .977724 | 167 | .222716 | 239 | .378398 | 311 | .492760 | 383 | .583199 | 455 | .658011 |
| 24 | .380211 | 96 | .982271 | 168 | .225309 | 240 | .380211 | 312 | .494155 | 384 | .584331 | 456 | .658965 |
| 25 | .397940 | 97 | .986772 | 169 | .227887 | 241 | .382017 | 313 | .495544 | 385 | .585461 | 457 | .659916 |
| 26 | .414973 | 98 | .991226 | 170 | .230449 | 242 | .383815 | 314 | .496930 | 386 | .586587 | 458 | .660865 |
| 27 | .431364 | 99 | .995635 | 171 | .232996 | 243 | .385606 | 315 | .498311 | 387 | .587711 | 459 | .661813 |
| 28 | .447158 | 100 | .000000 | 172 | .235528 | 244 | .387390 | 316 | .499687 | 388 | .588832 | 460 | .662758 |
| 29 | .462398 | 101 | .004321 | 173 | .238046 | 245 | .389166 | 317 | .501059 | 389 | .589950 | 461 | .663701 |
| 30 | .477121 | 102 | .008600 | 174 | .240549 | 246 | .390935 | 318 | .502427 | 390 | .591065 | 462 | .664642 |
| 31 | .491362 | 103 | .012837 | 175 | .243038 | 247 | .392697 | 319 | .503791 | 391 | .592177 | 463 | .665581 |
| 32 | .505150 | 104 | .017033 | 176 | .245513 | 248 | .394452 | 320 | .505150 | 392 | .593286 | 464 | .666518 |
| 33 | .518514 | 105 | .021189 | 177 | .247973 | 249 | .396199 | 321 | .506505 | 393 | .594393 | 465 | .667453 |
| 34 | .531479 | 106 | .025306 | 178 | .250420 | 250 | .397940 | 322 | .507856 | 394 | .595496 | 466 | .668386 |
| 35 | .544068 | 107 | .029384 | 179 | .252853 | 251 | .399674 | 323 | .509203 | 395 | .596597 | 467 | .669317 |
| 36 | .556303 | 108 | .033424 | 180 | .255273 | 252 | .401401 | 324 | .510545 | 396 | .597695 | 468 | .670246 |
| 37 | .568202 | 109 | .037427 | 181 | .257679 | 253 | .403121 | 325 | .511883 | 397 | .598791 | 469 | .671173 |
| 38 | .579784 | 110 | .041393 | 182 | .260071 | 254 | .404834 | 326 | .513218 | 398 | .599883 | 470 | .672098 |
| 39 | .591065 | 111 | .045323 | 183 | .262451 | 255 | .406540 | 327 | .514548 | 399 | .600973 | 471 | .673021 |
| 40 | .602060 | 112 | .049218 | 184 | .264818 | 256 | .408240 | 328 | .515874 | 400 | .602060 | 472 | .673942 |
| 41 | .612784 | 113 | .053078 | 185 | .267172 | 257 | .409933 | 329 | .517196 | 401 | .603144 | 473 | .674861 |
| 42 | .623249 | 114 | .056905 | 186 | .269513 | 258 | .411620 | 330 | .518514 | 402 | .604226 | 474 | .675778 |
| 43 | .633468 | 115 | .060698 | 187 | .271842 | 259 | .413300 | 331 | .519828 | 403 | .605305 | 475 | .676694 |
| 44 | .643453 | 116 | .064458 | 188 | .274158 | 260 | .414973 | 332 | .521138 | 404 | .606381 | 476 | .677607 |
| 45 | .653213 | 117 | .068186 | 189 | .276462 | 261 | .416641 | 333 | .522444 | 405 | .607455 | 477 | .678518 |
| 46 | 662758 | 118 | .071882 | 190 | .278754 | 262 | .418301 | 334 | .523746 | 406 | .608526 | 478 | .679428 |
| 47 | .672098 | 119 | .075547 | 191 | .281033 | 263 | .419956 | 335 | .525045 | 407 | .609594 | 479 | .680336 |
| 48 | .681241 | 120 | .079181 | 192 | .283301 | 264 | .421604 | 336 | .526339 | 408 | .610660 | 480 | .681241 |
| 49 | .690196 | 121 | .082785 | 193 | .285557 | 265 | .423246 | 337 | .527630 | 409 | .611723 | 481 | .682145 |
| 50 | .698970 | 122 | .086360 | 194 | .287802 | 266 | .424882 | 338 | .528917 | 410 | .612784 | 482 | .683047 |
| 51 | .707570 | 123 | .089905 | 195 | .290035 | 267 | .426511 | 339 | .530200 | 411 | .613842 | 483 | .683947 |
| 52 | .716003 | 124 | .093422 | 196 | .292256 | 268 | .428135 | 340 | .531479 | 412 | .614897 | 484 | .684845 |
| 53 | .724276 | 125 | .096910 | 197 | .294466 | 269 | .429752 | 341 | .532754 | 413 | .615950 | 485 | .685742 |
| 54 | .732394 | 126 | .100371 | 198 | .296665 | 270 | .431364 | 342 | .534026 | 414 | .617000 | 486 | .686636 |
| 55 | .740363 | 127 | .103804 | 199 | .298853 | 271 | .432969 | 343 | .535294 | 415 | .618048 | 487 | .687529 |
| 56 | .748188 | 128 | .107210 | 200 | .301030 | 272 | .434569 | 344 | .536558 | 416 | .619093 | 488 | .688420 |
| 57 | .755875 | 129 | .110590 | 201 | .303196 | 273 | .436163 | 345 | .537819 | 417 | .620136 | 489 | .689309 |
| 58 | .763428 | 130 | .113943 | 202 | .305351 | 274 | .437751 | 346 | .539076 | 418 | .621176 | 490 | .690196 |
| 59 | .770852 | 131 | .117271 | 203 | .307496 | 275 | .439333 | 347 | .540329 | 419 | .622214 | 491 | .691081 |
| 60 | .778151 | 132 | .120574 | 204 | .309630 | 276 | .440909 | 348 | .541579 | 420 | .623249 | 492 | .691965 |
| 61 | .785330 | 133 | .123852 | 205 | .311754 | 277 | .442480 | 349 | .542825 | 421 | .624282 | 493 | .692847 |
| 62 | .792392 | 134 | .127105 | 206 | .313867 | 278 | .444045 | 350 | .544068 | 422 | .625312 | 494 | .693727 |
| 63 | .799341 | 135 | .130334 | 207 | .315970 | 279 | .445604 | 351 | .545307 | 423 | .626340 | 495 | .694605 |
| 64 | .806180 | 136 | .133539 | 208 | .318063 | 280 | .447158 | 352 | .546543 | 424 | .627366 | 496 | .695482 |
| 65 | .812913 | 137 | .136721 | 209 | .320146 | 281 | .448706 | 353 | .547775 | 425 | .628389 | 497 | .696356 |
| 66 | .819544 | 138 | .139879 | 210 | .322219 | 282 | .450249 | 354 | .549003 | 426 | .629410 | 498 | .697229 |
| 67 | .826075 | 139 | .143015 | 211 | .324282 | 283 | .451786 | 355 | .550228 | 427 | .630428 | 499 | .698101 |
| 68 | .832509 | 140 | .146128 | 212 | .326336 | 284 | .453318 | 356 | .551450 | 428 | .631444 | 500 | .698970 |
| 69 | .838849 | 141 | .149219 | 213 | .328380 | 285 | .454845 | 357 | .552668 | 429 | .632457 | 501 | .699838 |
| 70 | .845098 | 142 | .152288 | 214 | .330414 | 286 | .456366 | 358 | .553883 | 430 | .633468 | 502 | .700704 |
| 71 | .851258 | 143 | .155336 | 215 | .332438 | 287 | .457882 | 359 | .555094 | 431 | .634477 | 503 | .701568 |
| 72 | .857333 | 144 | .158362 | 216 | .334454 | 288 | .459392 | 360 | .556303 | 432 | .635484 | 504 | .702431 |

## Log$^{s}$. of numbers from *one* to a *thousand*. (u.)

| No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. | No. | Log. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 505 | .703291 | 576 | .760422 | 647 | .810904 | 718 | .856124 | 789 | .897077 | 860 | .934498 | 931 | .968950 |
| 506 | .704151 | 577 | .761176 | 648 | .811575 | 719 | .856729 | 790 | .897627 | 861 | .935003 | 932 | .969416 |
| 507 | .705008 | 578 | .761928 | 649 | .812245 | 720 | .857333 | 791 | .898176 | 862 | .935507 | 933 | .969882 |
| 508 | .705864 | 579 | .762679 | 650 | .812913 | 721 | .857935 | 792 | .898725 | 863 | .936011 | 934 | .970347 |
| 509 | .706718 | 580 | .763428 | 651 | .813581 | 722 | .858537 | 793 | .899273 | 864 | .936514 | 935 | .970812 |
| 510 | .707570 | 581 | .764176 | 652 | .814248 | 723 | .859138 | 794 | .899821 | 865 | .937016 | 936 | .971276 |
| 511 | .708421 | 582 | .764923 | 653 | .814913 | 724 | .859739 | 795 | .900367 | 866 | .937518 | 937 | .971740 |
| 512 | .709270 | 583 | .765669 | 654 | .815578 | 725 | .860338 | 796 | .900913 | 867 | .938019 | 938 | .972203 |
| 513 | .710117 | 584 | .766413 | 655 | .816241 | 726 | .860937 | 797 | .901458 | 868 | .938520 | 939 | .972666 |
| 514 | .710963 | 585 | .767156 | 656 | .816904 | 727 | .861534 | 798 | .902003 | 869 | .939020 | 940 | .973128 |
| 515 | .711807 | 586 | .767898 | 657 | .817565 | 728 | .862131 | 799 | .902547 | 870 | .939519 | 941 | .973590 |
| 516 | .712650 | 587 | .768638 | 658 | .818226 | 729 | .862728 | 800 | .903090 | 871 | .940018 | 942 | .974051 |
| 517 | .713491 | 588 | .769377 | 659 | .818885 | 730 | .863323 | 801 | .903633 | 872 | .940516 | 943 | .974512 |
| 518 | .714330 | 589 | .770115 | 660 | .819544 | 731 | .863917 | 802 | .904174 | 873 | .941014 | 944 | .974972 |
| 519 | .715167 | 590 | .770852 | 661 | .820201 | 732 | .864511 | 803 | .904716 | 874 | .941511 | 945 | .975432 |
| 520 | .716003 | 591 | .771587 | 662 | .820858 | 733 | .865104 | 804 | .905256 | 875 | .942008 | 946 | .975891 |
| 521 | .716838 | 592 | .772322 | 663 | .821514 | 734 | .865696 | 805 | .905796 | 876 | .942504 | 947 | .976350 |
| 522 | .717671 | 593 | .773055 | 664 | .822168 | 735 | .866287 | 806 | .906335 | 877 | .943000 | 948 | .976808 |
| 523 | .718502 | 594 | .773786 | 665 | .822822 | 736 | .866878 | 807 | .906874 | 878 | .943495 | 949 | .977266 |
| 524 | .719331 | 595 | .774517 | 666 | .823474 | 737 | .867467 | 808 | .907411 | 879 | .943989 | 950 | .977724 |
| 525 | .720159 | 596 | .775246 | 667 | .824126 | 738 | .868056 | 809 | .907949 | 880 | .944483 | 951 | .978181 |
| 526 | .720986 | 597 | .775974 | 668 | .824776 | 739 | .868644 | 810 | .908485 | 881 | .944976 | 952 | .978637 |
| 527 | .721811 | 598 | .776701 | 669 | .825426 | 740 | .869232 | 811 | .909021 | 882 | .945469 | 953 | .979093 |
| 528 | .722634 | 599 | .777427 | 670 | .826075 | 741 | .869818 | 812 | .909556 | 883 | .945961 | 954 | .979548 |
| 529 | .723456 | 600 | .778151 | 671 | .826723 | 742 | .870404 | 813 | .910091 | 884 | .946452 | 955 | .980003 |
| 530 | .724276 | 601 | .778874 | 672 | .827369 | 743 | .870989 | 814 | .910624 | 885 | .946943 | 956 | .980458 |
| 531 | .725095 | 602 | .779596 | 673 | .828015 | 744 | .871573 | 815 | .911158 | 886 | .947434 | 957 | .980912 |
| 532 | .725912 | 603 | .780317 | 674 | .828660 | 745 | .872156 | 816 | .911690 | 887 | .947924 | 958 | .981366 |
| 533 | .726727 | 604 | .781037 | 675 | .829304 | 746 | .872739 | 817 | .912222 | 888 | .948413 | 959 | .981819 |
| 534 | .727541 | 605 | .781755 | 676 | .829947 | 747 | .873321 | 818 | .912753 | 889 | .948902 | 960 | .982271 |
| 535 | .728354 | 606 | .782473 | 677 | .830589 | 748 | .873902 | 819 | .913284 | 890 | .949390 | 961 | .982723 |
| 536 | .729165 | 607 | .783189 | 678 | .831230 | 749 | .874482 | 820 | .913814 | 891 | .949878 | 962 | .983175 |
| 537 | .729974 | 608 | .783904 | 679 | .831870 | 750 | .875061 | 821 | .914343 | 892 | .950365 | 963 | .983626 |
| 538 | .730782 | 609 | .784617 | 680 | .832509 | 751 | .875640 | 822 | .914872 | 893 | .950851 | 964 | .984077 |
| 539 | .731589 | 610 | .785330 | 681 | .833147 | 752 | .876218 | 823 | .915400 | 894 | .951338 | 965 | .984527 |
| 540 | .732394 | 611 | .786041 | 682 | .833784 | 753 | .876795 | 824 | .915927 | 895 | .951823 | 966 | .984977 |
| 541 | .733197 | 612 | .786751 | 683 | .834421 | 754 | .877371 | 825 | .916454 | 896 | .952308 | 967 | .985426 |
| 542 | .733999 | 613 | .787460 | 684 | .835056 | 755 | .877947 | 826 | .916980 | 897 | .952792 | 968 | .985875 |
| 543 | .734800 | 614 | .788168 | 685 | .835691 | 756 | .878522 | 827 | .917506 | 898 | .953276 | 969 | .986324 |
| 544 | .735599 | 615 | .788875 | 686 | .836324 | 757 | .879096 | 828 | .918030 | 899 | .953760 | 970 | .986772 |
| 545 | .736397 | 616 | .789581 | 687 | .836957 | 758 | .879669 | 829 | .918555 | 900 | .954243 | 971 | .987219 |
| 546 | .737193 | 617 | .790285 | 688 | .837588 | 759 | .880242 | 830 | .919078 | 901 | .954725 | 972 | .987666 |
| 547 | .737987 | 618 | .790988 | 689 | .838219 | 760 | .880814 | 831 | .919601 | 902 | .955207 | 973 | .988113 |
| 548 | .738781 | 619 | .791691 | 690 | .838849 | 761 | .881385 | 832 | .920123 | 903 | .955688 | 974 | .988559 |
| 549 | .739572 | 620 | .792392 | 691 | .839478 | 762 | .881955 | 833 | .920645 | 904 | .956168 | 975 | .989005 |
| 550 | .740363 | 621 | .793092 | 692 | .840106 | 763 | .882525 | 834 | .921166 | 905 | .956649 | 976 | .989450 |
| 551 | .741152 | 622 | .793790 | 693 | .840733 | 764 | .883093 | 835 | .921686 | 906 | .957128 | 977 | .989895 |
| 552 | .741939 | 623 | .794488 | 694 | .841359 | 765 | .883661 | 836 | .922206 | 907 | .957607 | 978 | .990339 |
| 553 | .742725 | 624 | .795185 | 695 | .841985 | 766 | .884229 | 837 | .922725 | 908 | .958086 | 979 | .990783 |
| 554 | .743510 | 625 | .795880 | 696 | .842609 | 767 | .884795 | 838 | .923244 | 909 | .958564 | 980 | .991226 |
| 555 | .744293 | 626 | .796574 | 697 | .843233 | 768 | .885361 | 839 | .923762 | 910 | .959041 | 981 | .991669 |
| 556 | .745075 | 627 | .797268 | 698 | .843855 | 769 | .885926 | 840 | .924279 | 911 | .959518 | 982 | .992111 |
| 557 | .745855 | 628 | .797960 | 699 | .844477 | 770 | .886491 | 841 | .924796 | 912 | .959995 | 983 | .992554 |
| 558 | .746634 | 629 | .798651 | 700 | .845098 | 771 | .887054 | 842 | .925312 | 913 | .960471 | 984 | .992995 |
| 559 | .747412 | 630 | .799341 | 701 | .845718 | 772 | .887617 | 843 | .925828 | 914 | .960946 | 985 | .993436 |
| 560 | .748188 | 631 | .800029 | 702 | .846337 | 773 | .888179 | 844 | .926342 | 915 | .961421 | 986 | .993877 |
| 561 | .748963 | 632 | .800717 | 703 | .846955 | 774 | .888741 | 845 | .926857 | 916 | .961895 | 987 | .994317 |
| 562 | .749736 | 633 | .801404 | 704 | .847573 | 775 | .889302 | 846 | .927370 | 917 | .962369 | 988 | .994757 |
| 563 | .750508 | 634 | .802089 | 705 | .848189 | 776 | .889862 | 847 | .927883 | 918 | .962843 | 989 | .995196 |
| 564 | .751279 | 635 | .802774 | 706 | .848805 | 777 | .890421 | 848 | .928396 | 919 | .963316 | 990 | .995635 |
| 565 | .752048 | 636 | .803457 | 707 | .849419 | 778 | .890980 | 849 | .928908 | 920 | .963788 | 991 | .996074 |
| 566 | .752816 | 637 | .804139 | 708 | .850033 | 779 | .891537 | 850 | .929419 | 921 | .964260 | 992 | .996512 |
| 567 | .753583 | 638 | .804821 | 709 | .850646 | 780 | .892095 | 851 | .929930 | 922 | .964731 | 993 | .996949 |
| 568 | .754348 | 639 | .805501 | 710 | .851258 | 781 | .892651 | 852 | .930440 | 923 | .965202 | 994 | .997386 |
| 569 | .755112 | 640 | .806180 | 711 | .851870 | 782 | .893207 | 853 | .930949 | 924 | .965672 | 995 | .997823 |
| 570 | .755875 | 641 | .806858 | 712 | .852480 | 783 | .893762 | 854 | .931458 | 925 | .966142 | 996 | .998259 |
| 571 | .756636 | 642 | .807535 | 713 | .853090 | 784 | .894316 | 855 | .931966 | 926 | .966611 | 997 | .998695 |
| 572 | .757396 | 643 | .808211 | 714 | .853698 | 785 | .894870 | 856 | .932474 | 927 | .967080 | 998 | .999131 |
| 573 | .758155 | 644 | .808886 | 715 | .854306 | 786 | .895423 | 857 | .932981 | 928 | .967548 | 999 | .999565 |
| 574 | .758912 | 645 | .809560 | 716 | .854913 | 787 | .895975 | 858 | .933487 | 929 | .968016 | 1000 | .000000 |
| 575 | .759668 | 646 | .810233 | 717 | .855519 | 788 | .896526 | 859 | .933993 | 930 | .968483 | | |

## Log. .000000 to .130012 No. 1000 to 1349. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1000 | .000000 | 000 | 1070 | .029384 | 000 | 1140 | .056905 | 000 | 1210 | .082785 | 000 | 1280 | .107210 | 000 |
| 1 | .000434 | 043 | 1 | .029789 | 040 | 1 | .057286 | 038 | 1 | .083144 | 036 | 1 | 107549 | 034 |
| 2 | .000868 | 086 | 2 | .030195 | 081 | 2 | .057666 | 076 | 2 | .083503 | 071 | 2 | .107888 | 067 |
| 3 | .001301 | 130 | 3 | .030600 | 121 | 3 | .058046 | 114 | 3 | .083861 | 107 | 3 | .108227 | 101 |
| 4 | .001734 | 173 | 4 | .031004 | 162 | 4 | .058426 | 152 | 4 | .084219 | 143 | 4 | .108565 | 135 |
| 5 | .002166 | 216 | 5 | .031408 | 202 | 5 | .058805 | 190 | 5 | .084576 | 179 | 5 | .108903 | 169 |
| 6 | .002598 | 259 | 6 | .031812 | 242 | 6 | .059185 | 228 | 6 | .084934 | 214 | 6 | .109241 | 203 |
| 7 | .003029 | 303 | 7 | .032216 | 283 | 7 | .059563 | 266 | 7 | .085291 | 250 | 7 | .109578 | 237 |
| 8 | .003460 | 346 | 8 | .032619 | 323 | 8 | .059942 | 304 | 8 | .085647 | 286 | 8 | .109916 | 270 |
| 9 | .003891 | 389 | 9 | .033021 | 364 | 9 | .060320 | 342 | 9 | .086004 | 322 | 9 | .110253 | 304 |
| 1010 | .004321 | 000 | 1080 | .033424 | 000 | 1150 | .060698 | 000 | 1220 | .086360 | 000 | 1290 | .110590 | 000 |
| 1 | .004751 | 043 | 1 | .033826 | 040 | 1 | .061075 | 038 | 1 | .086716 | 035 | 1 | .110926 | 034 |
| 2 | .005180 | 086 | 2 | .034227 | 080 | 2 | .061452 | 075 | 2 | 087071 | 071 | 2 | .111262 | 067 |
| 3 | .005609 | 128 | 3 | .034628 | 120 | 3 | .061829 | 113 | 3 | .087426 | 106 | 3 | .111598 | 101 |
| 4 | .006038 | 171 | 4 | .035029 | 160 | 4 | .062206 | 150 | 4 | .087781 | 142 | 4 | .111934 | 134 |
| 5 | .006466 | 214 | 5 | .035430 | 200 | 5 | .062582 | 188 | 5 | .088136 | 177 | 5 | .112270 | 168 |
| 6 | .006894 | 257 | 6 | .035830 | 240 | 6 | .062958 | 226 | 6 | .088490 | 213 | 6 | .112605 | 201 |
| 7 | .007321 | 300 | 7 | .036229 | 280 | 7 | 063333 | 263 | 7 | .088845 | 248 | 7 | 112940 | 235 |
| 8 | .007748 | 343 | 8 | .036629 | 321 | 8 | .063709 | 301 | 8 | .089198 | 284 | 8 | .113275 | 268 |
| 9 | .008174 | 385 | 9 | .037028 | 361 | 9 | .064083 | 338 | 9 | .089552 | 319 | 9 | 113609 | 302 |
| 1020 | .008600 | 000 | 1090 | .037426 | 000 | 1160 | .064458 | 000 | 1230 | .089905 | 000 | 1300 | .113943 | 000 |
| 1 | .009026 | 042 | 1 | .037825 | 040 | 1 | .064832 | 037 | 1 | .090258 | 035 | 1 | .114277 | 033 |
| 2 | 009451 | 085 | 2 | .038223 | 079 | 2 | .065206 | 075 | 2 | .090611 | 070 | 2 | .114611 | 067 |
| 3 | .009876 | 127 | 3 | .038620 | 119 | 3 | .065580 | 112 | 3 | .090963 | 106 | 3 | .114944 | 100 |
| 4 | .010300 | 170 | 4 | .039017 | 159 | 4 | .065953 | 149 | 4 | .091315 | 141 | 4 | .115278 | 133 |
| 5 | .010724 | 212 | 5 | .039414 | 198 | 5 | .066326 | 186 | 5 | 091667 | 176 | 5 | .115610 | 167 |
| 6 | .011147 | 254 | 6 | .039811 | 238 | 6 | .066699 | 224 | 6 | .092018 | 211 | 6 | .115943 | 200 |
| 7 | .011570 | 297 | 7 | .040207 | 278 | 7 | .067071 | 261 | 7 | .092370 | 246 | 7 | .116276 | 233 |
| 8 | .011993 | 339 | 8 | .040602 | 318 | 8 | .067443 | 298 | 8 | .092721 | 282 | 8 | .116608 | 267 |
| 9 | .012415 | 382 | 9 | .040998 | 357 | 9 | .067814 | 336 | 9 | .093071 | 317 | 9 | .116940 | 300 |
| 1030 | .012837 | 000 | 1100 | .041393 | 000 | 1170 | .068186 | 000 | 1240 | .093422 | 000 | 1310 | 117271 | 000 |
| 1 | .013259 | 042 | 1 | .041787 | 039 | 1 | .068557 | 037 | 1 | .093772 | 035 | 1 | .117603 | 033 |
| 2 | .013680 | 084 | 2 | .042182 | 079 | 2 | 068928 | 074 | 2 | .094122 | 070 | 2 | 117934 | 066 |
| 3 | .014100 | 126 | 3 | .042575 | 118 | 3 | .069298 | 111 | 3 | .094471 | 105 | 3 | .118265 | 099 |
| 4 | .014520 | 168 | 4 | .042969 | 157 | 4 | .069668 | 148 | 4 | .094820 | 140 | 4 | .118595 | 132 |
| 5 | .014940 | 210 | 5 | .043362 | 196 | 5 | .070038 | 185 | 5 | .095169 | 175 | 5 | .118926 | 165 |
| 6 | .015360 | 252 | 6 | .043755 | 236 | 6 | .070407 | 222 | 6 | .095518 | 210 | 6 | .119256 | 198 |
| 7 | .015779 | 294 | 7 | .044148 | 275 | 7 | .070776 | 259 | 7 | .095866 | 245 | 7 | 119586 | 231 |
| 8 | .016197 | 336 | 8 | .044540 | 314 | 8 | .071145 | 296 | 8 | .096215 | 280 | 8 | .119915 | 264 |
| 9 | .016615 | 378 | 9 | .044931 | 354 | 9 | .071514 | 333 | 9 | .096562 | 315 | 9 | .120245 | 297 |
| 1040 | .017033 | 000 | 1110 | .045323 | 000 | 1180 | .071882 | 000 | 1250 | .096910 | 000 | 1320 | .120574 | 000 |
| 1 | .017451 | 042 | 1 | .045714 | 039 | 1 | .072250 | 037 | 1 | .097257 | 035 | 1 | .120903 | 033 |
| 2 | .017868 | 083 | 2 | .046105 | 078 | 2 | .072617 | 073 | 2 | .097604 | 069 | 2 | .121231 | 066 |
| 3 | .018284 | 125 | 3 | .046495 | 117 | 3 | .072985 | 110 | 3 | .097951 | 104 | 3 | .121560 | 098 |
| 4 | .018700 | 166 | 4 | .046885 | 156 | 4 | .073352 | 147 | 4 | .098297 | 138 | 4 | .121888 | 131 |
| 5 | .019116 | 208 | 5 | .047275 | 195 | 5 | .073718 | 183 | 5 | .098644 | 173 | 5 | .122216 | 164 |
| 6 | .019532 | 250 | 6 | .047664 | 234 | 6 | .074085 | 220 | 6 | .098990 | 208 | 6 | .122543 | 197 |
| 7 | .019947 | 291 | 7 | .048053 | 273 | 7 | .074451 | 256 | 7 | .099335 | 240 | 7 | .122871 | 230 |
| 8 | .020361 | 333 | 8 | .048442 | 312 | 8 | .074816 | 293 | 8 | .099681 | 277 | 8 | .123198 | 262 |
| 9 | .020775 | 374 | 9 | .048830 | 351 | 9 | .075182 | 330 | 9 | .100026 | 311 | 9 | .123525 | 295 |
| 1050 | .021189 | 000 | 1120 | .049218 | 000 | 1190 | .075547 | 000 | 1260 | .100370 | 000 | 1330 | .123852 | 000 |
| 1 | .021603 | 041 | 1 | .049606 | 039 | 1 | .075912 | 036 | 1 | .100715 | 034 | 1 | .124178 | 033 |
| 2 | .022016 | 082 | 2 | .049993 | 077 | 2 | .076276 | 073 | 2 | .101059 | 069 | 2 | .124504 | 065 |
| 3 | .022428 | 124 | 3 | .050380 | 116 | 3 | .076640 | 109 | 3 | .101403 | 103 | 3 | .124830 | 098 |
| 4 | .022841 | 165 | 4 | .050766 | 154 | 4 | .077004 | 145 | 4 | .101747 | 137 | 4 | .125156 | 130 |
| 5 | .023252 | 206 | 5 | .051152 | 193 | 5 | .077368 | 181 | 5 | .102090 | 172 | 5 | .125481 | 163 |
| 6 | .023664 | 247 | 6 | .051538 | 232 | 6 | .077731 | 218 | 6 | .102434 | 206 | 6 | .125806 | 195 |
| 7 | .024075 | 288 | 7 | .051924 | 270 | 7 | .078094 | 254 | 7 | .102777 | 240 | 7 | .126131 | 228 |
| 8 | .024486 | 330 | 8 | .052309 | 309 | 8 | .078457 | 290 | 8 | .103119 | 275 | 8 | .126456 | 260 |
| 9 | .024896 | 371 | 9 | .052694 | 347 | 9 | .078819 | 327 | 9 | .103462 | 309 | 9 | .126781 | 293 |
| 1060 | .025306 | 000 | 1130 | .053078 | 000 | 1200 | .079181 | 000 | 1270 | .103804 | 000 | 1340 | .127105 | 000 |
| 1 | .025715 | 041 | 1 | .053463 | 038 | 1 | .079543 | 036 | 1 | .104146 | 034 | 1 | .127429 | 032 |
| 2 | .026124 | 082 | 2 | .053846 | 077 | 2 | .079904 | 072 | 2 | .104487 | 068 | 2 | .127752 | 065 |
| 3 | .026533 | 122 | 3 | .054230 | 115 | 3 | .080266 | 108 | 3 | .104828 | 102 | 3 | .128076 | 097 |
| 4 | .026942 | 163 | 4 | .054613 | 153 | 4 | .080626 | 144 | 4 | .105169 | 136 | 4 | .128399 | 129 |
| 5 | .027350 | 204 | 5 | .054996 | 191 | 5 | .080987 | 180 | 5 | .105510 | 170 | 5 | .128722 | 161 |
| 6 | .027757 | 245 | 6 | .055378 | 230 | 6 | .081347 | 216 | 6 | .105851 | 204 | 6 | .129045 | 194 |
| 7 | .028164 | 286 | 7 | .055760 | 268 | 7 | .081707 | 252 | 7 | .106191 | 238 | 7 | .129368 | 226 |
| 8 | 028571 | 326 | 8 | .056142 | 306 | 8 | .082067 | 288 | 8 | .106531 | 272 | 8 | .129690 | 258 |
| 9 | .028978 | 367 | 9 | .056524 | 345 | 9 | .082426 | 324 | 9 | .106870 | 306 | 9 | .130012 | 291 |

Log. .130334 to .230193 No. 1350 to 1699. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1350 | .130334 | 000 | 1420 | .152288 | 000 | 1490 | .173186 | 000 | 1560 | .193125 | 000 | 1630 | .212188 | 000 |
| 1 | .130655 | 032 | 1 | .152594 | 030 | 1 | .173478 | 029 | 1 | .193403 | 028 | 1 | .212454 | 027 |
| 2 | .130977 | 064 | 2 | .152900 | 061 | 2 | .173769 | 058 | 2 | .193681 | 056 | 2 | .212720 | 053 |
| 3 | .131298 | 096 | 3 | .153205 | 091 | 3 | .174060 | 087 | 3 | .193959 | 083 | 3 | .212986 | 080 |
| 4 | .131619 | 128 | 4 | .153510 | 122 | 4 | .174351 | 116 | 4 | .194237 | 111 | 4 | .213252 | 106 |
| 5 | .131939 | 160 | 5 | .153815 | 152 | 5 | .174641 | 145 | 5 | .194514 | 139 | 5 | .213518 | 133 |
| 6 | .132260 | 192 | 6 | .154119 | 183 | 6 | .174932 | 175 | 6 | .194792 | 166 | 6 | .213783 | 159 |
| 7 | .132580 | 224 | 7 | .154424 | 213 | 7 | .175222 | 204 | 7 | .195069 | 194 | 7 | .214049 | 186 |
| 8 | .132900 | 256 | 8 | .154728 | 244 | 8 | .175512 | 233 | 8 | .195346 | 222 | 8 | .214314 | 212 |
| 9 | .133219 | 288 | 9 | .155032 | 274 | 9 | .175802 | 261 | 9 | .195623 | 250 | 9 | .214579 | 239 |
| 1360 | .133539 | 000 | 1430 | .155336 | 000 | 1500 | .176091 | 000 | 1570 | .195900 | 000 | 1640 | .214844 | 000 |
| 1 | .133858 | 032 | 1 | .155640 | 030 | 1 | .176381 | 029 | 1 | .196176 | 027 | 1 | .215109 | 026 |
| 2 | .134177 | 064 | 2 | .155943 | 060 | 2 | .176670 | 058 | 2 | .196452 | 055 | 2 | .215373 | 053 |
| 3 | .134496 | 096 | 3 | .156246 | 091 | 3 | .176959 | 086 | 3 | .196729 | 083 | 3 | .215638 | 079 |
| 4 | .134814 | 127 | 4 | .156549 | 121 | 4 | .177248 | 115 | 4 | .197005 | 110 | 4 | .215902 | 106 |
| 5 | .135133 | 159 | 5 | .156852 | 151 | 5 | .177536 | 144 | 5 | .197281 | 138 | 5 | .216166 | 132 |
| 6 | .135451 | 191 | 6 | .157154 | 181 | 6 | .177825 | 173 | 6 | .197556 | 166 | 6 | .216430 | 159 |
| 7 | .135768 | 223 | 7 | .157457 | 211 | 7 | .178113 | 202 | 7 | .197832 | 193 | 7 | .216694 | 185 |
| 8 | .136086 | 255 | 8 | .157759 | 242 | 8 | .178401 | 231 | 8 | .198107 | 221 | 8 | .216957 | 211 |
| 9 | .136403 | 287 | 9 | .158061 | 272 | 9 | .178689 | 259 | 9 | .198382 | 248 | 9 | .217221 | 238 |
| 1370 | .136721 | 000 | 1440 | .158362 | 000 | 1510 | .178977 | 000 | 1580 | .198657 | 000 | 1650 | .217484 | 000 |
| 1 | .137037 | 032 | 1 | .158664 | 030 | 1 | .179264 | 029 | 1 | .198932 | 027 | 1 | .217747 | 026 |
| 2 | .137354 | 063 | 2 | .158965 | 060 | 2 | .179552 | 057 | 2 | .199206 | 055 | 2 | .218010 | 052 |
| 3 | .137670 | 094 | 3 | .159266 | 090 | 3 | .179839 | 086 | 3 | .199481 | 082 | 3 | .218273 | 079 |
| 4 | .137987 | 126 | 4 | .159567 | 120 | 4 | .180126 | 115 | 4 | .199755 | 110 | 4 | .218535 | 105 |
| 5 | .138303 | 158 | 5 | .159868 | 150 | 5 | .180413 | 144 | 5 | .200029 | 137 | 5 | .218798 | 131 |
| 6 | .138618 | 189 | 6 | .160168 | 180 | 6 | .180699 | 172 | 6 | .200303 | 164 | 6 | .219060 | 157 |
| 7 | .138934 | 221 | 7 | .160468 | 210 | 7 | .180986 | 201 | 7 | .200577 | 192 | 7 | .219322 | 183 |
| 8 | .139249 | 252 | 8 | .160769 | 240 | 8 | .181272 | 230 | 8 | .200850 | 219 | 8 | .219584 | 210 |
| 9 | .139564 | 284 | 9 | .161068 | 270 | 9 | .181558 | 258 | 9 | .201124 | 247 | 9 | .219846 | 236 |
| 1380 | .139879 | 000 | 1450 | .161368 | 000 | 1520 | .181844 | 000 | 1590 | .201397 | 000 | 1660 | .220108 | 000 |
| 1 | .140194 | 031 | 1 | .161667 | 030 | 1 | .182129 | 028 | 1 | .201670 | 027 | 1 | .220370 | 026 |
| 2 | .140508 | 063 | 2 | .161967 | 060 | 2 | .182415 | 057 | 2 | .201943 | 054 | 2 | .220631 | 052 |
| 3 | .140822 | 094 | 3 | .162266 | 089 | 3 | .182700 | 086 | 3 | .202216 | 082 | 3 | .220892 | 078 |
| 4 | .141136 | 125 | 4 | .162564 | 119 | 4 | .182985 | 114 | 4 | .202488 | 109 | 4 | .221153 | 104 |
| 5 | .141450 | 157 | 5 | .162863 | 149 | 5 | .183270 | 143 | 5 | .202761 | 136 | 5 | .221414 | 130 |
| 6 | .141763 | 188 | 6 | .163161 | 179 | 6 | .183554 | 171 | 6 | .203033 | 163 | 6 | .221675 | 157 |
| 7 | .142076 | 219 | 7 | .163460 | 209 | 7 | .183839 | 200 | 7 | .203305 | 191 | 7 | .221936 | 183 |
| 8 | .142389 | 251 | 8 | .163757 | 239 | 8 | .184123 | 228 | 8 | .203577 | 218 | 8 | .222196 | 209 |
| 9 | .142702 | 282 | 9 | .164055 | 269 | 9 | .184407 | 256 | 9 | .203848 | 245 | 9 | .222456 | 235 |
| 1390 | .143015 | 000 | 1460 | .164353 | 000 | 1530 | .184691 | 000 | 1600 | .204120 | 000 | 1670 | .222716 | 000 |
| 1 | .143327 | 031 | 1 | .164650 | 030 | 1 | .184975 | 028 | 1 | .204391 | 027 | 1 | .222976 | 026 |
| 2 | .143639 | 062 | 2 | .164947 | 059 | 2 | .185259 | 057 | 2 | .204662 | 054 | 2 | .223236 | 052 |
| 3 | .143951 | 093 | 3 | .165244 | 089 | 3 | .185542 | 085 | 3 | .204933 | 081 | 3 | .223496 | 078 |
| 4 | .144263 | 125 | 4 | .165541 | 119 | 4 | .185825 | 113 | 4 | .205204 | 108 | 4 | .223755 | 104 |
| 5 | .144574 | 156 | 5 | .165838 | 148 | 5 | .186108 | 142 | 5 | .205475 | 135 | 5 | .224015 | 130 |
| 6 | .144885 | 187 | 6 | .166134 | 178 | 6 | .186391 | 170 | 6 | .205745 | 162 | 6 | .224274 | 156 |
| 7 | .145196 | 218 | 7 | .166430 | 207 | 7 | .186674 | 198 | 7 | .206016 | 189 | 7 | .224533 | 182 |
| 8 | .145507 | 249 | 8 | .166726 | 237 | 8 | .186956 | 227 | 8 | .206286 | 216 | 8 | .224792 | 208 |
| 9 | .145818 | 280 | 9 | .167022 | 267 | 9 | .187239 | 255 | 9 | .206556 | 243 | 9 | .225051 | 234 |
| 1400 | .146128 | 000 | 1470 | .167317 | 000 | 1540 | .187521 | 000 | 1610 | .206826 | 000 | 1680 | .225309 | 000 |
| 1 | .146438 | 031 | 1 | .167613 | 029 | 1 | .187803 | 028 | 1 | .207095 | 027 | 1 | .225568 | 026 |
| 2 | .146748 | 062 | 2 | .167908 | 059 | 2 | .188084 | 056 | 2 | .207365 | 054 | 2 | .225826 | 052 |
| 3 | .147058 | 093 | 3 | .168203 | 088 | 3 | .188366 | 084 | 3 | .207634 | 081 | 3 | .226084 | 077 |
| 4 | .147367 | 124 | 4 | .168497 | 118 | 4 | .188647 | 113 | 4 | .207903 | 108 | 4 | .226342 | 103 |
| 5 | .147676 | 155 | 5 | .168792 | 147 | 5 | .188928 | 141 | 5 | .208172 | 135 | 5 | .226600 | 129 |
| 6 | .147985 | 186 | 6 | .169086 | 177 | 6 | .189209 | 169 | 6 | .208441 | 162 | 6 | .226858 | 155 |
| 7 | .148294 | 217 | 7 | .169380 | 206 | 7 | .189490 | 197 | 7 | .208710 | 188 | 7 | .227115 | 181 |
| 8 | .148603 | 248 | 8 | .169674 | 236 | 8 | .189771 | 225 | 8 | .208978 | 215 | 8 | .227372 | 206 |
| 9 | .148911 | 279 | 9 | .169968 | 265 | 9 | .190051 | 253 | 9 | .209247 | 241 | 9 | .227630 | 232 |
| 1410 | .149219 | 000 | 1480 | .170262 | 000 | 1550 | .190332 | 000 | 1620 | .209515 | 000 | 1690 | .227887 | 000 |
| 1 | .149527 | 031 | 1 | .170555 | 029 | 1 | .190612 | 028 | 1 | .209783 | 027 | 1 | .228144 | 026 |
| 2 | .149835 | 061 | 2 | .170848 | 058 | 2 | .190892 | 056 | 2 | .210051 | 054 | 2 | .228400 | 051 |
| 3 | .150142 | 092 | 3 | .171141 | 088 | 3 | .191171 | 084 | 3 | .210318 | 080 | 3 | .228657 | 077 |
| 4 | .150449 | 123 | 4 | .171434 | 117 | 4 | .191451 | 112 | 4 | .210586 | 107 | 4 | .228913 | 102 |
| 5 | .150756 | 154 | 5 | .171726 | 146 | 5 | .191730 | 140 | 5 | .210853 | 134 | 5 | .229170 | 128 |
| 6 | .151063 | 184 | 6 | .172019 | 175 | 6 | .192010 | 168 | 6 | .211120 | 161 | 6 | .229426 | 154 |
| 7 | .151370 | 215 | 7 | .172311 | 204 | 7 | .192289 | 196 | 7 | .211388 | 187 | 7 | .229682 | 179 |
| 8 | .151676 | 246 | 8 | .172603 | 234 | 8 | .192567 | 224 | 8 | .211654 | 214 | 8 | .229938 | 205 |
| 9 | .151982 | 277 | 9 | .172895 | 263 | 9 | .192846 | 252 | 9 | .211921 | 240 | 9 | .230193 | 231 |

Log. .230449 to .311542 No. 1700 to 2049. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1700 | .230449 | 000 | 1770 | .247973 | 000 | 1840 | .264818 | 000 | 1910 | .281033 | 000 | 1980 | .296665 | 000 |
| 1 | .230704 | 025 | 1 | 248219 | 025 | 1 | .265054 | 023 | 1 | .281261 | 023 | 1 | .296884 | 022 |
| 2 | .230960 | 051 | 2 | .248464 | 049 | 2 | .265290 | 047 | 2 | .281488 | 045 | 2 | .297104 | 044 |
| 3 | .231215 | 076 | 3 | .248709 | 074 | 3 | .265525 | 070 | 3 | .281715 | 068 | 3 | .297323 | 066 |
| 4 | .231470 | 102 | 4 | .248954 | 098 | 4 | .265761 | 094 | 4 | .281942 | 091 | 4 | .297542 | 088 |
| 5 | 231724 | 127 | 5 | .249198 | 123 | 5 | .265996 | 117 | 5 | .282169 | 113 | 5 | .297760 | 109 |
| 6 | .231979 | 153 | 6 | .249443 | 147 | 6 | .266232 | 141 | 6 | .282395 | 136 | 6 | .297979 | 131 |
| 7 | .232233 | 178 | 7 | .249687 | 172 | 7 | .266467 | 164 | 7 | .282622 | 159 | 7 | 298198 | 153 |
| 8 | .232488 | 204 | 8 | .249932 | 196 | 8 | .266702 | 188 | 8 | .282849 | 181 | 8 | .298416 | 175 |
| 9 | .232742 | 229 | 9 | .250176 | 220 | 9 | .266937 | 211 | 9 | .283075 | 204 | 9 | .298635 | 197 |
| 1710 | .232996 | 000 | 1780 | .250420 | 000 | 1850 | .267172 | 000 | 1920 | .283301 | 000 | 1990 | 298853 | 000 |
| 1 | .233250 | 025 | 1 | .250664 | 024 | 1 | .267406 | 023 | 1 | .283527 | 023 | 1 | .299071 | 022 |
| 2 | .233504 | 051 | 2 | .250908 | 049 | 2 | .267641 | 047 | 2 | .283753 | 045 | 2 | 299289 | 044 |
| 3 | .233757 | 076 | 3 | .251151 | 073 | 3 | .267875 | 070 | 3 | .283979 | 068 | 3 | .299507 | 065 |
| 4 | .234011 | 101 | 4 | .251395 | 097 | 4 | .268110 | 094 | 4 | .284205 | 090 | 4 | .299725 | 087 |
| 5 | .234264 | 127 | 5 | .251638 | 121 | 5 | .268344 | 117 | 5 | .284431 | 113 | 5 | .299943 | 109 |
| 6 | 234517 | 152 | 6 | .251881 | 146 | 6 | .268578 | 141 | 6 | .284656 | 135 | 6 | .300160 | 131 |
| 7 | .234770 | 177 | 7 | .252125 | 171 | 7 | .268812 | 164 | 7 | .284882 | 158 | 7 | .300378 | 153 |
| 8 | .235023 | 202 | 8 | .252367 | 195 | 8 | .269046 | 188 | 8 | .285107 | 180 | 8 | .300595 | 174 |
| 9 | .235276 | 228 | 9 | .252610 | 219 | 9 | .269279 | 211 | 9 | .285332 | 203 | 9 | .300813 | 196 |
| 1720 | .235528 | 000 | 1790 | .252853 | 000 | 1860 | .269513 | 000 | 1930 | .285557 | 000 | 2000 | .301030 | 000 |
| 1 | .235781 | 025 | 1 | .253096 | 024 | 1 | .269746 | 023 | 1 | .285782 | 022 | 1 | .301247 | 022 |
| 2 | .236033 | 050 | 2 | .253338 | 048 | 2 | .269980 | 047 | 2 | .286007 | 045 | 2 | .301464 | 043 |
| 3 | .236285 | 076 | 3 | .253580 | 073 | 3 | .270213 | 070 | 3 | .286232 | 067 | 3 | .301681 | 065 |
| 4 | .236537 | 101 | 4 | .253822 | 097 | 4 | .270446 | 093 | 4 | .286456 | 089 | 4 | .301898 | 087 |
| 5 | .236789 | 126 | 5 | .254064 | 121 | 5 | .270679 | 116 | 5 | .286681 | 112 | 5 | .302114 | 108 |
| 6 | .237041 | 151 | 6 | .254306 | 145 | 6 | .270912 | 140 | 6 | 286905 | 134 | 6 | .302331 | 130 |
| 7 | .237292 | 176 | 7 | 254548 | 170 | 7 | .271144 | 163 | 7 | .287130 | 157 | 7 | .302547 | 152 |
| 8 | .237544 | 202 | 8 | .254790 | 194 | 8 | .271377 | 186 | 8 | .287354 | 179 | 8 | .302764 | 173 |
| 9 | 237795 | 227 | 9 | .255031 | 218 | 9 | .271609 | 210 | 9 | .287578 | 202 | 9 | .302980 | 195 |
| 1730 | 238046 | 000 | 1800 | .255272 | 000 | 1870 | .271842 | 000 | 1940 | .287802 | 000 | 2010 | .303196 | 000 |
| 1 | .238297 | 025 | 1 | .255514 | 024 | 1 | .272074 | 023 | 1 | .288025 | 022 | 1 | .303412 | 022 |
| 2 | .238548 | 050 | 2 | .255755 | 048 | 2 | .272306 | 046 | 2 | .288249 | 045 | 2 | .303628 | 043 |
| 3 | .238799 | 075 | 3 | .255996 | 072 | 3 | .272538 | 070 | 3 | .288473 | 067 | 3 | .303844 | 065 |
| 4 | .239049 | 100 | 4 | .256236 | 096 | 4 | .272770 | 093 | 4 | .288696 | 089 | 4 | .304059 | 086 |
| 5 | .239299 | 125 | 5 | .256477 | 120 | 5 | .273001 | 116 | 5 | .288920 | 112 | 5 | .304275 | 108 |
| 6 | .239550 | 150 | 6 | .256718 | 144 | 6 | .273233 | 139 | 6 | .289143 | 134 | 6 | .304490 | 129 |
| 7 | .239800 | 175 | 7 | .256958 | 168 | 7 | .273464 | 162 | 7 | .289366 | 156 | 7 | 304706 | 151 |
| 8 | .240050 | 200 | 8 | .257198 | 192 | 8 | .273696 | 186 | 8 | .289589 | 178 | 8 | .304921 | 172 |
| 9 | .240300 | 225 | 9 | .257439 | 216 | 9 | .273927 | 209 | 9 | .289812 | 201 | 9 | .305136 | 194 |
| 1740 | .240549 | 000 | 1810 | .257679 | 000 | 1880 | .274158 | 000 | 1950 | .290035 | 000 | 2020 | .305351 | 000 |
| 1 | .240799 | 025 | 1 | 257918 | 024 | 1 | .274389 | 023 | 1 | .290257 | 022 | 1 | .305566 | 021 |
| 2 | .241048 | 050 | 2 | .258158 | 048 | 2 | .274620 | 046 | 2 | .290480 | 044 | 2 | .305781 | 043 |
| 3 | .241297 | 075 | 3 | .258398 | 072 | 3 | .274850 | 069 | 3 | .290702 | 067 | 3 | .305996 | 064 |
| 4 | .241546 | 100 | 4 | .258637 | 096 | 4 | .275081 | 092 | 4 | .290925 | 089 | 4 | .306210 | 086 |
| 5 | .241795 | 124 | 5 | .258877 | 120 | 5 | .275311 | 115 | 5 | .291147 | 111 | 5 | .306425 | 107 |
| 6 | .242044 | 149 | 6 | 259116 | 144 | 6 | .275542 | 138 | 6 | .291369 | 133 | 6 | .306639 | 129 |
| 7 | .242293 | 174 | 7 | .259355 | 167 | 7 | .275772 | 161 | 7 | .291591 | 156 | 7 | .306854 | 150 |
| 8 | .242541 | 199 | 8 | .259594 | 192 | 8 | .276002 | 184 | 8 | .291813 | 178 | 8 | .307068 | 172 |
| 9 | .242790 | 223 | 9 | .259833 | 215 | 9 | .276232 | 207 | 9 | .292034 | 200 | 9 | .307282 | 193 |
| 1750 | .243038 | 000 | 1820 | .260071 | 000 | 1890 | 276462 | 000 | 1960 | .292256 | 000 | 2030 | .307496 | 000 |
| 1 | .243286 | 025 | 1 | .260310 | 024 | 1 | .276691 | 023 | 1 | 292478 | 022 | 1 | .307710 | 021 |
| 2 | .243534 | 050 | 2 | .260548 | 048 | 2 | .276921 | 046 | 2 | .292699 | 044 | 2 | .307924 | 043 |
| 3 | .243782 | 074 | 3 | .260787 | 071 | 3 | .277151 | 069 | 3 | .292920 | 066 | 3 | .308137 | 064 |
| 4 | .244030 | 099 | 4 | .261025 | 095 | 4 | .277380 | 092 | 4 | .293141 | 088 | 4 | .308351 | 085 |
| 5 | .244277 | 124 | 5 | .261263 | 119 | 5 | .277609 | 115 | 5 | .293363 | 110 | 5 | .308564 | 107 |
| 6 | .244524 | 149 | 6 | .261501 | 143 | 6 | .277838 | 138 | 6 | .293583 | 133 | 6 | .308778 | 128 |
| 7 | .244772 | 174 | 7 | .261738 | 167 | 7 | .278067 | 161 | 7 | .293804 | 155 | 7 | .308991 | 149 |
| 8 | .245019 | 198 | 8 | .261976 | 191 | 8 | .278296 | 183 | 8 | .294025 | 177 | 8 | .309204 | 171 |
| 9 | .245266 | 222 | 9 | .262214 | 214 | 9 | .278525 | 206 | 9 | .294246 | 199 | 9 | .309417 | 192 |
| 1760 | 245513 | 000 | 1830 | .262451 | 000 | 1900 | .278754 | 000 | 1970 | .294466 | 000 | 2040 | .309630 | 000 |
| 1 | .245759 | 025 | 1 | .262688 | 024 | 1 | .278982 | 023 | 1 | .294687 | 022 | 1 | .309843 | 021 |
| 2 | .246006 | 049 | 2 | .262925 | 047 | 2 | .279210 | 045 | 2 | .294907 | 044 | 2 | .310056 | 043 |
| 3 | .246252 | 074 | 3 | .263162 | 071 | 3 | .279439 | 068 | 3 | .295127 | 066 | 3 | .310268 | 064 |
| 4 | .246499 | 098 | 4 | .263399 | 095 | 4 | .279667 | 091 | 4 | .295347 | 088 | 4 | .310481 | 085 |
| 5 | .246745 | 123 | 5 | .263636 | 118 | 5 | .279895 | 114 | 5 | .295567 | 110 | 5 | .310693 | 106 |
| 6 | .246991 | 148 | 6 | .263873 | 142 | 6 | .280123 | 137 | 6 | .295787 | 132 | 6 | .310906 | 127 |
| 7 | .247236 | 173 | 7 | .264109 | 166 | 7 | .280351 | 160 | 7 | .296007 | 154 | 7 | .311118 | 148 |
| 8 | .247482 | 197 | 8 | .264345 | 190 | 8 | .280578 | 182 | 8 | .296226 | 176 | 8 | .311330 | 170 |
| 9 | .247728 | 221 | 9 | .264582 | 213 | 9 | .280806 | 205 | 9 | .296446 | 198 | 9 | .311542 | 191 |

(n) Log. .311754 to .380030 No. 2050 to 2399. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2050 | .311754 | 000 | 2120 | .326336 | 000 | 2190 | .340444 | 000 | 2260 | .354108 | 000 | 2330 | .367356 | 000 |
| 1 | .311966 | 021 | 1 | .326541 | 020 | 1 | .340642 | 020 | 1 | .354301 | 019 | 1 | .367542 | 019 |
| 2 | .312177 | 042 | 2 | .326745 | 041 | 2 | .340840 | 040 | 2 | .354493 | 038 | 2 | .367728 | 037 |
| 3 | .312389 | 063 | 3 | .326950 | 061 | 3 | .341039 | 059 | 3 | .354685 | 058 | 3 | .367915 | 056 |
| 4 | .312600 | 084 | 4 | .327154 | 082 | 4 | .341237 | 079 | 4 | .354876 | 077 | 4 | .368101 | 075 |
| 5 | .312812 | 106 | 5 | .327359 | 102 | 5 | .341434 | 099 | 5 | .355068 | 096 | 5 | .368287 | 093 |
| 6 | .313023 | 127 | 6 | .327563 | 123 | 6 | .341632 | 119 | 6 | .355260 | 115 | 6 | .368473 | 112 |
| 7 | .313234 | 148 | 7 | .327767 | 143 | 7 | .341830 | 139 | 7 | .355451 | 134 | 7 | .368659 | 130 |
| 8 | .313445 | 169 | 8 | .327972 | 164 | 8 | .342028 | 158 | 8 | .355643 | 154 | 8 | .368844 | 149 |
| 9 | .313656 | 190 | 9 | .328176 | 184 | 9 | .342225 | 178 | 9 | .355834 | 173 | 9 | .369030 | 167 |
| 2060 | .313867 | 000 | 2130 | .328380 | 000 | 2200 | .342423 | 000 | 2270 | .356026 | 000 | 2340 | .369216 | 000 |
| 1 | .314078 | 021 | 1 | .328583 | 020 | 1 | .342620 | 020 | 1 | .356217 | 019 | 1 | .369401 | 019 |
| 2 | .314289 | 042 | 2 | .328787 | 041 | 2 | .342817 | 039 | 2 | .356408 | 038 | 2 | .369587 | 037 |
| 3 | .314499 | 063 | 3 | .328991 | 061 | 3 | .343014 | 059 | 3 | .356599 | 057 | 3 | .369772 | 056 |
| 4 | .314710 | 084 | 4 | .329194 | 081 | 4 | .343212 | 079 | 4 | .356790 | 076 | 4 | .369958 | 074 |
| 5 | .314920 | 105 | 5 | .329398 | 102 | 5 | .343409 | 099 | 5 | .356981 | 095 | 5 | .370143 | 093 |
| 6 | .315130 | 126 | 6 | .329601 | 122 | 6 | .343605 | 118 | 6 | .357172 | 115 | 6 | .370328 | 111 |
| 7 | .315340 | 147 | 7 | .329804 | 142 | 7 | .343802 | 138 | 7 | .357363 | 134 | 7 | .370513 | 130 |
| 8 | .315550 | 168 | 8 | .330008 | 163 | 8 | .343999 | 158 | 8 | .357554 | 153 | 8 | .370698 | 148 |
| 9 | .315760 | 189 | 9 | .330211 | 183 | 9 | .344196 | 178 | 9 | .357744 | 172 | 9 | .370883 | 167 |
| 2070 | .315970 | 000 | 2140 | .330414 | 000 | 2210 | .344392 | 000 | 2280 | .357935 | 000 | 2350 | .371068 | 000 |
| 1 | .316180 | 021 | 1 | .330617 | 020 | 1 | .344589 | 020 | 1 | .358125 | 019 | 1 | .371253 | 018 |
| 2 | .316390 | 042 | 2 | .330819 | 040 | 2 | .344785 | 039 | 2 | .358316 | 038 | 2 | .371437 | 037 |
| 3 | .316599 | 063 | 3 | .331022 | 061 | 3 | .344981 | 059 | 3 | .358506 | 057 | 3 | .371622 | 055 |
| 4 | .316809 | 084 | 4 | .331225 | 081 | 4 | .345178 | 078 | 4 | .358696 | 076 | 4 | .371806 | 074 |
| 5 | .317018 | 105 | 5 | .331427 | 101 | 5 | .345374 | 098 | 5 | .358886 | 095 | 5 | .371991 | 092 |
| 6 | .317227 | 126 | 6 | .331630 | 121 | 6 | .345570 | 118 | 6 | .359076 | 114 | 6 | .372175 | 111 |
| 7 | .317436 | 147 | 7 | .331832 | 141 | 7 | .345766 | 137 | 7 | .359266 | 133 | 7 | .372360 | 129 |
| 8 | .317645 | 168 | 8 | .332034 | 162 | 8 | .345962 | 157 | 8 | .359456 | 152 | 8 | .372544 | 148 |
| 9 | .317854 | 189 | 9 | .332236 | 182 | 9 | .346157 | 176 | 9 | .359646 | 171 | 9 | .372728 | 166 |
| 2080 | .318063 | 000 | 2150 | .332438 | 000 | 2220 | .346353 | 000 | 2290 | .359835 | 000 | 2360 | .372912 | 000 |
| 1 | .318272 | 021 | 1 | .332640 | 020 | 1 | .346549 | 019 | 1 | .360025 | 019 | 1 | .373096 | 018 |
| 2 | .318481 | 042 | 2 | .332842 | 040 | 2 | .346744 | 039 | 2 | .360215 | 038 | 2 | .373280 | 037 |
| 3 | .318689 | 063 | 3 | .333044 | 060 | 3 | .346939 | 058 | 3 | .360404 | 057 | 3 | .373464 | 055 |
| 4 | .318898 | 083 | 4 | .333246 | 081 | 4 | .347135 | 078 | 4 | .360593 | 076 | 4 | .373647 | 074 |
| 5 | .319106 | 104 | 5 | .333447 | 101 | 5 | .347330 | 097 | 5 | .360783 | 095 | 5 | .373831 | 092 |
| 6 | .319314 | 125 | 6 | .333649 | 121 | 6 | .347525 | 117 | 6 | .360972 | 114 | 6 | .374015 | 110 |
| 7 | .319522 | 146 | 7 | .333850 | 141 | 7 | .347720 | 137 | 7 | .361161 | 133 | 7 | .374198 | 129 |
| 8 | .319730 | 167 | 8 | .334051 | 161 | 8 | .347915 | 156 | 8 | .361350 | 152 | 8 | .374382 | 147 |
| 9 | .319938 | 188 | 9 | .334253 | 181 | 9 | .348110 | 175 | 9 | .361539 | 171 | 9 | .374565 | 165 |
| 2090 | .320146 | 000 | 2160 | .334454 | 000 | 2230 | .348305 | 000 | 2300 | .361728 | 000 | 2370 | .374748 | 000 |
| 1 | .320354 | 021 | 1 | .334655 | 020 | 1 | .348500 | 019 | 1 | .361917 | 019 | 1 | .374932 | 018 |
| 2 | .320562 | 041 | 2 | .334856 | 040 | 2 | .348694 | 039 | 2 | .362105 | 038 | 2 | .375115 | 037 |
| 3 | .320769 | 062 | 3 | .335056 | 060 | 3 | .348889 | 058 | 3 | .362294 | 056 | 3 | .375298 | 055 |
| 4 | .320977 | 083 | 4 | .335257 | 080 | 4 | .349083 | 078 | 4 | .362482 | 075 | 4 | .375481 | 073 |
| 5 | .321184 | 104 | 5 | .335458 | 100 | 5 | .349277 | 097 | 5 | .362671 | 094 | 5 | .375664 | 092 |
| 6 | .321391 | 125 | 6 | .335658 | 120 | 6 | .349472 | 117 | 6 | .362859 | 113 | 6 | .375846 | 110 |
| 7 | .321598 | 145 | 7 | .335859 | 140 | 7 | .349666 | 137 | 7 | .363048 | 132 | 7 | .376029 | 128 |
| 8 | .321805 | 166 | 8 | .336059 | 160 | 8 | .349860 | 156 | 8 | .363236 | 151 | 8 | .376212 | 147 |
| 9 | .322012 | 187 | 9 | .336260 | 180 | 9 | .350054 | 175 | 9 | .363424 | 170 | 9 | .376394 | 165 |
| 2100 | .322219 | 000 | 2170 | .336460 | 000 | 2240 | .350248 | 000 | 2310 | .363612 | 000 | 2380 | .376577 | 000 |
| 1 | .322426 | 021 | 1 | .336660 | 020 | 1 | .350442 | 019 | 1 | .363800 | 019 | 1 | .376759 | 018 |
| 2 | .322633 | 041 | 2 | .336860 | 040 | 2 | .350636 | 039 | 2 | .363988 | 037 | 2 | .376942 | 036 |
| 3 | .322839 | 062 | 3 | .337060 | 060 | 3 | .350829 | 058 | 3 | .364176 | 056 | 3 | .377124 | 055 |
| 4 | .323046 | 082 | 4 | .337259 | 080 | 4 | .351023 | 077 | 4 | .364363 | 075 | 4 | .377306 | 073 |
| 5 | .323252 | 103 | 5 | .337459 | 100 | 5 | .351216 | 097 | 5 | .364551 | 094 | 5 | .377488 | 091 |
| 6 | .323458 | 124 | 6 | .337659 | 120 | 6 | .351410 | 116 | 6 | .364739 | 112 | 6 | .377670 | 109 |
| 7 | .323664 | 144 | 7 | .337858 | 140 | 7 | .351603 | 135 | 7 | .364926 | 131 | 7 | .377852 | 127 |
| 8 | .323871 | 165 | 8 | .338058 | 160 | 8 | .351796 | 155 | 8 | .365113 | 150 | 8 | .378034 | 146 |
| 9 | .324077 | 186 | 9 | .338257 | 180 | 9 | .351989 | 174 | 9 | .365301 | 169 | 9 | .378216 | 164 |
| 2110 | .324282 | 000 | 2180 | .338456 | 000 | 2250 | .352182 | 000 | 2320 | .365488 | 000 | 2390 | .378398 | 000 |
| 1 | .324488 | 021 | 1 | .338656 | 020 | 1 | .352375 | 019 | 1 | .365675 | 019 | 1 | .378580 | 018 |
| 2 | .324694 | 041 | 2 | .338855 | 040 | 2 | .352568 | 038 | 2 | .365862 | 037 | 2 | .378761 | 036 |
| 3 | .324899 | 062 | 3 | .339054 | 060 | 3 | .352761 | 058 | 3 | .366049 | 056 | 3 | .378943 | 055 |
| 4 | .325105 | 082 | 4 | .339253 | 080 | 4 | .352954 | 077 | 4 | .366236 | 075 | 4 | .379124 | 073 |
| 5 | .325310 | 103 | 5 | .339451 | 100 | 5 | .353146 | 096 | 5 | .366423 | 093 | 5 | .379305 | 091 |
| 6 | .325516 | 123 | 6 | .339650 | 119 | 6 | .353339 | 115 | 6 | .366610 | 112 | 6 | .379487 | 109 |
| 7 | .325721 | 144 | 7 | .339849 | 139 | 7 | .353532 | 134 | 7 | .366796 | 131 | 7 | .379668 | 127 |
| 8 | .325926 | 164 | 8 | .340047 | 159 | 8 | .353724 | 154 | 8 | .366983 | 150 | 8 | .379849 | 146 |
| 9 | .326131 | 185 | 9 | .340246 | 179 | 9 | .353916 | 173 | 9 | .367169 | 168 | 9 | .380030 | 164 |

(u.) Log. .380211 to .439175 No. 2400 to 2749. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2400 | .380211 | 000 | 2470 | .392697 | 000 | 2540 | .404834 | 000 | 2610 | .416640 | 000 | 2680 | .428135 | 000 |
| 1 | .380392 | 018 | 1 | .392873 | 018 | 1 | .405005 | 017 | 1 | .416807 | 017 | 1 | 428297 | 016 |
| 2 | 380573 | 036 | 2 | .393048 | 035 | 2 | .405175 | 034 | 2 | .416973 | 033 | 2 | .428459 | 032 |
| 3 | .380754 | 055 | 3 | .393224 | 053 | 3 | .405346 | 051 | 3 | .417139 | 050 | 3 | .428621 | 048 |
| 4 | .380934 | 073 | 4 | .393400 | 070 | 4 | .405517 | 068 | 4 | .417306 | 066 | 4 | 428782 | 065 |
| 5 | .381115 | 091 | 5 | .393575 | 088 | 5 | .405688 | 085 | 5 | .417472 | 083 | 5 | .428944 | 081 |
| 6 | .381296 | 109 | 6 | .393751 | 106 | 6 | .405858 | 102 | 6 | .417638 | 100 | 6 | .429106 | 097 |
| 7 | .381476 | 127 | 7 | .393926 | 123 | 7 | .406029 | 119 | 7 | .417804 | 116 | 7 | .429268 | 113 |
| 8 | .381656 | 145 | 8 | .394101 | 141 | 8 | .406199 | 136 | 8 | .417970 | 133 | 8 | .429429 | 129 |
| 9 | .381837 | 163 | 9 | .394276 | 158 | 9 | .406370 | 153 | 9 | .418135 | 149 | 9 | .429591 | 145 |
| 2410 | .382017 | 000 | 2480 | .394452 | 000 | 2550 | .406540 | 000 | 2620 | .418301 | 000 | 2690 | .429752 | 000 |
| 1 | 382197 | 018 | 1 | .394627 | 017 | 1 | .406710 | 017 | 1 | .418467 | 017 | 1 | .429914 | 016 |
| 2 | .382377 | 036 | 2 | .394802 | 035 | 2 | .406881 | 034 | 2 | .418633 | 033 | 2 | .430075 | 032 |
| 3 | .382557 | 054 | 3 | .394977 | 053 | 3 | .407051 | 051 | 3 | .418798 | 050 | 3 | .430236 | 048 |
| 4 | .382737 | 072 | 4 | .395152 | 070 | 4 | .407221 | 068 | 4 | .418964 | 066 | 4 | .430398 | 065 |
| 5 | .382917 | 090 | 5 | .395326 | 087 | 5 | .407391 | 085 | 5 | .419129 | 083 | 5 | .430559 | 081 |
| 6 | .383097 | 108 | 6 | .395501 | 104 | 6 | .407561 | 102 | 6 | .419295 | 099 | 6 | .430720 | 097 |
| 7 | .383277 | 126 | 7 | .395676 | 122 | 7 | .407731 | 119 | 7 | .419460 | 116 | 7 | .430881 | 113 |
| 8 | .383456 | 144 | 8 | .395850 | 139 | 8 | .407900 | 136 | 8 | .419625 | 132 | 8 | .431042 | 129 |
| 9 | .383636 | 162 | 9 | .396025 | 157 | 9 | .408070 | 153 | 9 | .419791 | 149 | 9 | .431203 | 145 |
| 2420 | .383815 | 000 | 2490 | .396199 | 000 | 2560 | 408240 | 000 | 2630 | .419956 | 000 | 2700 | .431364 | 000 |
| 1 | .383995 | 018 | 1 | .396374 | 017 | 1 | .408410 | 017 | 1 | .420121 | 016 | 1 | .431525 | 016 |
| 2 | .384174 | 036 | 2 | .396548 | 035 | 2 | .408579 | 034 | 2 | .420286 | 033 | 2 | .431685 | 032 |
| 3 | .384353 | 054 | 3 | .396722 | 053 | 3 | .408749 | 051 | 3 | .420451 | 049 | 3 | .431846 | 048 |
| 4 | .384533 | 072 | 4 | .396896 | 070 | 4 | .408918 | 068 | 4 | .420616 | 066 | 4 | .432007 | 064 |
| 5 | .384712 | 090 | 5 | .397070 | 087 | 5 | .409087 | 085 | 5 | .420781 | 082 | 5 | .432167 | 080 |
| 6 | .384891 | 108 | 6 | .397245 | 104 | 6 | .409257 | 102 | 6 | .420945 | 099 | 6 | .432328 | 096 |
| 7 | .385070 | 126 | 7 | .397418 | 122 | 7 | .409426 | 119 | 7 | .421110 | 115 | 7 | .432488 | 112 |
| 8 | .385249 | 144 | 8 | .397592 | 139 | 8 | .409595 | 136 | 8 | .421275 | 132 | 8 | .432649 | 128 |
| 9 | .385427 | 162 | 9 | .397766 | 157 | 9 | .409764 | 153 | 9 | .421439 | 148 | 9 | .432809 | 144 |
| 2430 | .385606 | 000 | 2500 | .397940 | 000 | 2570 | .409933 | 000 | 2640 | .421604 | 000 | 2710 | .432969 | 000 |
| 1 | .385785 | 018 | 1 | .398114 | 017 | 1 | .410102 | 017 | 1 | .421768 | 016 | 1 | .433129 | 016 |
| 2 | .385964 | 035 | 2 | .398287 | 035 | 2 | .410271 | 034 | 2 | .421933 | 033 | 2 | .433290 | 032 |
| 3 | .386142 | 053 | 3 | .398461 | 053 | 3 | .410440 | 050 | 3 | .422097 | 049 | 3 | .433450 | 048 |
| 4 | .386321 | 071 | 4 | .398634 | 069 | 4 | .410608 | 067 | 4 | .422261 | 066 | 4 | .433610 | 064 |
| 5 | .386499 | 089 | 5 | .398808 | 087 | 5 | .410777 | 084 | 5 | .422426 | 082 | 5 | .433770 | 080 |
| 6 | .386677 | 107 | 6 | .398981 | 104 | 6 | .410946 | 101 | 6 | .422590 | 099 | 6 | .433930 | 096 |
| 7 | .386855 | 125 | 7 | .399154 | 121 | 7 | .411114 | 118 | 7 | .422754 | 115 | 7 | .434090 | 112 |
| 8 | .387034 | 143 | 8 | .399327 | 138 | 8 | .411283 | 135 | 8 | .422918 | 132 | 8 | .434249 | 128 |
| 9 | .387212 | 161 | 9 | .399501 | 156 | 9 | .411451 | 152 | 9 | .423082 | 148 | 9 | .434409 | 144 |
| 2440 | .387390 | 000 | 2510 | .399674 | 000 | 2580 | .411620 | 000 | 2650 | .423246 | 000 | 2720 | .434569 | 000 |
| 1 | .387568 | 018 | 1 | .399847 | 017 | 1 | .411788 | 017 | 1 | .423410 | 016 | 1 | .434728 | 016 |
| 2 | .387746 | 036 | 2 | .400020 | 035 | 2 | .411956 | 034 | 2 | .423573 | 033 | 2 | .434888 | 032 |
| 3 | .387923 | 053 | 3 | 400192 | 053 | 3 | .412124 | 050 | 3 | .423737 | 049 | 3 | .435048 | 048 |
| 4 | .388101 | 071 | 4 | 400365 | 069 | 4 | .412292 | 067 | 4 | .423901 | 065 | 4 | .435207 | 064 |
| 5 | .388279 | 089 | 5 | .400538 | 087 | 5 | .412460 | 084 | 5 | .424064 | 081 | 5 | .435366 | 080 |
| 6 | .388456 | 107 | 6 | .400711 | 104 | 6 | .412628 | 101 | 6 | .424228 | 098 | 6 | .435526 | 096 |
| 7 | .388634 | 125 | 7 | .400883 | 121 | 7 | .412796 | 118 | 7 | .424392 | 114 | 7 | .435685 | 112 |
| 8 | .388811 | 142 | 8 | .401056 | 138 | 8 | .412964 | 135 | 8 | .424555 | 131 | 8 | .435844 | 128 |
| 9 | .388989 | 160 | 9 | .401228 | 156 | 9 | .413132 | 152 | 9 | .424718 | 147 | 9 | .436003 | 144 |
| 2450 | .389166 | 000 | 2520 | .401400 | 000 | 2590 | .413300 | 000 | 2660 | .424882 | 000 | 2730 | .436163 | 000 |
| 1 | .389343 | 018 | 1 | .401573 | 017 | 1 | .413467 | 017 | 1 | .425045 | 016 | 1 | .436322 | 016 |
| 2 | .389520 | 036 | 2 | .401745 | 034 | 2 | .413635 | 033 | 2 | .425208 | 033 | 2 | .436481 | 032 |
| 3 | .389697 | 053 | 3 | .401917 | 052 | 3 | .413802 | 050 | 3 | .425371 | 049 | 3 | .436640 | 047 |
| 4 | .389875 | 071 | 4 | .402089 | 069 | 4 | .413970 | 067 | 4 | .425534 | 065 | 4 | .436798 | 063 |
| 5 | .390051 | 089 | 5 | .402261 | 086 | 5 | .414137 | 084 | 5 | .425697 | 081 | 5 | .436957 | 079 |
| 6 | .390228 | 107 | 6 | .402433 | 103 | 6 | .414305 | 101 | 6 | .425860 | 098 | 6 | .437116 | 095 |
| 7 | .390405 | 125 | 7 | .402605 | 120 | 7 | .414472 | 117 | 7 | .426023 | 114 | 7 | .437275 | 111 |
| 8 | .390582 | 142 | 8 | .402777 | 138 | 8 | .414639 | 134 | 8 | .426186 | 130 | 8 | .437433 | 127 |
| 9 | .390758 | 160 | 9 | .402949 | 155 | 9 | .414806 | 151 | 9 | .426349 | 147 | 9 | .437592 | 143 |
| 60 | 390935 | 000 | 2530 | 403120 | 000 | 2600 | .414973 | 000 | 2670 | .426511 | 000 | 2740 | .437751 | 000 |
| 1 | .391112 | 018 | 1 | .403292 | 017 | 1 | .415140 | 017 | 1 | .426674 | 016 | 1 | .437909 | 016 |
| 2 | .391288 | 035 | 2 | .403464 | 034 | 2 | .415307 | 033 | 2 | .426836 | 033 | 2 | .438067 | 032 |
| 3 | .391464 | 053 | 3 | .403635 | 052 | 3 | .415474 | 050 | 3 | .426999 | 049 | 3 | .438226 | 047 |
| 4 | .391641 | 070 | 4 | .403807 | 069 | 4 | .415641 | 067 | 4 | .427161 | 065 | 4 | .438384 | 063 |
| 5 | .391817 | 088 | 5 | .403978 | 086 | 5 | .415808 | 084 | 5 | .427324 | 081 | 5 | .438542 | 079 |
| 6 | .391993 | 106 | 6 | .404149 | 103 | 6 | .415974 | 101 | 6 | .427486 | 098 | 6 | .438700 | 095 |
| 7 | .392169 | 123 | 7 | .404320 | 120 | 7 | .416141 | 117 | 7 | .427648 | 114 | 7 | .438859 | 111 |
| 8 | .392345 | 141 | 8 | .404492 | 137 | 8 | .416308 | 134 | 8 | .427811 | 130 | 8 | .439017 | 127 |
| 9 | .392521 | 158 | 9 | .404663 | 154 | 9 | .416474 | 150 | 9 | .427973 | 147 | 9 | .439175 | 143 |

(u.) Log. .439333 to .491222 No. 2750 to 3099. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2750 | .439333 | 000 | 2820 | .450249 | 000 | 2890 | .460898 | 000 | 2960 | 471292 | 000 | 3030 | .481443 | 000 |
| 1 | .439491 | 016 | 1 | .450403 | 015 | 1 | .461048 | 015 | 1 | .471438 | 015 | 1 | .481586 | 014 |
| 2 | .439648 | 032 | 2 | .450557 | 031 | 2 | .461198 | 030 | 2 | .471585 | 029 | 2 | .481729 | 029 |
| 3 | .439806 | 047 | 3 | .450711 | 046 | 3 | .461348 | 045 | 3 | .471732 | 044 | 3 | .481872 | 043 |
| 4 | .439964 | 063 | 4 | .450865 | 062 | 4 | .461498 | 060 | 4 | .471878 | 059 | 4 | .482016 | 057 |
| 5 | 440122 | 079 | 5 | .451018 | 077 | 5 | .461649 | 075 | 5 | .472025 | 073 | 5 | .482159 | 071 |
| 6 | .440279 | 095 | 6 | .451172 | 092 | 6 | .461799 | 090 | 6 | .472171 | 088 | 6 | .482302 | 086 |
| 7 | .440437 | 111 | 7 | .451326 | 108 | 7 | .461948 | 105 | 7 | .472317 | 102 | 7 | .482445 | 100 |
| 8 | .440594 | 126 | 8 | .451479 | 123 | 8 | .462098 | 120 | 8 | .472464 | 117 | 8 | .482588 | 114 |
| 9 | .440752 | 142 | 9 | .451633 | 139 | 9 | .462248 | 135 | 9 | .472610 | 132 | 9 | .482731 | 129 |
| 2760 | .440909 | 000 | 2830 | .451786 | 000 | 2900 | 462398 | 000 | 2970 | .472756 | 000 | 3040 | .482874 | 000 |
| 1 | .441066 | 016 | 1 | .451940 | 015 | 1 | .462548 | 015 | 1 | .472903 | 015 | 1 | .483016 | 014 |
| 2 | .441224 | 031 | 2 | .452093 | 031 | 2 | .462697 | 030 | 2 | .473049 | 029 | 2 | .483159 | 028 |
| 3 | .441381 | 047 | 3 | .452247 | 046 | 3 | .462847 | 045 | 3 | .473195 | 044 | 3 | .483302 | 043 |
| 4 | .441538 | 063 | 4 | .452400 | 061 | 4 | .462997 | 060 | 4 | .473341 | 059 | 4 | .483445 | 057 |
| 5 | .441695 | 078 | 5 | .452553 | 077 | 5 | .463146 | 075 | 5 | .473487 | 073 | 5 | .483587 | 071 |
| 6 | .441852 | 094 | 6 | .452706 | 092 | 6 | .463296 | 090 | 6 | .473633 | 088 | 6 | .483730 | 085 |
| 7 | .442009 | 110 | 7 | .452859 | 107 | 7 | .463445 | 105 | 7 | .473779 | 102 | 7 | .483872 | 099 |
| 8 | .442166 | 126 | 8 | .453012 | 123 | 8 | .463594 | 120 | 8 | .473925 | 117 | 8 | .484015 | 114 |
| 9 | .442323 | 141 | 9 | .453165 | 138 | 9 | .463744 | 135 | 9 | .474070 | 132 | 9 | .484157 | 128 |
| 2770 | .442480 | 000 | 2840 | .453318 | 000 | 2910 | .463893 | 000 | 2980 | .474216 | 000 | 3050 | .484300 | 000 |
| 1 | .442636 | 016 | 1 | .453471 | 015 | 1 | .464042 | 015 | 1 | .474362 | 015 | 1 | .484442 | 014 |
| 2 | .442793 | 031 | 2 | .453624 | 031 | 2 | .464191 | 030 | 2 | .474508 | 029 | 2 | .484584 | 028 |
| 3 | .442950 | 047 | 3 | .453777 | 046 | 3 | .464340 | 045 | 3 | .474653 | 044 | 3 | .484727 | 043 |
| 4 | .443106 | 063 | 4 | 453930 | 061 | 4 | .464489 | 060 | 4 | .474799 | 058 | 4 | .484869 | 057 |
| 5 | .443263 | 078 | 5 | .454082 | 077 | 5 | .464639 | 075 | 5 | .474944 | 073 | 5 | .485011 | 071 |
| 6 | .443419 | 094 | 6 | .454235 | 092 | 6 | .464787 | 090 | 6 | .475090 | 088 | 6 | .485153 | 085 |
| 7 | .443576 | 110 | 7 | .454387 | 107 | 7 | .464936 | 105 | 7 | .475235 | 102 | 7 | .485296 | 099 |
| 8 | .443732 | 126 | 8 | .454540 | 123 | 8 | .465085 | 120 | 8 | .475381 | 117 | 8 | .485437 | 114 |
| 9 | .443888 | 141 | 9 | .454692 | 138 | 9 | 465234 | 135 | 9 | .475526 | 131 | 9 | .485579 | 128 |
| 2780 | .444045 | 000 | 2850 | 454845 | 000 | 2920 | .465383 | 000 | 2990 | .475671 | 000 | 3060 | .485721 | 000 |
| 1 | .444201 | 016 | 1 | .454997 | 015 | 1 | .465532 | 015 | 1 | .475816 | 015 | 1 | .485863 | 014 |
| 2 | .444357 | 031 | 2 | .455149 | 030 | 2 | .465680 | 030 | 2 | .475962 | 029 | 2 | .486005 | 028 |
| 3 | .444513 | 047 | 3 | .455302 | 046 | 3 | 465829 | 044 | 3 | .476107 | 043 | 3 | .486147 | 043 |
| 4 | 444669 | 062 | 4 | .455454 | 061 | 4 | .465977 | 059 | 4 | .476252 | 058 | 4 | .486289 | 057 |
| 5 | 444825 | 078 | 5 | .455606 | 076 | 5 | .466126 | 074 | 5 | .476397 | 072 | 5 | .486430 | 071 |
| 6 | .444981 | 094 | 6 | .455758 | 091 | 6 | .466274 | 089 | 6 | .476542 | 087 | 6 | .486572 | 085 |
| 7 | .445137 | 109 | 7 | .455910 | 106 | 7 | .466423 | 104 | 7 | .476687 | 101 | 7 | .486714 | 099 |
| 8 | .445293 | 125 | 8 | .456062 | 122 | 8 | .466571 | 118 | 8 | .476832 | 116 | 8 | .486855 | 114 |
| 9 | .445448 | 140 | 9 | .456214 | 137 | 9 | .466719 | 133 | 9 | .476976 | 130 | 9 | .486997 | 128 |
| 2790 | .445604 | 000 | 2860 | .456366 | 000 | 2930 | .466868 | 000 | 3000 | .477121 | 000 | 3070 | .487138 | 000 |
| 1 | .445760 | 016 | 1 | .456518 | 015 | 1 | .467016 | 015 | 1 | .477266 | 014 | 1 | .487280 | 014 |
| 2 | .445915 | 031 | 2 | .456670 | 030 | 2 | .467164 | 030 | 2 | .477411 | 029 | 2 | .487421 | 028 |
| 3 | .446071 | 047 | 3 | .456821 | 046 | 3 | .467312 | 044 | 3 | .477555 | 043 | 3 | .487563 | 042 |
| 4 | .446226 | 062 | 4 | .456973 | 061 | 4 | .467460 | 059 | 4 | .477700 | 058 | 4 | .487704 | 057 |
| 5 | .446382 | 078 | 5 | .457125 | 076 | 5 | .467608 | 074 | 5 | .477844 | 072 | 5 | .487845 | 071 |
| 6 | .446537 | 094 | 6 | .457276 | 091 | 6 | .467756 | 089 | 6 | .477989 | 087 | 6 | .487986 | 085 |
| 7 | .446692 | 109 | 7 | .457428 | 106 | 7 | .467904 | 104 | 7 | .478133 | 101 | 7 | .488127 | 099 |
| 8 | .446848 | 125 | 8 | .457579 | 122 | 8 | .468052 | 118 | 8 | .478278 | 116 | 8 | .488269 | 113 |
| 9 | .447003 | 140 | 9 | .457730 | 137 | 9 | .468200 | 133 | 9 | .478422 | 130 | 9 | .488410 | 127 |
| 2800 | .447158 | 000 | 2870 | 457882 | 000 | 2940 | .468347 | 000 | 3010 | .478566 | 000 | 3080 | .488551 | 000 |
| 1 | .447313 | 015 | 1 | .458033 | 015 | 1 | .468495 | 015 | 1 | .478711 | 014 | 1 | .488692 | 014 |
| 2 | .447468 | 031 | 2 | .458184 | 030 | 2 | .468643 | 030 | 2 | .478855 | 029 | 2 | .488833 | 028 |
| 3 | .447623 | 046 | 3 | .458336 | 045 | 3 | .468790 | 044 | 3 | .478999 | 043 | 3 | 488973 | 042 |
| 4 | .447778 | 062 | 4 | .458487 | 061 | 4 | 468938 | 059 | 4 | .479143 | 058 | 4 | .489114 | 056 |
| 5 | 447933 | 077 | 5 | .458638 | 076 | 5 | .469085 | 074 | 5 | .479287 | 072 | 5 | .489255 | 070 |
| 6 | .448088 | 093 | 6 | .458789 | 091 | 6 | .469233 | 089 | 6 | .479431 | 086 | 6 | .489396 | 084 |
| 7 | .448242 | 108 | 7 | .458940 | 106 | 7 | .469380 | 104 | 7 | .479575 | 101 | 7 | .489537 | 098 |
| 8 | .448397 | 124 | 8 | .459091 | 121 | 8 | .469527 | 118 | 8 | .479719 | 115 | 8 | .489677 | 112 |
| 9 | .448552 | 139 | 9 | .459242 | 136 | 9 | .469675 | 133 | 9 | .479863 | 130 | 9 | .489818 | 126 |
| 2810 | .448706 | 000 | 2880 | .459392 | 000 | 2950 | .469822 | 000 | 3020 | .480007 | 000 | 3090 | .489958 | 000 |
| 1 | .448861 | 015 | 1 | .459543 | 015 | 1 | .469969 | 015 | 1 | .480151 | 014 | 1 | .490099 | 014 |
| 2 | .449015 | 031 | 2 | .459694 | 030 | 2 | .470116 | 029 | 2 | .480294 | 029 | 2 | .490239 | 028 |
| 3 | .449170 | 046 | 3 | .459845 | 045 | 3 | .470263 | 044 | 3 | .480438 | 043 | 3 | .490380 | 042 |
| 4 | .449324 | 062 | 4 | .459995 | 061 | 4 | .470410 | 059 | 4 | .480582 | 058 | 4 | .490520 | 056 |
| 5 | .449478 | 077 | 5 | .460146 | 076 | 5 | .470557 | 074 | 5 | .480725 | 072 | 5 | .490661 | 070 |
| 6 | .449633 | 092 | 6 | .460296 | 091 | 6 | .470704 | 088 | 6 | .480869 | 086 | 6 | .490801 | 084 |
| 7 | .449787 | 108 | 7 | .460447 | 106 | 7 | .470851 | 103 | 7 | .481012 | 101 | 7 | .490941 | 098 |
| 8 | .449941 | 123 | 8 | .460597 | 121 | 8 | .470998 | 118 | 8 | .481156 | 115 | 8 | .491081 | 112 |
| 9 | .450095 | 139 | 9 | .460747 | 136 | 9 | .471145 | 132 | 9 | .481299 | 130 | 9 | .491222 | 126 |

(n.) Log. .491362 to .537693 No. 3100 to 3449. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3100 | .491362 | 000 | 3170 | .501059 | 000 | 3240 | .510545 | 000 | 3310 | .519828 | 000 | 3380 | .528917 | 000 |
| 1 | .491502 | 014 | 1 | .501196 | 014 | 1 | .510679 | 013 | 1 | .519959 | 013 | 1 | .529045 | 013 |
| 2 | .491642 | 028 | 2 | .501333 | 027 | 2 | .510813 | 027 | 2 | .520090 | 026 | 2 | .529174 | 026 |
| 3 | .491782 | 042 | 3 | .501470 | 041 | 3 | .510947 | 040 | 3 | .520221 | 039 | 3 | .529302 | 038 |
| 4 | .491922 | 056 | 4 | .501607 | 055 | 4 | .511081 | 054 | 4 | .520352 | 052 | 4 | .529430 | 051 |
| 5 | .492062 | 070 | 5 | .501744 | 068 | 5 | .511215 | 067 | 5 | .520483 | 066 | 5 | .529559 | 064 |
| 6 | .492201 | 084 | 6 | .501880 | 082 | 6 | .511348 | 080 | 6 | .520614 | 079 | 6 | .529687 | 077 |
| 7 | .492341 | 098 | 7 | .502017 | 096 | 7 | .511482 | 094 | 7 | .520745 | 092 | 7 | .529815 | 090 |
| 8 | .492481 | 112 | 8 | .502154 | 110 | 8 | .511616 | 107 | 8 | .520876 | 105 | 8 | .529943 | 103 |
| 9 | .492621 | 126 | 9 | .502290 | 123 | 9 | .511750 | 121 | 9 | .521007 | 118 | 9 | .530072 | 116 |
| 3110 | .492760 | 000 | 3180 | .502427 | 000 | 3250 | .511883 | 000 | 3320 | .521138 | 000 | 3390 | .530200 | 000 |
| 1 | .492900 | 014 | 1 | .502564 | 014 | 1 | .512017 | 013 | 1 | .521269 | 013 | 1 | .530328 | 013 |
| 2 | .493040 | 028 | 2 | .502700 | 027 | 2 | .512150 | 027 | 2 | .521400 | 026 | 2 | .530456 | 026 |
| 3 | .493179 | 042 | 3 | .502837 | 041 | 3 | .512284 | 040 | 3 | .521530 | 039 | 3 | .530584 | 038 |
| 4 | .493319 | 056 | 4 | .502973 | 054 | 4 | .512417 | 053 | 4 | .521661 | 052 | 4 | .530712 | 051 |
| 5 | .493458 | 070 | 5 | .503109 | 068 | 5 | .512551 | 067 | 5 | .521792 | 065 | 5 | .530840 | 064 |
| 6 | .493597 | 084 | 6 | .503246 | 082 | 6 | .512684 | 080 | 6 | .521922 | 078 | 6 | .530968 | 077 |
| 7 | .493737 | 098 | 7 | .503382 | 095 | 7 | .512818 | 093 | 7 | .522053 | 097 | 7 | .531095 | 090 |
| 8 | .493876 | 112 | 8 | .503518 | 109 | 8 | .512951 | 107 | 8 | .522183 | 104 | 8 | .531223 | 102 |
| 9 | .494015 | 126 | 9 | .503654 | 123 | 9 | .513084 | 120 | 9 | .522314 | 117 | 9 | .531351 | 115 |
| 3120 | .494155 | 000 | 3190 | .503791 | 000 | 3260 | .513218 | 000 | 3330 | .522444 | 000 | 3400 | .531479 | 000 |
| 1 | .494294 | 014 | 1 | .503927 | 014 | 1 | .513351 | 013 | 1 | .522575 | 013 | 1 | .531607 | 013 |
| 2 | .494433 | 028 | 2 | .504063 | 027 | 2 | .513484 | 027 | 2 | .522705 | 026 | 2 | .531734 | 025 |
| 3 | .494572 | 041 | 3 | .504199 | 041 | 3 | .513617 | 040 | 3 | .522835 | 039 | 3 | .531862 | 038 |
| 4 | .494711 | 056 | 4 | .504335 | 054 | 4 | .513750 | 053 | 4 | .522966 | 052 | 4 | .531990 | 051 |
| 5 | .494850 | 069 | 5 | .504471 | 068 | 5 | .513883 | 066 | 5 | .523096 | 065 | 5 | .532117 | 063 |
| 6 | .494989 | 083 | 6 | .504607 | 082 | 6 | .514016 | 080 | 6 | .523226 | 078 | 6 | .532245 | 076 |
| 7 | .495128 | 097 | 7 | .504743 | 095 | 7 | .514149 | 093 | 7 | .523356 | 097 | 7 | .532372 | 089 |
| 8 | .495267 | 111 | 8 | .504878 | 109 | 8 | .514282 | 106 | 8 | .523486 | 104 | 8 | .532500 | 102 |
| 9 | .495406 | 125 | 9 | .505014 | 122 | 9 | .514415 | 120 | 9 | .523616 | 117 | 9 | .532627 | 114 |
| 3130 | .495544 | 000 | 3200 | .505150 | 000 | 3270 | .514548 | 000 | 3340 | .523746 | 000 | 3410 | .532754 | 000 |
| 1 | .495683 | 014 | 1 | .505286 | 014 | 1 | .514680 | 013 | 1 | .523876 | 013 | 1 | .532882 | 013 |
| 2 | .495822 | 028 | 2 | .505421 | 027 | 2 | .514813 | 027 | 2 | .524006 | 026 | 2 | .533009 | 025 |
| 3 | .495960 | 041 | 3 | .505557 | 041 | 3 | .514946 | 040 | 3 | .524136 | 039 | 3 | .533136 | 038 |
| 4 | .496099 | 056 | 4 | .505692 | 054 | 4 | .515079 | 053 | 4 | .524266 | 052 | 4 | .533263 | 051 |
| 5 | .496237 | 069 | 5 | .505828 | 068 | 5 | .515211 | 066 | 5 | .524396 | 065 | 5 | .533391 | 063 |
| 6 | .496376 | 083 | 6 | .505963 | 082 | 6 | .515344 | 080 | 6 | .524526 | 078 | 6 | .533518 | 076 |
| 7 | .496514 | 097 | 7 | .506099 | 095 | 7 | .515476 | 093 | 7 | .524656 | 091 | 7 | .533645 | 089 |
| 8 | .496653 | 111 | 8 | .506234 | 109 | 8 | .515609 | 106 | 8 | .524785 | 104 | 8 | .533772 | 102 |
| 9 | .496791 | 125 | 9 | .506370 | 122 | 9 | .515741 | 120 | 9 | .524915 | 117 | 9 | .533899 | 114 |
| 3140 | .496930 | 000 | 3210 | .506505 | 000 | 3280 | .515874 | 000 | 3350 | .525045 | 000 | 3420 | .534026 | 000 |
| 1 | .497068 | 014 | 1 | .506640 | 013 | 1 | .516006 | 013 | 1 | .525174 | 013 | 1 | .534153 | 013 |
| 2 | .497206 | 028 | 2 | .506775 | 027 | 2 | .516139 | 026 | 2 | .525304 | 026 | 2 | .534280 | 025 |
| 3 | .497344 | 041 | 3 | .506911 | 040 | 3 | .516271 | 040 | 3 | .525434 | 039 | 3 | .534407 | 038 |
| 4 | .497482 | 055 | 4 | .507046 | 054 | 4 | .516403 | 053 | 4 | .525563 | 052 | 4 | .534534 | 051 |
| 5 | .497621 | 069 | 5 | .507181 | 067 | 5 | .516535 | 066 | 5 | .525692 | 065 | 5 | .534661 | 063 |
| 6 | .497759 | 083 | 6 | .507316 | 081 | 6 | .516668 | 079 | 6 | .525822 | 078 | 6 | .534787 | 076 |
| 7 | .497897 | 097 | 7 | .507451 | 094 | 7 | .516800 | 092 | 7 | .525951 | 091 | 7 | .534914 | 089 |
| 8 | .498035 | 110 | 8 | .507586 | 108 | 8 | .516932 | 106 | 8 | .526081 | 104 | 8 | .535041 | 102 |
| 9 | .498173 | 124 | 9 | .507721 | 121 | 9 | .517064 | 119 | 9 | .526210 | 117 | 9 | .535167 | 114 |
| 3150 | .498311 | 000 | 3220 | .507856 | 000 | 3290 | .517196 | 000 | 3360 | .526339 | 000 | 3430 | .535294 | 000 |
| 1 | .498448 | 014 | 1 | .507991 | 013 | 1 | .517328 | 013 | 1 | .526468 | 013 | 1 | .535421 | 013 |
| 2 | .498586 | 028 | 2 | .508125 | 027 | 2 | .517460 | 026 | 2 | .526598 | 026 | 2 | .535547 | 025 |
| 3 | .498724 | 041 | 3 | .508260 | 040 | 3 | .517592 | 040 | 3 | .526727 | 039 | 3 | .535674 | 038 |
| 4 | .498862 | 055 | 4 | .508395 | 054 | 4 | .517724 | 053 | 4 | .526856 | 052 | 4 | .535800 | 050 |
| 5 | .498999 | 069 | 5 | .508530 | 067 | 5 | .517855 | 066 | 5 | .526985 | 065 | 5 | .535927 | 063 |
| 6 | .499137 | 083 | 6 | .508664 | 081 | 6 | .517987 | 079 | 6 | .527114 | 078 | 6 | .536053 | 076 |
| 7 | .499275 | 097 | 7 | .508799 | 094 | 7 | .518119 | 092 | 7 | .527243 | 091 | 7 | .536179 | 088 |
| 8 | .499412 | 110 | 8 | .508933 | 108 | 8 | .518251 | 106 | 8 | .527372 | 104 | 8 | .536306 | 101 |
| 9 | .499550 | 124 | 9 | .509068 | 121 | 9 | .518382 | 119 | 9 | .527501 | 117 | 9 | .536432 | 114 |
| 160 | .499687 | 000 | 3230 | .509202 | 000 | 3300 | .518514 | 000 | 3370 | .527630 | 000 | 3440 | .536558 | 000 |
| 1 | .499824 | 014 | 1 | .509337 | 013 | 1 | .518645 | 013 | 1 | .527759 | 013 | 1 | .536685 | 013 |
| 2 | .499962 | 027 | 2 | .509471 | 027 | 2 | .518777 | 026 | 2 | .527888 | 026 | 2 | .536811 | 025 |
| 3 | .500099 | 041 | 3 | .509606 | 040 | 3 | .518909 | 039 | 3 | .528016 | 038 | 3 | .536937 | 038 |
| 4 | .500236 | 055 | 4 | .509740 | 054 | 4 | .519040 | 052 | 4 | .528145 | 051 | 4 | .537063 | 050 |
| 5 | .500374 | 068 | 5 | .509874 | 067 | 5 | .519171 | 066 | 5 | .528274 | 064 | 5 | .537189 | 063 |
| 6 | .500511 | 082 | 6 | .510008 | 081 | 6 | .519303 | 079 | 6 | .528402 | 077 | 6 | .537315 | 076 |
| 7 | .500648 | 096 | 7 | .510143 | 094 | 7 | .519434 | 092 | 7 | .528531 | 090 | 7 | .537441 | 088 |
| 8 | .500785 | 110 | 8 | .510277 | 108 | 8 | .519565 | 105 | 8 | .528660 | 103 | 8 | .537567 | 101 |
| 9 | .500922 | 123 | 9 | .510411 | 121 | 9 | .519697 | 118 | 9 | .528788 | 116 | 9 | .537693 | 114 |

(u.) Log. .537819 to .579669 No. 3450 to 3799. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3450 | .537819 | 000 | 3520 | .546543 | 000 | 3590 | .555094 | 000 | 3660 | .563481 | 000 | 3730 | .571709 | 000 |
| 1 | .537945 | 013 | 1 | .546666 | 012 | 1 | .555215 | 012 | 1 | .563600 | 012 | 1 | .571827 | 012 |
| 2 | .538071 | 025 | 2 | .546789 | 025 | 2 | .555336 | 024 | 2 | .563718 | 024 | 2 | .571942 | 023 |
| 3 | .538197 | 038 | 3 | .546913 | 037 | 3 | .555457 | 036 | 3 | .563837 | 036 | 3 | .572058 | 035 |
| 4 | .538322 | 050 | 4 | .547036 | 049 | 4 | .555578 | 048 | 4 | .563955 | 048 | 4 | .572174 | 047 |
| 5 | .538448 | 063 | 5 | .547159 | 062 | 5 | .555699 | 060 | 5 | .564074 | 060 | 5 | .572291 | 058 |
| 6 | .538574 | 076 | 6 | .547282 | 074 | 6 | .555820 | 072 | 6 | .564192 | 071 | 6 | .572407 | 070 |
| 7 | .538699 | 088 | 7 | .547405 | 086 | 7 | .555940 | 084 | 7 | .564311 | 083 | 7 | .572523 | 081 |
| 8 | .538825 | 101 | 8 | .547529 | 099 | 8 | .556061 | 096 | 8 | .564429 | 095 | 8 | .572639 | 093 |
| 9 | .538951 | 114 | 9 | .547652 | 111 | 9 | .556182 | 108 | 9 | .564548 | 107 | 9 | .572755 | 105 |
| 3460 | .539076 | 000 | 3530 | .547775 | 000 | 3600 | .556302 | 000 | 3670 | .564666 | 000 | 3740 | .572872 | 000 |
| 1 | .539202 | 013 | 1 | .547898 | 012 | 1 | .556423 | 012 | 1 | .564784 | 012 | 1 | .572988 | 012 |
| 2 | .539327 | 025 | 2 | .548021 | 025 | 2 | .556544 | 024 | 2 | .564903 | 024 | 2 | .573104 | 023 |
| 3 | .539452 | 038 | 3 | .548144 | 037 | 3 | .556664 | 036 | 3 | .565021 | 036 | 3 | .573220 | 035 |
| 4 | .539578 | 050 | 4 | .548266 | 049 | 4 | .556785 | 048 | 4 | .565139 | 047 | 4 | .573336 | 046 |
| 5 | .539703 | 063 | 5 | .548389 | 061 | 5 | .556905 | 060 | 5 | .565257 | 059 | 5 | .573452 | 058 |
| 6 | .539829 | 075 | 6 | .548512 | 074 | 6 | .557026 | 072 | 6 | .565375 | 071 | 6 | .573568 | 070 |
| 7 | .539954 | 088 | 7 | .548635 | 086 | 7 | .557146 | 084 | 7 | .565494 | 083 | 7 | .573684 | 081 |
| 8 | .540079 | 100 | 8 | .548758 | 098 | 8 | .557266 | 096 | 8 | .565612 | 095 | 8 | .573800 | 093 |
| 9 | .540204 | 113 | 9 | .548881 | 111 | 9 | .557387 | 108 | 9 | .565730 | 107 | 9 | .573915 | 104 |
| 3470 | .540329 | 000 | 3540 | .549003 | 000 | 3610 | .557507 | 000 | 3680 | .565848 | 000 | 3750 | .574031 | 000 |
| 1 | .540455 | 012 | 1 | .549126 | 012 | 1 | .557627 | 012 | 1 | .565966 | 012 | 1 | .574147 | 012 |
| 2 | .540580 | 025 | 2 | .549249 | 025 | 2 | .557748 | 024 | 2 | .566084 | 024 | 2 | .574263 | 023 |
| 3 | .540705 | 037 | 3 | .549371 | 037 | 3 | .557868 | 036 | 3 | .566202 | 035 | 3 | .574379 | 035 |
| 4 | .540830 | 050 | 4 | .549494 | 049 | 4 | .557988 | 048 | 4 | .566320 | 047 | 4 | .574494 | 046 |
| 5 | .540955 | 062 | 5 | .549616 | 061 | 5 | .558108 | 060 | 5 | .566437 | 059 | 5 | .574610 | 058 |
| 6 | .541080 | 075 | 6 | .549739 | 074 | 6 | .558228 | 072 | 6 | .566555 | 071 | 6 | .574726 | 070 |
| 7 | .541205 | 087 | 7 | .549861 | 086 | 7 | .558348 | 084 | 7 | .566673 | 083 | 7 | .574841 | 081 |
| 8 | .541330 | 100 | 8 | .549984 | 098 | 8 | .558469 | 096 | 8 | .566791 | 094 | 8 | .574957 | 093 |
| 9 | .541454 | 112 | 9 | .550106 | 111 | 9 | .558589 | 108 | 9 | .566909 | 106 | 9 | .575072 | 104 |
| 3480 | .541579 | 000 | 3550 | .550228 | 000 | 3620 | .558709 | 000 | 3690 | .567026 | 000 | 3760 | .575188 | 000 |
| 1 | .541704 | 012 | 1 | .550351 | 012 | 1 | .558828 | 012 | 1 | .567144 | 012 | 1 | .575303 | 012 |
| 2 | .541829 | 025 | 2 | .550473 | 024 | 2 | .558948 | 024 | 2 | .567262 | 024 | 2 | .575419 | 023 |
| 3 | .541953 | 037 | 3 | .550595 | 037 | 3 | .559068 | 036 | 3 | .567379 | 035 | 3 | .575534 | 035 |
| 4 | .542078 | 050 | 4 | .550717 | 049 | 4 | .559188 | 048 | 4 | .567497 | 047 | 4 | .575650 | 046 |
| 5 | .542203 | 062 | 5 | .550840 | 061 | 5 | .559308 | 060 | 5 | .567614 | 059 | 5 | .575765 | 058 |
| 6 | .542327 | 075 | 6 | .550962 | 073 | 6 | .559428 | 072 | 6 | .567732 | 071 | 6 | .575880 | 069 |
| 7 | .542452 | 087 | 7 | .551084 | 086 | 7 | .559548 | 084 | 7 | .567849 | 083 | 7 | .575996 | 080 |
| 8 | .542576 | 100 | 8 | .551206 | 098 | 8 | .559667 | 096 | 8 | .567967 | 094 | 8 | .576111 | 092 |
| 9 | .542701 | 112 | 9 | .551328 | 110 | 9 | .559787 | 108 | 9 | .568084 | 106 | 9 | .576226 | 104 |
| 3490 | .542825 | 000 | 3560 | .551450 | 000 | 3630 | .559907 | 000 | 3700 | .568202 | 000 | 3770 | .576341 | 000 |
| 1 | .542950 | 012 | 1 | .551572 | 012 | 1 | .560026 | 012 | 1 | .568319 | 012 | 1 | .576456 | 012 |
| 2 | .543074 | 025 | 2 | .551694 | 024 | 2 | .560146 | 024 | 2 | .568436 | 023 | 2 | .576572 | 023 |
| 3 | .543199 | 037 | 3 | .551816 | 037 | 3 | .560265 | 036 | 3 | .568554 | 035 | 3 | .576687 | 035 |
| 4 | .543323 | 050 | 4 | .551938 | 049 | 4 | .560385 | 048 | 4 | .568671 | 047 | 4 | .576802 | 046 |
| 5 | .543447 | 062 | 5 | .552059 | 061 | 5 | .560504 | 060 | 5 | .568788 | 058 | 5 | .576917 | 058 |
| 6 | .543571 | 075 | 6 | .552181 | 073 | 6 | .560624 | 072 | 6 | .568905 | 070 | 6 | .577032 | 069 |
| 7 | .543696 | 087 | 7 | .552303 | 086 | 7 | .560743 | 084 | 7 | .569023 | 082 | 7 | .577147 | 069 |
| 8 | .543820 | 100 | 8 | .552425 | 098 | 8 | .560863 | 096 | 8 | .569140 | 094 | 8 | .577262 | 092 |
| 9 | .543944 | 112 | 9 | .552546 | 110 | 9 | .560982 | 108 | 9 | .569257 | 106 | 9 | .577377 | 104 |
| 3500 | .544068 | 000 | 3570 | .552668 | 000 | 3640 | .561101 | 000 | 3710 | .569374 | 000 | 3780 | .577492 | 000 |
| 1 | .544192 | 012 | 1 | .552790 | 012 | 1 | .561221 | 012 | 1 | .569491 | 012 | 1 | .577607 | 011 |
| 2 | .544316 | 025 | 2 | .552911 | 024 | 2 | .561340 | 024 | 2 | .569608 | 023 | 2 | .577721 | 023 |
| 3 | .544440 | 037 | 3 | .553033 | 036 | 3 | .561459 | 036 | 3 | .569725 | 035 | 3 | .577836 | 034 |
| 4 | .544564 | 050 | 4 | .553154 | 049 | 4 | .561578 | 048 | 4 | .569842 | 047 | 4 | .577951 | 046 |
| 5 | .544688 | 062 | 5 | .553276 | 061 | 5 | .561697 | 060 | 5 | .569959 | 058 | 5 | .578066 | 057 |
| 6 | .544812 | 074 | 6 | .553397 | 073 | 6 | .561817 | 072 | 6 | .570076 | 070 | 6 | .578181 | 068 |
| 7 | .544936 | 087 | 7 | .553519 | 085 | 7 | .561936 | 084 | 7 | .570193 | 082 | 7 | .578295 | 069 |
| 8 | .545060 | 099 | 8 | .553640 | 097 | 8 | .562055 | 096 | 8 | .570309 | 094 | 8 | .578410 | 091 |
| 9 | .545183 | 112 | 9 | .553762 | 109 | 9 | .562174 | 108 | 9 | .570426 | 106 | 9 | .578525 | 103 |
| 3510 | .545307 | 000 | 3580 | .553883 | 000 | 3650 | .562293 | 000 | 3720 | .570543 | 000 | 3790 | .578639 | 000 |
| 1 | .545431 | 012 | 1 | .554004 | 012 | 1 | .562412 | 012 | 1 | .570660 | 012 | 1 | .578754 | 011 |
| 2 | .545554 | 025 | 2 | .554126 | 024 | 2 | .562531 | 024 | 2 | .570776 | 023 | 2 | .578868 | 023 |
| 3 | .545678 | 037 | 3 | .554247 | 036 | 3 | .562650 | 036 | 3 | .570893 | 035 | 3 | .578983 | 034 |
| 4 | .545802 | 049 | 4 | .554368 | 049 | 4 | .562768 | 048 | 4 | .571010 | 047 | 4 | .579097 | 046 |
| 5 | .545925 | 062 | 5 | .554489 | 061 | 5 | .562887 | 060 | 5 | .571126 | 058 | 5 | .579212 | 057 |
| 6 | .546049 | 074 | 6 | .554610 | 073 | 6 | .563006 | 071 | 6 | .571243 | 070 | 6 | .579326 | 068 |
| 7 | .546172 | 086 | 7 | .554731 | 085 | 7 | .563125 | 083 | 7 | .571359 | 081 | 7 | .579441 | 080 |
| 8 | .546296 | 099 | 8 | .554852 | 097 | 8 | .563244 | 095 | 8 | .571476 | 093 | 8 | .579555 | 091 |
| 9 | .546419 | 111 | 9 | .554973 | 109 | 9 | .563362 | 107 | 9 | .571592 | 105 | 9 | .579669 | 103 |

(u.) Log. .579784 to .617943 No. 3800 to 4149 (u.)

| No. | Log. | Part. | No. | Log. | Part. | No | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3800 | .579784 | 000 | 3870 | .587711 | 000 | 3940 | .595496 | 000 | 4010 | .603144 | 000 | 4080 | .610660 | 000 |
| 1 | .579898 | 011 | 1 | .587823 | 011 | 1 | .595606 | 011 | 1 | .603253 | 011 | 1 | .610767 | 011 |
| 2 | .580012 | 023 | 2 | .587935 | 022 | 2 | .595717 | 022 | 2 | .603361 | 022 | 2 | .610873 | 021 |
| 3 | .580126 | 034 | 3 | .588047 | 034 | 3 | .595827 | 033 | 3 | .603469 | 033 | 3 | .610979 | 032 |
| 4 | .580240 | 046 | 4 | .588160 | 045 | 4 | .595937 | 044 | 4 | .603577 | 043 | 4 | .611086 | 042 |
| 5 | .580355 | 057 | 5 | .588272 | 056 | 5 | .596047 | 055 | 5 | .603685 | 054 | 5 | .611192 | 053 |
| 6 | .580469 | 068 | 6 | .588384 | 067 | 6 | .596157 | 066 | 6 | .603794 | 065 | 6 | .611298 | 064 |
| 7 | .580583 | 080 | 7 | .588496 | 078 | 7 | .596267 | 077 | 7 | .603902 | 076 | 7 | .611405 | 074 |
| 8 | .580697 | 091 | 8 | .588608 | 090 | 8 | .596377 | 088 | 8 | .604010 | 087 | 8 | .611511 | 085 |
| 9 | .580811 | 103 | 9 | .588720 | 101 | 9 | .596487 | 099 | 9 | .604118 | 098 | 9 | .611617 | 095 |
| 3810 | .580925 | 000 | 3880 | .588832 | 000 | 3950 | .596597 | 000 | 4020 | .604226 | 000 | 4090 | .611723 | 000 |
| 1 | .581039 | 011 | 1 | .588944 | 011 | 1 | .596707 | 011 | 1 | .604334 | 011 | 1 | .611829 | 011 |
| 2 | .581153 | 023 | 2 | .589055 | 022 | 2 | .596817 | 022 | 2 | .604442 | 022 | 2 | .611936 | 021 |
| 3 | .581267 | 034 | 3 | .589167 | 033 | 3 | .596927 | 033 | 3 | .604550 | 032 | 3 | .612042 | 032 |
| 4 | .581381 | 046 | 4 | .589279 | 044 | 4 | .597037 | 044 | 4 | .604658 | 043 | 4 | .612148 | 042 |
| 5 | .581494 | 057 | 5 | .589391 | 056 | 5 | .597146 | 055 | 5 | .604766 | 054 | 5 | .612254 | 053 |
| 6 | .581608 | 068 | 6 | .589503 | 067 | 6 | .597256 | 066 | 6 | .604874 | 065 | 6 | .612360 | 064 |
| 7 | .581722 | 080 | 7 | .589614 | 078 | 7 | .597366 | 077 | 7 | .604982 | 076 | 7 | .612466 | 074 |
| 8 | .581836 | 091 | 8 | .589726 | 089 | 8 | .597476 | 088 | 8 | .605089 | 086 | 8 | .612572 | 085 |
| 9 | .581950 | 103 | 9 | .589838 | 100 | 9 | .597585 | 099 | 9 | .605197 | 097 | 9 | .612678 | 095 |
| 3820 | .582063 | 000 | 3890 | .589950 | 000 | 3960 | .597695 | 000 | 4030 | .605305 | 000 | 4100 | .612784 | 000 |
| 1 | .582177 | 011 | 1 | .590061 | 011 | 1 | .597805 | 011 | 1 | .605413 | 011 | 1 | .612890 | 011 |
| 2 | .582291 | 023 | 2 | .590173 | 022 | 2 | .597914 | 022 | 2 | .605520 | 022 | 2 | .612996 | 021 |
| 3 | .582404 | 034 | 3 | .590284 | 033 | 3 | .598024 | 033 | 3 | .605628 | 032 | 3 | .613101 | 032 |
| 4 | .582518 | 045 | 4 | .590396 | 044 | 4 | .598134 | 044 | 4 | .605736 | 043 | 4 | .613207 | 042 |
| 5 | .582631 | 056 | 5 | .590507 | 056 | 5 | .598243 | 055 | 5 | .605843 | 054 | 5 | .613313 | 053 |
| 6 | .582745 | 068 | 6 | .590619 | 067 | 6 | .598353 | 066 | 6 | .605951 | 065 | 6 | .613419 | 064 |
| 7 | .582858 | 079 | 7 | .590730 | 078 | 7 | .598462 | 077 | 7 | .606059 | 076 | 7 | .613525 | 074 |
| 8 | .582972 | 090 | 8 | .590842 | 089 | 8 | .598572 | 088 | 8 | .606166 | 086 | 8 | .613630 | 085 |
| 9 | .583085 | 102 | 9 | .590953 | 100 | 9 | .598681 | 099 | 9 | .606274 | 097 | 9 | .613736 | 095 |
| 3830 | .583199 | 000 | 3900 | .591065 | 000 | 3970 | .598790 | 000 | 4040 | .606381 | 000 | 4110 | .613842 | 000 |
| 1 | .583312 | 011 | 1 | .591176 | 011 | 1 | .598900 | 011 | 1 | .606489 | 011 | 1 | .613947 | 011 |
| 2 | .583425 | 023 | 2 | .591287 | 022 | 2 | .599009 | 022 | 2 | .606596 | 021 | 2 | .614053 | 021 |
| 3 | .583539 | 034 | 3 | .591399 | 033 | 3 | .599119 | 033 | 3 | .606704 | 032 | 3 | .614159 | 032 |
| 4 | .583652 | 045 | 4 | .591510 | 044 | 4 | .599228 | 044 | 4 | .606811 | 043 | 4 | .614264 | 042 |
| 5 | .583765 | 056 | 5 | .591621 | 056 | 5 | .599337 | 055 | 5 | .606918 | 054 | 5 | .614370 | 053 |
| 6 | .583879 | 068 | 6 | .591732 | 067 | 6 | .599446 | 066 | 6 | .607026 | 064 | 6 | .614475 | 063 |
| 7 | .583992 | 079 | 7 | .591843 | 078 | 7 | .599556 | 077 | 7 | .607133 | 075 | 7 | .614581 | 074 |
| 8 | .584105 | 090 | 8 | .591955 | 089 | 8 | .599665 | 088 | 8 | .607240 | 086 | 8 | .614686 | 084 |
| 9 | .584218 | 102 | 9 | .592066 | 100 | 9 | .599774 | 099 | 9 | .607348 | 096 | 9 | .614792 | 095 |
| 3840 | .584331 | 000 | 3910 | .592177 | 000 | 3980 | .599883 | 000 | 4050 | .607455 | 000 | 4120 | .614897 | 000 |
| 1 | .584444 | 011 | 1 | .592288 | 011 | 1 | .599992 | 011 | 1 | .607562 | 011 | 1 | .615003 | 011 |
| 2 | .584557 | 023 | 2 | .592399 | 022 | 2 | .600101 | 022 | 2 | .607669 | 021 | 2 | .615108 | 021 |
| 3 | .584670 | 034 | 3 | .592510 | 033 | 3 | .600210 | 033 | 3 | .607777 | 032 | 3 | .615213 | 031 |
| 4 | .584783 | 045 | 4 | .592621 | 044 | 4 | .600319 | 044 | 4 | .607884 | 043 | 4 | .615319 | 042 |
| 5 | .584896 | 056 | 5 | .592732 | 055 | 5 | .600428 | 054 | 5 | .607991 | 054 | 5 | .615424 | 052 |
| 6 | .585009 | 068 | 6 | .592843 | 067 | 6 | .600537 | 065 | 6 | .608098 | 064 | 6 | .615529 | 063 |
| 7 | .585122 | 079 | 7 | .592954 | 078 | 7 | .600646 | 076 | 7 | .608205 | 075 | 7 | .615634 | 073 |
| 8 | .585235 | 090 | 8 | .593064 | 089 | 8 | .600755 | 087 | 8 | .608312 | 086 | 8 | .615740 | 084 |
| 9 | .585348 | 102 | 9 | .593175 | 100 | 9 | .600864 | 098 | 9 | .608419 | 096 | 9 | .615845 | 095 |
| 3850 | .585461 | 000 | 3920 | .593286 | 000 | 3990 | .600973 | 000 | 4060 | .608526 | 000 | 4130 | .615950 | 000 |
| 1 | .585573 | 011 | 1 | .593397 | 011 | 1 | .601082 | 011 | 1 | .608633 | 011 | 1 | .616055 | 011 |
| 2 | .585686 | 022 | 2 | .593508 | 022 | 2 | .601190 | 022 | 2 | .608740 | 021 | 2 | .616160 | 021 |
| 3 | .585799 | 034 | 3 | .593618 | 033 | 3 | .601299 | 033 | 3 | .608847 | 032 | 3 | .616265 | 031 |
| 4 | .585912 | 045 | 4 | .593729 | 044 | 4 | .601408 | 044 | 4 | .608954 | 043 | 4 | .616370 | 042 |
| 5 | .586024 | 056 | 5 | .593840 | 055 | 5 | .601517 | 054 | 5 | .609060 | 053 | 5 | .616475 | 052 |
| 6 | .586137 | 067 | 6 | .593950 | 066 | 6 | .601625 | 065 | 6 | .609167 | 064 | 6 | .616580 | 063 |
| 7 | .586250 | 078 | 7 | .594061 | 077 | 7 | .601734 | 076 | 7 | .609274 | 075 | 7 | .616685 | 073 |
| 8 | .586362 | 090 | 8 | .594171 | 088 | 8 | .601843 | 087 | 8 | .609381 | 086 | 8 | .616790 | 084 |
| 9 | .586475 | 101 | 9 | .594282 | 099 | 9 | .601951 | 098 | 9 | .609488 | 096 | 9 | .616895 | 095 |
| 3860 | .586587 | 000 | 3930 | .594393 | 000 | 4000 | .602060 | 000 | 4070 | .609594 | 000 | 4140 | .617000 | 000 |
| 1 | .586700 | 011 | 1 | .594503 | 011 | 1 | .602169 | 011 | 1 | .609701 | 011 | 1 | .617105 | 010 |
| 2 | .586812 | 022 | 2 | .594613 | 022 | 2 | .602277 | 022 | 2 | .609808 | 021 | 2 | .617210 | 021 |
| 3 | .586925 | 034 | 3 | .594724 | 033 | 3 | .602386 | 033 | 3 | .609914 | 032 | 3 | .617315 | 031 |
| 4 | .587037 | 045 | 4 | .594834 | 044 | 4 | .602494 | 043 | 4 | .610021 | 043 | 4 | .617420 | 042 |
| 5 | .587149 | 056 | 5 | .594945 | 055 | 5 | .602602 | 054 | 5 | .610128 | 053 | 5 | .617524 | 052 |
| 6 | .587262 | 067 | 6 | .595055 | 066 | 6 | .602711 | 065 | 6 | .610234 | 064 | 6 | .617629 | 063 |
| 7 | .587374 | 078 | 7 | .595165 | 077 | 7 | .602819 | 076 | 7 | .610341 | 075 | 7 | .617734 | 073 |
| 8 | .587486 | 090 | 8 | .595276 | 088 | 8 | .602928 | 087 | 8 | .610447 | 086 | 8 | .617839 | 084 |
| 9 | .587599 | 101 | 9 | .595386 | 099 | 9 | .603036 | 098 | 9 | .610554 | 096 | 9 | .617943 | 094 |

(u.) Log. .618048 to .653116 No. 4150 to 4499. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4150 | .618048 | 000 | 4220 | .625312 | 000 | 4290 | .632457 | 000 | 4360 | .639486 | 000 | 4430 | .646404 | 000 |
| 1 | .618153 | 010 | 1 | .625415 | 010 | 1 | .632558 | 010 | 1 | .639586 | 010 | 1 | .646502 | 010 |
| 2 | .618257 | 021 | 2 | .625518 | 021 | 2 | .632660 | 020 | 2 | .639686 | 020 | 2 | .646600 | 020 |
| 3 | .618362 | 031 | 3 | .625621 | 031 | 3 | .632761 | 030 | 3 | .639785 | 030 | 3 | .646698 | 029 |
| 4 | .618466 | 042 | 4 | .625724 | 041 | 4 | .632862 | 041 | 4 | .639885 | 040 | 4 | .646796 | 039 |
| 5 | .618571 | 052 | 5 | .625827 | 051 | 5 | .632963 | 051 | 5 | .639984 | 050 | 5 | .646894 | 049 |
| 6 | .618675 | 062 | 6 | .625929 | 062 | 6 | .633064 | 061 | 6 | .640084 | 060 | 6 | .646991 | 059 |
| 7 | .618780 | 073 | 7 | .626032 | 072 | 7 | .633165 | 071 | 7 | .640183 | 070 | 7 | .647089 | 069 |
| 8 | .618884 | 083 | 8 | .626135 | 082 | 8 | .633266 | 081 | 8 | .640283 | 080 | 8 | .647187 | 078 |
| 9 | .618989 | 094 | 9 | .626238 | 093 | 9 | .633367 | 091 | 9 | .640382 | 090 | 9 | .647285 | 088 |
| 4160 | .619093 | 000 | 4230 | .626340 | 000 | 4300 | .633468 | 000 | 4370 | .640481 | 000 | 4440 | .647383 | 000 |
| 1 | .619198 | 010 | 1 | .626443 | 010 | 1 | .633569 | 010 | 1 | .640581 | 010 | 1 | .647481 | 010 |
| 2 | .619302 | 021 | 2 | .626546 | 021 | 2 | .633670 | 020 | 2 | .640680 | 020 | 2 | .647579 | 020 |
| 3 | .619406 | 031 | 3 | .626648 | 031 | 3 | .633771 | 030 | 3 | .640779 | 030 | 3 | .647676 | 029 |
| 4 | .619511 | 042 | 4 | .626751 | 041 | 4 | .633872 | 040 | 4 | .640879 | 040 | 4 | .647774 | 039 |
| 5 | .619615 | 052 | 5 | .626853 | 051 | 5 | .633973 | 050 | 5 | .640978 | 050 | 5 | .647872 | 049 |
| 6 | .619719 | 062 | 6 | .626956 | 062 | 6 | .634074 | 061 | 6 | .641077 | 060 | 6 | .647969 | 059 |
| 7 | .619823 | 073 | 7 | .627058 | 072 | 7 | .634175 | 071 | 7 | .641176 | 070 | 7 | .648067 | 069 |
| 8 | .619928 | 083 | 8 | .627161 | 082 | 8 | .634276 | 081 | 8 | .641276 | 080 | 8 | .648165 | 078 |
| 9 | .620032 | 094 | 9 | .627263 | 093 | 9 | .634376 | 091 | 9 | .641375 | 090 | 9 | .648262 | 088 |
| 4170 | .620136 | 000 | 4240 | .627366 | 000 | 4310 | .634477 | 000 | 4380 | .641474 | 000 | 4450 | .648360 | 000 |
| 1 | .620240 | 010 | 1 | .627468 | 010 | 1 | .634578 | 010 | 1 | .641573 | 010 | 1 | .648458 | 010 |
| 2 | .620344 | 021 | 2 | .627571 | 020 | 2 | .634679 | 020 | 2 | .641672 | 020 | 2 | .648555 | 019 |
| 3 | .620448 | 031 | 3 | .627673 | 031 | 3 | .634779 | 030 | 3 | .641771 | 030 | 3 | .648653 | 029 |
| 4 | .620552 | 042 | 4 | .627775 | 041 | 4 | .634880 | 040 | 4 | .641870 | 040 | 4 | .648750 | 039 |
| 5 | .620656 | 052 | 5 | .627878 | 051 | 5 | .634981 | 050 | 5 | .641970 | 050 | 5 | .648848 | 049 |
| 6 | .620760 | 062 | 6 | .627980 | 061 | 6 | .635081 | 061 | 6 | .642069 | 059 | 6 | .648945 | 058 |
| 7 | .620864 | 073 | 7 | .628082 | 072 | 7 | .635182 | 071 | 7 | .642168 | 069 | 7 | .649043 | 068 |
| 8 | .620968 | 083 | 8 | .628184 | 082 | 8 | .635283 | 081 | 8 | .642267 | 079 | 8 | .649140 | 078 |
| 9 | .621072 | 094 | 9 | .628287 | 092 | 9 | .635383 | 091 | 9 | .642366 | 089 | 9 | .649237 | 088 |
| 4180 | .621176 | 000 | 4250 | .628389 | 000 | 4320 | .635484 | 000 | 4390 | .642464 | 000 | 4460 | .649335 | 000 |
| 1 | .621280 | 010 | 1 | .628491 | 010 | 1 | .635584 | 010 | 1 | .642563 | 010 | 1 | .649432 | 010 |
| 2 | .621384 | 021 | 2 | .628593 | 020 | 2 | .635685 | 020 | 2 | .642662 | 020 | 2 | .649530 | 019 |
| 3 | .621488 | 031 | 3 | .628695 | 031 | 3 | .635785 | 030 | 3 | .642761 | 030 | 3 | .649627 | 029 |
| 4 | .621592 | 042 | 4 | .628797 | 041 | 4 | .635886 | 040 | 4 | .642860 | 040 | 4 | .649724 | 039 |
| 5 | .621695 | 052 | 5 | .628900 | 051 | 5 | .635986 | 050 | 5 | .642959 | 049 | 5 | .649821 | 049 |
| 6 | .621799 | 062 | 6 | .629002 | 061 | 6 | .636086 | 060 | 6 | .643058 | 059 | 6 | .649919 | 058 |
| 7 | .621903 | 073 | 7 | .629104 | 072 | 7 | .636187 | 070 | 7 | .643156 | 069 | 7 | .650016 | 068 |
| 8 | .622007 | 083 | 8 | .629206 | 082 | 8 | .636287 | 080 | 8 | .643255 | 079 | 8 | .650113 | 078 |
| 9 | .622110 | 094 | 9 | .629308 | 092 | 9 | .636388 | 090 | 9 | .643354 | 089 | 9 | .650210 | 088 |
| 4190 | .622214 | 000 | 4260 | .629410 | 000 | 4330 | .636488 | 000 | 4400 | .643453 | 000 | 4470 | .650307 | 000 |
| 1 | .622318 | 010 | 1 | .629511 | 010 | 1 | .636588 | 010 | 1 | .643551 | 010 | 1 | .650405 | 010 |
| 2 | .622421 | 021 | 2 | .629613 | 020 | 2 | .636688 | 020 | 2 | .643650 | 020 | 2 | .650502 | 019 |
| 3 | .622525 | 031 | 3 | .629715 | 030 | 3 | .636789 | 030 | 3 | .643749 | 030 | 3 | .650599 | 029 |
| 4 | .622628 | 041 | 4 | .629817 | 041 | 4 | .636889 | 040 | 4 | .643847 | 039 | 4 | .650696 | 039 |
| 5 | .622732 | 052 | 5 | .629919 | 051 | 5 | .636989 | 050 | 5 | .643946 | 049 | 5 | .650793 | 049 |
| 6 | .622835 | 062 | 6 | .630021 | 061 | 6 | .637089 | 060 | 6 | .644044 | 059 | 6 | .650890 | 058 |
| 7 | .622939 | 072 | 7 | .630123 | 071 | 7 | .637189 | 070 | 7 | .644143 | 069 | 7 | .650987 | 068 |
| 8 | .623042 | 083 | 8 | .630224 | 081 | 8 | .637289 | 080 | 8 | .644242 | 079 | 8 | .651084 | 078 |
| 9 | .623146 | 093 | 9 | .630326 | 091 | 9 | .637390 | 090 | 9 | .644340 | 089 | 9 | .651181 | 088 |
| 4200 | .623249 | 000 | 4270 | .630428 | 000 | 4340 | .637490 | 000 | 4410 | .644439 | 000 | 4480 | .651278 | 000 |
| 1 | .623353 | 010 | 1 | .630530 | 010 | 1 | .637590 | 010 | 1 | .644537 | 010 | 1 | .651375 | 010 |
| 2 | .623456 | 021 | 2 | .630631 | 020 | 2 | .637690 | 020 | 2 | .644636 | 020 | 2 | .651472 | 019 |
| 3 | .623559 | 031 | 3 | .630733 | 030 | 3 | .637790 | 030 | 3 | .644734 | 030 | 3 | .651569 | 029 |
| 4 | .623663 | 041 | 4 | .630834 | 041 | 4 | .637890 | 040 | 4 | .644832 | 039 | 4 | .651666 | 038 |
| 5 | .623766 | 052 | 5 | .630936 | 051 | 5 | .637990 | 050 | 5 | .644931 | 049 | 5 | .651762 | 048 |
| 6 | .623869 | 062 | 6 | .631038 | 061 | 6 | .638090 | 060 | 6 | .645029 | 059 | 6 | .651859 | 058 |
| 7 | .623972 | 072 | 7 | .631139 | 071 | 7 | .638190 | 070 | 7 | .645127 | 069 | 7 | .651956 | 067 |
| 8 | .624076 | 083 | 8 | .631241 | 081 | 8 | .638289 | 080 | 8 | .645226 | 079 | 8 | .652053 | 077 |
| 9 | .624179 | 093 | 9 | .631342 | 091 | 9 | .638389 | 090 | 9 | .645324 | 089 | 9 | .652150 | 087 |
| 4210 | .624282 | 000 | 4280 | .631444 | 000 | 4350 | .638489 | 000 | 4420 | .645422 | 000 | 4490 | .652246 | 000 |
| 1 | .624385 | 010 | 1 | .631545 | 010 | 1 | .638589 | 010 | 1 | .645520 | 010 | 1 | .652343 | 010 |
| 2 | .624488 | 021 | 2 | .631647 | 020 | 2 | .638689 | 020 | 2 | .645619 | 020 | 2 | .652440 | 019 |
| 3 | .624591 | 031 | 3 | .631748 | 030 | 3 | .638789 | 030 | 3 | .645717 | 030 | 3 | .652536 | 029 |
| 4 | .624694 | 041 | 4 | .631849 | 041 | 4 | .638888 | 040 | 4 | .645815 | 039 | 4 | .652633 | 038 |
| 5 | .624798 | 051 | 5 | .631951 | 051 | 5 | .638988 | 050 | 5 | .645913 | 049 | 5 | .652730 | 048 |
| 6 | .624901 | 062 | 6 | .632052 | 061 | 6 | .639088 | 060 | 6 | .646011 | 059 | 6 | .652826 | 058 |
| 7 | .625004 | 072 | 7 | .632153 | 071 | 7 | .639188 | 070 | 7 | .646109 | 069 | 7 | .652923 | 067 |
| 8 | .625107 | 082 | 8 | .632255 | 081 | 8 | .639287 | 080 | 8 | .646208 | 079 | 8 | .653019 | 077 |
| 9 | .625209 | 093 | 9 | .632356 | 091 | 9 | .639387 | 090 | 9 | .646306 | 089 | 9 | .653116 | 087 |

(u.) Log. .653213 to .685652 No. 4500 to 4849. (v.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4500 | .653213 | 000 | 4570 | .659916 | 009 | 4640 | .666518 | 000 | 4710 | .673021 | 000 | 4780 | .679422 | 000 |
| 1 | .653309 | 010 | 1 | .660011 | 010 | 1 | .666612 | 009 | 1 | .673113 | 009 | 1 | .679519 | 009 |
| 2 | .653405 | 019 | 2 | .660106 | 019 | 2 | .666705 | 019 | 2 | .673205 | 018 | 2 | .679610 | 018 |
| 3 | .653502 | 029 | 3 | .660201 | 028 | 3 | .666799 | 028 | 3 | .673297 | 028 | 3 | .679700 | 027 |
| 4 | .653598 | 038 | 4 | .660296 | 038 | 4 | .666892 | 037 | 4 | .673390 | 037 | 4 | .679791 | 036 |
| 5 | .653695 | 048 | 5 | .660391 | 047 | 5 | .666986 | 047 | 5 | .673482 | 046 | 5 | .679882 | 045 |
| 6 | .653791 | 058 | 6 | .660486 | 057 | 6 | .667079 | 056 | 6 | .673574 | 055 | 6 | .679973 | 055 |
| 7 | .653888 | 067 | 7 | .660581 | 067 | 7 | .667173 | 065 | 7 | .673666 | 064 | 7 | .680063 | 064 |
| 8 | .653984 | 077 | 8 | .660676 | 076 | 8 | .667266 | 074 | 8 | .673758 | 074 | 8 | .680154 | 073 |
| 9 | .654080 | 087 | 9 | .660771 | 086 | 9 | .667359 | 084 | 9 | .673850 | 083 | 9 | .680245 | 082 |
| 4510 | .654176 | 000 | 4580 | .660865 | 000 | 4650 | .667453 | 000 | 4720 | .673942 | 000 | 4790 | .680335 | 000 |
| 1 | .654273 | 010 | 1 | .660960 | 009 | 1 | .667546 | 009 | 1 | .674034 | 009 | 1 | .680426 | 009 |
| 2 | .654369 | 019 | 2 | .661055 | 019 | 2 | .667640 | 019 | 2 | .674126 | 018 | 2 | .680517 | 018 |
| 3 | .654465 | 029 | 3 | .661150 | 028 | 3 | .667733 | 028 | 3 | .674218 | 028 | 3 | .680607 | 027 |
| 4 | .654562 | 038 | 4 | .661245 | 038 | 4 | .667826 | 037 | 4 | .674310 | 037 | 4 | .680698 | 036 |
| 5 | .654658 | 048 | 5 | .661339 | 047 | 5 | .667920 | 047 | 5 | .674402 | 046 | 5 | .680789 | 045 |
| 6 | .654754 | 058 | 6 | .661434 | 057 | 6 | .668013 | 056 | 6 | .674494 | 055 | 6 | .680879 | 055 |
| 7 | .654850 | 067 | 7 | .661529 | 066 | 7 | .668106 | 065 | 7 | .674586 | 064 | 7 | .680970 | 064 |
| 8 | .654946 | 077 | 8 | .661623 | 076 | 8 | .668199 | 074 | 8 | .674677 | 074 | 8 | .681060 | 073 |
| 9 | .655042 | 086 | 9 | .661718 | 085 | 9 | .668293 | 084 | 9 | .674769 | 083 | 9 | .681151 | 082 |
| 4520 | .655138 | 000 | 4590 | .661813 | 000 | 4660 | .668386 | 000 | 4730 | .674861 | 000 | 4800 | .681241 | 000 |
| 1 | .655234 | 010 | 1 | .661907 | 009 | 1 | .668479 | 009 | 1 | .674953 | 009 | 1 | .681332 | 009 |
| 2 | .655331 | 019 | 2 | .662002 | 019 | 2 | .668572 | 019 | 2 | .675045 | 018 | 2 | .681422 | 018 |
| 3 | .655427 | 029 | 3 | .662096 | 028 | 3 | .668665 | 028 | 3 | .675136 | 028 | 3 | .681513 | 027 |
| 4 | .655523 | 038 | 4 | .662191 | 038 | 4 | .668758 | 037 | 4 | .675228 | 037 | 4 | .681603 | 036 |
| 5 | .655619 | 048 | 5 | .662285 | 047 | 5 | .668852 | 047 | 5 | .675320 | 046 | 5 | .681693 | 045 |
| 6 | .655714 | 058 | 6 | .662380 | 057 | 6 | .668945 | 056 | 6 | .675412 | 055 | 6 | .681784 | 054 |
| 7 | .655810 | 067 | 7 | .662474 | 066 | 7 | .669038 | 065 | 7 | .675503 | 064 | 7 | .681874 | 063 |
| 8 | .655906 | 077 | 8 | .662569 | 076 | 8 | .669131 | 074 | 8 | .675595 | 074 | 8 | .681964 | 072 |
| 9 | .656002 | 086 | 9 | .662663 | 085 | 9 | .669224 | 084 | 9 | .675687 | 083 | 9 | .682055 | 081 |
| 4530 | .656098 | 000 | 4600 | .662758 | 000 | 4670 | .669317 | 000 | 4740 | .675778 | 000 | 4810 | .682145 | 000 |
| 1 | .656194 | 010 | 1 | .662852 | 009 | 1 | .669410 | 009 | 1 | .675870 | 009 | 1 | .682235 | 009 |
| 2 | .656290 | 019 | 2 | .662947 | 019 | 2 | .669503 | 019 | 2 | .675961 | 018 | 2 | .682326 | 018 |
| 3 | .656386 | 029 | 3 | .663041 | 028 | 3 | .669596 | 028 | 3 | .676053 | 027 | 3 | .682416 | 027 |
| 4 | .656481 | 038 | 4 | .663135 | 038 | 4 | .669689 | 037 | 4 | .676145 | 036 | 4 | .682506 | 036 |
| 5 | .656577 | 048 | 5 | .663230 | 047 | 5 | .669782 | 047 | 5 | .676236 | 046 | 5 | .682596 | 045 |
| 6 | .656673 | 058 | 6 | .663324 | 057 | 6 | .669875 | 056 | 6 | .676328 | 055 | 6 | .682686 | 054 |
| 7 | .656769 | 067 | 7 | .663418 | 066 | 7 | .669967 | 065 | 7 | .676419 | 064 | 7 | .682777 | 063 |
| 8 | .656864 | 077 | 8 | .663512 | 076 | 8 | .670060 | 074 | 8 | .676511 | 073 | 8 | .682867 | 072 |
| 9 | .656960 | 086 | 9 | .663607 | 085 | 9 | .670153 | 084 | 9 | .676602 | 082 | 9 | .682957 | 081 |
| 4540 | .657056 | 000 | 4610 | .663701 | 000 | 4680 | .670246 | 000 | 4750 | .676694 | 000 | 4820 | .683047 | 000 |
| 1 | .657151 | 010 | 1 | .663795 | 009 | 1 | .670339 | 009 | 1 | .676785 | 009 | 1 | .683137 | 009 |
| 2 | .657247 | 019 | 2 | .663889 | 019 | 2 | .670431 | 018 | 2 | .676876 | 018 | 2 | .683227 | 018 |
| 3 | .657343 | 028 | 3 | .663983 | 028 | 3 | .670524 | 028 | 3 | .676968 | 027 | 3 | .683317 | 027 |
| 4 | .657438 | 038 | 4 | .664078 | 038 | 4 | .670617 | 037 | 4 | .677059 | 036 | 4 | .683407 | 036 |
| 5 | .657534 | 047 | 5 | .664172 | 047 | 5 | .670710 | 046 | 5 | .677150 | 046 | 5 | .683497 | 045 |
| 6 | .657629 | 057 | 6 | .664266 | 056 | 6 | .670802 | 055 | 6 | .677242 | 055 | 6 | .683587 | 054 |
| 7 | .657725 | 067 | 7 | .664360 | 066 | 7 | .670895 | 064 | 7 | .677333 | 064 | 7 | .683677 | 063 |
| 8 | .657820 | 076 | 8 | .664454 | 075 | 8 | .670988 | 074 | 8 | .677424 | 073 | 8 | .683767 | 072 |
| 9 | .657916 | 086 | 9 | .664548 | 085 | 9 | .671080 | 083 | 9 | .677516 | 082 | 9 | .683857 | 081 |
| 4550 | .658011 | 000 | 4620 | .664642 | 000 | 4690 | .671173 | 000 | 4760 | .677607 | 000 | 4830 | .683947 | 000 |
| 1 | .658107 | 010 | 1 | .664736 | 009 | 1 | .671265 | 009 | 1 | .677698 | 009 | 1 | .684037 | 009 |
| 2 | .658202 | 019 | 2 | .664830 | 019 | 2 | .671358 | 018 | 2 | .677789 | 018 | 2 | .684127 | 018 |
| 3 | .658298 | 028 | 3 | .664924 | 028 | 3 | .671451 | 028 | 3 | .677881 | 027 | 3 | .684217 | 027 |
| 4 | .658393 | 038 | 4 | .665018 | 038 | 4 | .671543 | 037 | 4 | .677972 | 036 | 4 | .684307 | 036 |
| 5 | .658488 | 047 | 5 | .665112 | 047 | 5 | .671636 | 046 | 5 | .678063 | 045 | 5 | .684396 | 045 |
| 6 | .658584 | 057 | 6 | .665206 | 056 | 6 | .671728 | 055 | 6 | .678154 | 055 | 6 | .684486 | 054 |
| 7 | .658679 | 067 | 7 | .665299 | 066 | 7 | .671821 | 064 | 7 | .678245 | 064 | 7 | .684576 | 063 |
| 8 | .658774 | 076 | 8 | .665393 | 075 | 8 | .671913 | 074 | 8 | .678336 | 073 | 8 | .684666 | 072 |
| 9 | .658870 | 086 | 9 | .665487 | 085 | 9 | .672005 | 083 | 9 | .678427 | 082 | 9 | .684756 | 081 |
| 4560 | .658965 | 000 | 4630 | .665581 | 000 | 4700 | .672098 | 000 | 4770 | .678518 | 000 | 4840 | .684845 | 000 |
| 1 | .659060 | 010 | 1 | .665675 | 009 | 1 | .672190 | 009 | 1 | .678609 | 009 | 1 | .684935 | 009 |
| 2 | .659155 | 019 | 2 | .665769 | 019 | 2 | .672283 | 018 | 2 | .678700 | 018 | 2 | .685025 | 018 |
| 3 | .659250 | 028 | 3 | .665862 | 028 | 3 | .672375 | 028 | 3 | .678791 | 027 | 3 | .685114 | 027 |
| 4 | .659346 | 038 | 4 | .665956 | 038 | 4 | .672467 | 037 | 4 | .678882 | 036 | 4 | .685204 | 036 |
| 5 | .659441 | 047 | 5 | .666050 | 047 | 5 | .672560 | 046 | 5 | .678973 | 045 | 5 | .685294 | 045 |
| 6 | .659536 | 057 | 6 | .666143 | 056 | 6 | .672652 | 055 | 6 | .679064 | 055 | 6 | .685383 | 054 |
| 7 | .659631 | 067 | 7 | .666237 | 066 | 7 | .672744 | 064 | 7 | .679155 | 064 | 7 | .685473 | 063 |
| 8 | .659726 | 076 | 8 | .666331 | 075 | 8 | .672836 | 074 | 8 | .679246 | 073 | 8 | .685563 | 072 |
| 9 | .659821 | 086 | 9 | .666424 | 085 | 9 | .672929 | 083 | 9 | .679337 | 082 | 9 | .685652 | 081 |

Log. .685742 to .715920 No. 4850 to 5199. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4850 | .685742 | 00 | 4920 | .691965 | 00 | 4990 | .698100 | 00 | 5060 | .704150 | 00 | 5130 | .710117 | 00 |
| 1 | .685831 | 09 | 1 | .692053 | 09 | 1 | .698188 | 09 | 1 | .704236 | 09 | 1 | .710202 | 08 |
| 2 | .685921 | 18 | 2 | .692142 | 18 | 2 | .698275 | 17 | 2 | .704322 | 17 | 2 | .710287 | 17 |
| 3 | .686010 | 27 | 3 | .692230 | 27 | 3 | .698362 | 26 | 3 | .704408 | 26 | 3 | .710371 | 25 |
| 4 | .686100 | 36 | 4 | .692318 | 35 | 4 | .698448 | 35 | 4 | .704494 | 34 | 4 | .710456 | 34 |
| 5 | .686189 | 45 | 5 | .692406 | 44 | 5 | .698535 | 44 | 5 | .704579 | 43 | 5 | .710540 | 42 |
| 6 | .686279 | 54 | 6 | .692494 | 53 | 6 | .698622 | 52 | 6 | .704665 | 52 | 6 | .710625 | 51 |
| 7 | .686368 | 63 | 7 | .692583 | 62 | 7 | .698709 | 61 | 7 | .704751 | 60 | 7 | .710710 | 59 |
| 8 | .686457 | 72 | 8 | .692671 | 71 | 8 | .698796 | 70 | 8 | .704837 | 69 | 8 | .710794 | 68 |
| 9 | .686547 | 81 | 9 | .692759 | 80 | 9 | .698883 | 79 | 9 | .704922 | 77 | 9 | .710879 | 76 |
| 4860 | .686636 | 00 | 4930 | .692847 | 00 | 5000 | .698970 | 00 | 5070 | .705008 | 00 | 5140 | .710963 | 00 |
| 1 | .686726 | 09 | 1 | .692935 | 09 | 1 | .699057 | 09 | 1 | .705094 | 09 | 1 | .711048 | 08 |
| 2 | .686815 | 18 | 2 | .693023 | 18 | 2 | .699144 | 17 | 2 | .705179 | 17 | 2 | .711132 | 17 |
| 3 | .686904 | 27 | 3 | .693111 | 26 | 3 | .699230 | 26 | 3 | .705265 | 26 | 3 | .711216 | 25 |
| 4 | .686994 | 36 | 4 | .693199 | 35 | 4 | .699317 | 35 | 4 | .705350 | 34 | 4 | .711301 | 34 |
| 5 | .687083 | 45 | 5 | .693287 | 44 | 5 | .699404 | 43 | 5 | .705436 | 43 | 5 | .711385 | 42 |
| 6 | .687172 | 54 | 6 | .693375 | 53 | 6 | .699491 | 52 | 6 | .705522 | 52 | 6 | .711470 | 51 |
| 7 | .687261 | 63 | 7 | .693463 | 62 | 7 | .699578 | 61 | 7 | .705607 | 60 | 7 | .711554 | 59 |
| 8 | .687351 | 72 | 8 | .693551 | 70 | 8 | .699664 | 70 | 8 | .705693 | 69 | 8 | .711638 | 68 |
| 9 | .687440 | 81 | 9 | .693639 | 79 | 9 | .699751 | 78 | 9 | .705778 | 77 | 9 | .711723 | 76 |
| 4870 | .687529 | 00 | 4940 | .693727 | 00 | 5010 | .699838 | 00 | 5080 | .705864 | 00 | 5150 | .711807 | 00 |
| 1 | .687618 | 09 | 1 | .693815 | 09 | 1 | .699924 | 09 | 1 | .705949 | 09 | 1 | .711891 | 08 |
| 2 | .687707 | 18 | 2 | .693903 | 18 | 2 | .700011 | 17 | 2 | .706035 | 17 | 2 | .711976 | 17 |
| 3 | .687796 | 27 | 3 | .693991 | 26 | 3 | .700098 | 26 | 3 | .706120 | 26 | 3 | .712060 | 25 |
| 4 | .687885 | 36 | 4 | .694078 | 35 | 4 | .700184 | 35 | 4 | .706205 | 34 | 4 | .712144 | 34 |
| 5 | .687975 | 45 | 5 | .694166 | 44 | 5 | .700271 | 43 | 5 | .706291 | 43 | 5 | .712229 | 42 |
| 6 | .688064 | 54 | 6 | .694254 | 53 | 6 | .700357 | 52 | 6 | .706376 | 51 | 6 | .712313 | 51 |
| 7 | .688153 | 62 | 7 | .694342 | 62 | 7 | .700444 | 61 | 7 | .706462 | 60 | 7 | .712397 | 59 |
| 8 | .688242 | 72 | 8 | .694430 | 70 | 8 | .700531 | 70 | 8 | .706547 | 68 | 8 | .712481 | 68 |
| 9 | .688331 | 80 | 9 | .694517 | 79 | 9 | .700617 | 78 | 9 | .706632 | 77 | 9 | .712565 | 76 |
| 4880 | .688420 | 00 | 4950 | .694605 | 00 | 5020 | .700704 | 00 | 5090 | .706718 | 00 | 5160 | .712650 | 00 |
| 1 | .688509 | 09 | 1 | .694693 | 09 | 1 | .700790 | 09 | 1 | .706803 | 09 | 1 | .712734 | 08 |
| 2 | .688598 | 18 | 2 | .694781 | 18 | 2 | .700877 | 17 | 2 | .706888 | 17 | 2 | .712818 | 17 |
| 3 | .688687 | 27 | 3 | .694868 | 26 | 3 | .700963 | 26 | 3 | .706974 | 26 | 3 | .712902 | 25 |
| 4 | .688776 | 36 | 4 | .694956 | 35 | 4 | .701050 | 35 | 4 | .707059 | 34 | 4 | .712986 | 34 |
| 5 | .688865 | 45 | 5 | .695044 | 44 | 5 | .701136 | 43 | 5 | .707144 | 43 | 5 | .713070 | 42 |
| 6 | .688953 | 54 | 6 | .695131 | 53 | 6 | .701222 | 52 | 6 | .707229 | 51 | 6 | .713154 | 50 |
| 7 | .689042 | 62 | 7 | .695219 | 62 | 7 | .701309 | 61 | 7 | .707315 | 60 | 7 | .713238 | 59 |
| 8 | .689131 | 72 | 8 | .695306 | 70 | 8 | .701395 | 70 | 8 | .707400 | 68 | 8 | .713322 | 67 |
| 9 | .689220 | 80 | 9 | .695394 | 79 | 9 | .701482 | 78 | 9 | .707485 | 77 | 9 | .713406 | 76 |
| 4890 | .689309 | 00 | 4960 | .695482 | 00 | 5030 | .701568 | 00 | 5100 | .707570 | 00 | 5170 | .713490 | 00 |
| 1 | .689398 | 09 | 1 | .695569 | 09 | 1 | .701654 | 09 | 1 | .707655 | 09 | 1 | .713574 | 08 |
| 2 | .689486 | 18 | 2 | .695657 | 17 | 2 | .701741 | 17 | 2 | .707740 | 17 | 2 | .713658 | 17 |
| 3 | .689575 | 27 | 3 | .695744 | 26 | 3 | .701827 | 26 | 3 | .707826 | 26 | 3 | .713742 | 25 |
| 4 | .689664 | 36 | 4 | .695832 | 35 | 4 | .701913 | 35 | 4 | .707911 | 34 | 4 | .713826 | 34 |
| 5 | .689753 | 45 | 5 | .695919 | 44 | 5 | .701999 | 43 | 5 | .707996 | 43 | 5 | .713910 | 42 |
| 6 | .689841 | 54 | 6 | .696007 | 52 | 6 | .702086 | 52 | 6 | .708081 | 51 | 6 | .713994 | 50 |
| 7 | .689930 | 62 | 7 | .696094 | 61 | 7 | .702172 | 61 | 7 | .708166 | 60 | 7 | .714078 | 59 |
| 8 | .690019 | 72 | 8 | .696182 | 70 | 8 | .702258 | 70 | 8 | .708251 | 68 | 8 | .714162 | 67 |
| 9 | .690107 | 80 | 9 | .696269 | 79 | 9 | .702344 | 78 | 9 | .708336 | 77 | 9 | .714246 | 76 |
| 4900 | .690196 | 00 | 4970 | .696356 | 00 | 5040 | .702430 | 00 | 5110 | .708421 | 00 | 5180 | .714330 | 00 |
| 1 | .690285 | 09 | 1 | .696444 | 09 | 1 | .702517 | 09 | 1 | .708506 | 09 | 1 | .714414 | 08 |
| 2 | .690373 | 18 | 2 | .696531 | 17 | 2 | .702603 | 17 | 2 | .708591 | 17 | 2 | .714497 | 17 |
| 3 | .690462 | 27 | 3 | .696618 | 26 | 3 | .702689 | 26 | 3 | .708676 | 26 | 3 | .714581 | 25 |
| 4 | .690550 | 35 | 4 | .696706 | 35 | 4 | .702775 | 34 | 4 | .708761 | 34 | 4 | .714665 | 34 |
| 5 | .690639 | 44 | 5 | .696793 | 44 | 5 | .702861 | 43 | 5 | .708846 | 43 | 5 | .714749 | 42 |
| 6 | .690727 | 53 | 6 | .696880 | 52 | 6 | .702947 | 52 | 6 | .708931 | 51 | 6 | .714832 | 50 |
| 7 | .690816 | 62 | 7 | .696968 | 61 | 7 | .703033 | 60 | 7 | .709015 | 60 | 7 | .714916 | 59 |
| 8 | .690905 | 71 | 8 | .697055 | 70 | 8 | .703119 | 69 | 8 | .709100 | 68 | 8 | .715000 | 67 |
| 9 | .690993 | 80 | 9 | .697142 | 79 | 9 | .703205 | 77 | 9 | .709185 | 77 | 9 | .715084 | 76 |
| 4910 | .691081 | 00 | 4980 | .697229 | 00 | 5050 | .703291 | 00 | 5120 | .709270 | 00 | 5190 | .715167 | 00 |
| 1 | .691170 | 09 | 1 | .697316 | 09 | 1 | .703377 | 09 | 1 | .709355 | 08 | 1 | .715251 | 08 |
| 2 | .691258 | 18 | 2 | .697404 | 17 | 2 | .703463 | 17 | 2 | .709440 | 17 | 2 | .715335 | 17 |
| 3 | .691347 | 27 | 3 | .697491 | 26 | 3 | .703549 | 26 | 3 | .709524 | 25 | 3 | .715418 | 25 |
| 4 | .691435 | 35 | 4 | .697578 | 35 | 4 | .703635 | 34 | 4 | .709609 | 34 | 4 | .715502 | 34 |
| 5 | .691523 | 44 | 5 | .697665 | 44 | 5 | .703721 | 43 | 5 | .709694 | 42 | 5 | .715586 | 42 |
| 6 | .691612 | 53 | 6 | .697752 | 52 | 6 | .703807 | 52 | 6 | .709779 | 51 | 6 | .715669 | 50 |
| 7 | .691700 | 62 | 7 | .697839 | 61 | 7 | .703893 | 60 | 7 | .709863 | 59 | 7 | .715753 | 59 |
| 8 | .691788 | 71 | 8 | .697926 | 70 | 8 | .703979 | 69 | 8 | .709948 | 68 | 8 | .715836 | 67 |
| 9 | .691877 | 80 | 9 | .698013 | 79 | 9 | .704065 | 77 | 9 | .710033 | 76 | 9 | .715920 | 76 |

Log. .716003 to .744215 No. 5200 to 5549. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5200 | .716003 | 00 | 5270 | .721811 | 00 | 5340 | .727541 | 00 | 5410 | .733197 | 00 | 5480 | .738781 | 00 |
| 1 | .716087 | 08 | 1 | .721893 | 08 | 1 | .727623 | 08 | 1 | .733277 | 08 | 1 | .738860 | 08 |
| 2 | .716170 | 17 | 2 | .721975 | 16 | 2 | .727704 | 16 | 2 | .733358 | 16 | 2 | .738939 | 16 |
| 3 | .716254 | 25 | 3 | .722058 | 25 | 3 | .727785 | 24 | 3 | .733438 | 24 | 3 | .739018 | 24 |
| 4 | .716337 | 34 | 4 | .722140 | 33 | 4 | .727866 | 33 | 4 | .733518 | 32 | 4 | .739097 | 32 |
| 5 | .716421 | 42 | 5 | .722222 | 41 | 5 | .727948 | 41 | 5 | .733598 | 40 | 5 | .739177 | 40 |
| 6 | .716504 | 50 | 6 | .722305 | 49 | 6 | .728029 | 49 | 6 | .733679 | 48 | 6 | .739256 | 47 |
| 7 | .716588 | 59 | 7 | .722387 | 58 | 7 | .728110 | 57 | 7 | .733759 | 56 | 7 | .739335 | 55 |
| 8 | .716671 | 67 | 8 | .722469 | 66 | 8 | .728191 | 65 | 8 | .733839 | 64 | 8 | .739414 | 63 |
| 9 | .716754 | 76 | 9 | .722552 | 74 | 9 | .728273 | 73 | 9 | .733919 | 72 | 9 | .739493 | 71 |
| 5210 | .716838 | 00 | 5280 | .722634 | 00 | 5350 | .728354 | 00 | 5420 | .733999 | 00 | 5490 | .739572 | 00 |
| 1 | .716921 | 08 | 1 | .722716 | 08 | 1 | .728435 | 08 | 1 | .734079 | 08 | 1 | .739651 | 08 |
| 2 | .717004 | 17 | 2 | .722798 | 16 | 2 | .728516 | 16 | 2 | .734159 | 16 | 2 | .739730 | 16 |
| 3 | .717088 | 25 | 3 | .722881 | 25 | 3 | .728597 | 24 | 3 | .734240 | 24 | 3 | .739810 | 24 |
| 4 | .717171 | 33 | 4 | .722963 | 33 | 4 | .728678 | 33 | 4 | .734320 | 32 | 4 | .739889 | 32 |
| 5 | .717254 | 42 | 5 | .723045 | 41 | 5 | .728759 | 41 | 5 | .734400 | 40 | 5 | .739968 | 40 |
| 6 | .717338 | 50 | 6 | .723127 | 49 | 6 | .728841 | 49 | 6 | .734480 | 48 | 6 | .740047 | 47 |
| 7 | .717421 | 58 | 7 | .723209 | 58 | 7 | .728922 | 57 | 7 | .734560 | 56 | 7 | .740126 | 55 |
| 8 | .717504 | 66 | 8 | .723291 | 66 | 8 | .729003 | 65 | 8 | .734640 | 64 | 8 | .740205 | 63 |
| 9 | .717587 | 75 | 9 | .723374 | 74 | 9 | .729084 | 73 | 9 | .734720 | 72 | 9 | .740284 | 71 |
| 5220 | .717670 | 00 | 5290 | .723456 | 00 | 5360 | .729165 | 00 | 5430 | .734800 | 00 | 5500 | .740363 | 00 |
| 1 | .717754 | 08 | 1 | .723538 | 08 | 1 | .729246 | 08 | 1 | .734880 | 08 | 1 | .740442 | 08 |
| 2 | .717837 | 17 | 2 | .723620 | 16 | 2 | .729327 | 16 | 2 | .734960 | 16 | 2 | .740521 | 16 |
| 3 | .717920 | 25 | 3 | .723702 | 25 | 3 | .729408 | 24 | 3 | .735040 | 24 | 3 | .740599 | 24 |
| 4 | .718003 | 33 | 4 | .723784 | 33 | 4 | .729489 | 32 | 4 | .735120 | 32 | 4 | .740678 | 32 |
| 5 | .718086 | 42 | 5 | .723866 | 41 | 5 | .729570 | 41 | 5 | .735200 | 40 | 5 | .740757 | 40 |
| 6 | .718169 | 50 | 6 | .723948 | 49 | 6 | .729651 | 49 | 6 | .735279 | 48 | 6 | .740836 | 47 |
| 7 | .718252 | 58 | 7 | .724030 | 57 | 7 | .729732 | 57 | 7 | .735359 | 56 | 7 | .740915 | 55 |
| 8 | .718336 | 66 | 8 | .724112 | 66 | 8 | .729812 | 65 | 8 | .735439 | 64 | 8 | .740994 | 63 |
| 9 | .718419 | 75 | 9 | .724194 | 74 | 9 | .729893 | 73 | 9 | .735519 | 72 | 9 | .741073 | 71 |
| 5230 | .718502 | 00 | 5300 | .724276 | 00 | 5370 | .729974 | 00 | 5440 | .735599 | 00 | 5510 | .741152 | 00 |
| 1 | .718585 | 08 | 1 | .724358 | 08 | 1 | .730055 | 08 | 1 | .735679 | 08 | 1 | .741230 | 08 |
| 2 | .718668 | 17 | 2 | .724440 | 16 | 2 | .730136 | 16 | 2 | .735758 | 16 | 2 | .741309 | 16 |
| 3 | .718751 | 25 | 3 | .724522 | 25 | 3 | .730217 | 24 | 3 | .735838 | 24 | 3 | .741388 | 24 |
| 4 | .718834 | 33 | 4 | .724603 | 33 | 4 | .730298 | 32 | 4 | .735918 | 32 | 4 | .741467 | 32 |
| 5 | .718917 | 42 | 5 | .724685 | 41 | 5 | .730378 | 40 | 5 | .735998 | 40 | 5 | .741545 | 40 |
| 6 | .719000 | 50 | 6 | .724767 | 49 | 6 | .730459 | 49 | 6 | .736078 | 48 | 6 | .741624 | 47 |
| 7 | .719083 | 58 | 7 | .724849 | 57 | 7 | .730540 | 57 | 7 | .736157 | 56 | 7 | .741703 | 55 |
| 8 | .719165 | 66 | 8 | .724931 | 66 | 8 | .730621 | 65 | 8 | .736237 | 64 | 8 | .741782 | 63 |
| 9 | .719248 | 75 | 9 | .725013 | 74 | 9 | .730701 | 73 | 9 | .736317 | 72 | 9 | .741860 | 71 |
| 5240 | .719331 | 00 | 5310 | .725094 | 00 | 5380 | .730782 | 00 | 5450 | .736396 | 00 | 5520 | .741939 | 00 |
| 1 | .719414 | 08 | 1 | .725176 | 08 | 1 | .730863 | 08 | 1 | .736476 | 08 | 1 | .742018 | 08 |
| 2 | .719497 | 17 | 2 | .725258 | 16 | 2 | .730944 | 16 | 2 | .736556 | 16 | 2 | .742096 | 16 |
| 3 | .719580 | 25 | 3 | .725340 | 25 | 3 | .731024 | 24 | 3 | .736635 | 24 | 3 | .742175 | 23 |
| 4 | .719663 | 33 | 4 | .725422 | 33 | 4 | .731105 | 32 | 4 | .736715 | 32 | 4 | .742254 | 31 |
| 5 | .719745 | 41 | 5 | .725503 | 41 | 5 | .731186 | 40 | 5 | .736795 | 40 | 5 | .742332 | 39 |
| 6 | .719828 | 50 | 6 | .725585 | 49 | 6 | .731266 | 49 | 6 | .736874 | 48 | 6 | .742411 | 47 |
| 7 | .719911 | 58 | 7 | .725667 | 57 | 7 | .731347 | 57 | 7 | .736954 | 56 | 7 | .742489 | 55 |
| 8 | .719994 | 66 | 8 | .725748 | 66 | 8 | .731428 | 65 | 8 | .737033 | 64 | 8 | .742568 | 63 |
| 9 | .720077 | 75 | 9 | .725830 | 74 | 9 | .731508 | 73 | 9 | .737113 | 72 | 9 | .742647 | 71 |
| 5250 | .720159 | 00 | 5320 | .725912 | 00 | 5390 | .731589 | 00 | 5460 | .737193 | 00 | 5530 | .742725 | 00 |
| 1 | .720242 | 08 | 1 | .725993 | 08 | 1 | .731669 | 08 | 1 | .737272 | 08 | 1 | .742804 | 08 |
| 2 | .720325 | 17 | 2 | .726075 | 16 | 2 | .731750 | 16 | 2 | .737352 | 16 | 2 | .742882 | 16 |
| 3 | .720407 | 25 | 3 | .726156 | 24 | 3 | .731830 | 24 | 3 | .737431 | 24 | 3 | .742961 | 23 |
| 4 | .720490 | 33 | 4 | .726238 | 33 | 4 | 731911 | 32 | 4 | .737511 | 32 | 4 | .743039 | 31 |
| 5 | .720573 | 41 | 5 | .726320 | 41 | 5 | .731991 | 40 | 5 | .737590 | 40 | 5 | .743118 | 39 |
| 6 | .720655 | 50 | 6 | .726401 | 49 | 6 | .732072 | 48 | 6 | .737670 | 48 | 6 | .743196 | 47 |
| 7 | .720738 | 58 | 7 | .726483 | 57 | 7 | .732152 | 56 | 7 | .737749 | 56 | 7 | .743274 | 55 |
| 8 | .720821 | 66 | 8 | .726564 | 65 | 8 | .732233 | 64 | 8 | .737828 | 64 | 8 | .743353 | 63 |
| 9 | .720903 | 75 | 9 | .726646 | 73 | 9 | .732313 | 72 | 9 | .737908 | 72 | 9 | .743431 | 71 |
| 5260 | .720986 | 00 | 5330 | .726727 | 00 | 5400 | .732394 | 00 | 5470 | .737987 | 00 | 5540 | .743510 | 00 |
| 1 | .721068 | 08 | 1 | .726809 | 08 | 1 | .732474 | 08 | 1 | .738067 | 08 | 1 | .743588 | 08 |
| 2 | .721151 | 16 | 2 | .726890 | 16 | 2 | .732555 | 16 | 2 | .738146 | 16 | 2 | .743666 | 16 |
| 3 | .721233 | 25 | 3 | .726972 | 24 | 3 | .732635 | 24 | 3 | .738225 | 24 | 3 | .743745 | 23 |
| 4 | .721316 | 33 | 4 | .727053 | 33 | 4 | .732715 | 32 | 4 | .738305 | 32 | 4 | .743823 | 31 |
| 5 | .721398 | 41 | 5 | .727134 | 41 | 5 | .732796 | 40 | 5 | .738384 | 40 | 5 | .743902 | 39 |
| 6 | .721481 | 49 | 6 | .727216 | 49 | 6 | .732876 | 48 | 6 | .738463 | 48 | 6 | .743980 | 47 |
| 7 | .721563 | 58 | 7 | .727297 | 57 | 7 | .732956 | 56 | 7 | .738543 | 56 | 7 | .744058 | 55 |
| 8 | .721646 | 66 | 8 | .727379 | 65 | 8 | .733037 | 64 | 8 | .738622 | 64 | 8 | .744136 | 63 |
| 9 | .721728 | 74 | 9 | .727460 | 73 | 9 | .733117 | 72 | 9 | .738701 | 72 | 9 | .744215 | 71 |

Log. .744293 to .770778 No. 5550 to 5899. (u.)

| No. | Log. | Part | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Par |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5550 | .744293 | 00 | 5620 | .749736 | 00 | 5690 | .755112 | 00 | 5760 | .760422 | 00 | 5830 | .765669 | 00 |
| 1 | .744371 | 08 | 1 | .749814 | 08 | 1 | .755189 | 08 | 1 | .760498 | 08 | 1 | .765743 | 07 |
| 2 | .744449 | 16 | 2 | .749891 | 16 | 2 | .755265 | 15 | 2 | .760573 | 15 | 2 | .765817 | 15 |
| 3 | .744528 | 23 | 3 | .749968 | 23 | 3 | .755341 | 23 | 3 | .760649 | 23 | 3 | .765892 | 22 |
| 4 | .744606 | 31 | 4 | .750045 | 31 | 4 | .755417 | 30 | 4 | .760724 | 30 | 4 | .765966 | 30 |
| 5 | .744684 | 39 | 5 | .750122 | 39 | 5 | .755494 | 38 | 5 | .760799 | 38 | 5 | .766041 | 37 |
| 6 | .744762 | 47 | 6 | .750200 | 47 | 6 | .755570 | 46 | 6 | .760875 | 45 | 6 | .766115 | 45 |
| 7 | .744840 | 55 | 7 | .750277 | 54 | 7 | .755646 | 53 | 7 | .760950 | 53 | 7 | .766190 | 52 |
| 8 | .744918 | 63 | 8 | .750354 | 62 | 8 | .755722 | 61 | 8 | .761025 | 60 | 8 | .766264 | 60 |
| 9 | .744997 | 71 | 9 | .750431 | 70 | 9 | .755799 | 69 | 9 | .761100 | 68 | 9 | .766338 | 67 |
| 5560 | .745075 | 00 | 5630 | .750508 | 00 | 5700 | .755875 | 00 | 5770 | .761176 | 00 | 5840 | .766413 | 00 |
| 1 | .745153 | 08 | 1 | .750585 | 08 | 1 | .755951 | 08 | 1 | .761251 | 08 | 1 | .766487 | 07 |
| 2 | .745231 | 16 | 2 | .750663 | 16 | 2 | .756027 | 15 | 2 | .761326 | 15 | 2 | .766562 | 15 |
| 3 | .745309 | 23 | 3 | .750740 | 23 | 3 | .756103 | 23 | 3 | .761402 | 23 | 3 | .766636 | 22 |
| 4 | .745387 | 31 | 4 | .750817 | 31 | 4 | .756179 | 30 | 4 | .761477 | 30 | 4 | .766710 | 30 |
| 5 | .745465 | 39 | 5 | .750894 | 39 | 5 | .756256 | 38 | 5 | .761552 | 38 | 5 | .766784 | 37 |
| 6 | .745543 | 47 | 6 | .750971 | 47 | 6 | .756332 | 46 | 6 | .761627 | 45 | 6 | .766859 | 45 |
| 7 | .745621 | 55 | 7 | .751048 | 54 | 7 | .756408 | 53 | 7 | .761702 | 53 | 7 | .766933 | 52 |
| 8 | .745699 | 62 | 8 | .751125 | 62 | 8 | .756484 | 61 | 8 | .761777 | 60 | 8 | .767007 | 60 |
| 9 | .745777 | 70 | 9 | .751202 | 70 | 9 | .756560 | 69 | 9 | .761853 | 68 | 9 | .767082 | 67 |
| 5570 | .745855 | 00 | 5640 | .751279 | 00 | 5710 | .756636 | 00 | 5780 | .761928 | 00 | 5850 | .767156 | 00 |
| 1 | .745933 | 08 | 1 | .751356 | 08 | 1 | .756712 | 08 | 1 | .762003 | 08 | 1 | .767230 | 07 |
| 2 | .746011 | 16 | 2 | .751433 | 15 | 2 | .756788 | 15 | 2 | .762078 | 15 | 2 | .767304 | 15 |
| 3 | .746089 | 23 | 3 | .751510 | 23 | 3 | .756864 | 23 | 3 | .762153 | 22 | 3 | .767378 | 22 |
| 4 | .746167 | 31 | 4 | .751587 | 30 | 4 | .756940 | 30 | 4 | .762228 | 30 | 4 | .767453 | 30 |
| 5 | .746245 | 39 | 5 | .751664 | 38 | 5 | .757016 | 38 | 5 | .762303 | 38 | 5 | .767527 | 37 |
| 6 | .746323 | 47 | 6 | .751741 | 46 | 6 | .757092 | 46 | 6 | .762378 | 45 | 6 | .767601 | 45 |
| 7 | .746401 | 55 | 7 | .751818 | 54 | 7 | .757168 | 53 | 7 | .762453 | 52 | 7 | .767675 | 52 |
| 8 | .746478 | 62 | 8 | .751895 | 62 | 8 | .757244 | 61 | 8 | .762528 | 60 | 8 | .767749 | 59 |
| 9 | .746556 | 70 | 9 | .751972 | 70 | 9 | .757320 | 69 | 9 | .762603 | 68 | 9 | .767823 | 67 |
| 5580 | .746634 | 00 | 5650 | .752048 | 00 | 5720 | .757396 | 00 | 5790 | .762679 | 00 | 5860 | .767898 | 00 |
| 1 | .746712 | 08 | 1 | .752125 | 08 | 1 | .757472 | 08 | 1 | .762754 | 08 | 1 | .767972 | 07 |
| 2 | .746790 | 16 | 2 | .752202 | 15 | 2 | .757548 | 15 | 2 | .762829 | 15 | 2 | .768046 | 15 |
| 3 | .746868 | 23 | 3 | .752279 | 23 | 3 | .757624 | 23 | 3 | .762903 | 22 | 3 | .768120 | 22 |
| 4 | .746945 | 31 | 4 | .752356 | 30 | 4 | .757700 | 30 | 4 | .762978 | 30 | 4 | .768194 | 30 |
| 5 | .747023 | 39 | 5 | .752433 | 38 | 5 | .757775 | 38 | 5 | .763053 | 38 | 5 | .768268 | 37 |
| 6 | .747101 | 47 | 6 | .752509 | 46 | 6 | .757851 | 46 | 6 | .763128 | 45 | 6 | .768342 | 45 |
| 7 | .747179 | 55 | 7 | .752586 | 54 | 7 | .757927 | 53 | 7 | .763203 | 52 | 7 | .768416 | 52 |
| 8 | .747256 | 62 | 8 | .752663 | 62 | 8 | .758003 | 61 | 8 | .763278 | 60 | 8 | .768490 | 59 |
| 9 | .747334 | 70 | 9 | .752740 | 70 | 9 | .758079 | 68 | 9 | .763353 | 68 | 9 | .768564 | 67 |
| 5590 | .747412 | 00 | 5660 | .752816 | 00 | 5730 | .758155 | 00 | 5800 | .763428 | 00 | 5870 | .768638 | 00 |
| 1 | .747489 | 08 | 1 | .752893 | 08 | 1 | .758230 | 08 | 1 | .763503 | 07 | 1 | .768712 | 07 |
| 2 | .747567 | 16 | 2 | .752970 | 15 | 2 | .758306 | 15 | 2 | .763578 | 15 | 2 | .768786 | 15 |
| 3 | .747645 | 23 | 3 | .753047 | 23 | 3 | .758382 | 23 | 3 | .763653 | 22 | 3 | .768860 | 22 |
| 4 | .747722 | 31 | 4 | .753123 | 30 | 4 | .758458 | 30 | 4 | .763727 | 30 | 4 | .768934 | 30 |
| 5 | .747800 | 39 | 5 | .753200 | 38 | 5 | .758533 | 38 | 5 | .763802 | 37 | 5 | .769008 | 37 |
| 6 | .747878 | 47 | 6 | .753277 | 46 | 6 | .758609 | 46 | 6 | .763877 | 45 | 6 | .769082 | 45 |
| 7 | .747955 | 54 | 7 | .753353 | 54 | 7 | .758685 | 53 | 7 | .763952 | 52 | 7 | .769156 | 52 |
| 8 | .748033 | 62 | 8 | .753430 | 62 | 8 | .758760 | 61 | 8 | .764027 | 60 | 8 | .769230 | 59 |
| 9 | .748110 | 70 | 9 | .753506 | 70 | 9 | .758836 | 68 | 9 | .764101 | 67 | 9 | .769303 | 67 |
| 5600 | .748188 | 00 | 5670 | .753583 | 00 | 5740 | .758912 | 00 | 5810 | .764176 | 00 | 5880 | .769377 | 00 |
| 1 | .748266 | 08 | 1 | .753660 | 08 | 1 | .758987 | 08 | 1 | .764251 | 07 | 1 | .769451 | 07 |
| 2 | .748343 | 16 | 2 | .753736 | 15 | 2 | .759063 | 15 | 2 | .764326 | 15 | 2 | .769525 | 15 |
| 3 | .748421 | 23 | 3 | .753813 | 23 | 3 | .759139 | 23 | 3 | .764400 | 22 | 3 | .769599 | 22 |
| 4 | .748498 | 31 | 4 | .753889 | 30 | 4 | .759214 | 30 | 4 | .764475 | 30 | 4 | .769673 | 30 |
| 5 | .748576 | 39 | 5 | .753966 | 38 | 5 | .759290 | 38 | 5 | .764550 | 37 | 5 | .769746 | 37 |
| 6 | .748653 | 47 | 6 | .754042 | 46 | 6 | .759366 | 45 | 6 | .764624 | 45 | 6 | .769820 | 45 |
| 7 | .748731 | 54 | 7 | .754119 | 54 | 7 | .759441 | 53 | 7 | .764699 | 52 | 7 | .769894 | 52 |
| 8 | .748808 | 62 | 8 | .754195 | 62 | 8 | .759517 | 60 | 8 | .764774 | 60 | 8 | .769968 | 59 |
| 9 | .748885 | 70 | 9 | .754272 | 70 | 9 | .759592 | 68 | 9 | .764848 | 67 | 9 | .770042 | 67 |
| 5610 | .748963 | 00 | 5680 | .754348 | 00 | 5750 | .759668 | 00 | 5820 | .764923 | 00 | 5890 | .770115 | 00 |
| 1 | .749040 | 08 | 1 | .754425 | 08 | 1 | .759743 | 08 | 1 | .764998 | 07 | 1 | .770189 | 07 |
| 2 | .749118 | 16 | 2 | .754501 | 15 | 2 | .759819 | 15 | 2 | .765072 | 15 | 2 | .770263 | 15 |
| 3 | .749195 | 23 | 3 | .754578 | 23 | 3 | .759894 | 23 | 3 | .765147 | 22 | 3 | .770336 | 22 |
| 4 | .749272 | 31 | 4 | .754654 | 30 | 4 | .759970 | 30 | 4 | .765221 | 30 | 4 | .770410 | 30 |
| 5 | .749350 | 39 | 5 | .754730 | 38 | 5 | .760045 | 38 | 5 | .765296 | 37 | 5 | .770484 | 37 |
| 6 | .749427 | 47 | 6 | .754807 | 46 | 6 | .760121 | 45 | 6 | .765370 | 45 | 6 | .770557 | 45 |
| 7 | .749504 | 54 | 7 | .754883 | 53 | 7 | .760196 | 53 | 7 | .765445 | 52 | 7 | .770631 | 52 |
| 8 | .749582 | 62 | 8 | .754960 | 61 | 8 | .760272 | 60 | 8 | .765519 | 60 | 8 | .770705 | 59 |
| 9 | .749659 | 70 | 9 | .755036 | 69 | 9 | .760347 | 68 | 9 | .765594 | 67 | 9 | .770778 | 67 |

Log. .770852 to .795810 No. 5900 to 6249. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5900 | .770852 | 00 | 5970 | .775974 | 00 | 6040 | .781037 | 00 | 6110 | .786041 | 00 | 6180 | .790988 | 00 |
| 1 | .770926 | 07 | 1 | .776047 | 07 | 1 | .781109 | 07 | 1 | .786112 | 07 | 1 | .791059 | 07 |
| 2 | .770999 | 15 | 2 | .776120 | 15 | 2 | .781181 | 14 | 2 | .786183 | 14 | 2 | .791129 | 14 |
| 3 | .771073 | 22 | 3 | .776192 | 22 | 3 | .781253 | 22 | 3 | .786254 | 21 | 3 | .791199 | 21 |
| 4 | .771146 | 30 | 4 | .776265 | 29 | 4 | .781324 | 29 | 4 | .786325 | 28 | 4 | .791269 | 28 |
| 5 | .771220 | 37 | 5 | .776338 | 37 | 5 | .781396 | 36 | 5 | .786396 | 36 | 5 | .791340 | 35 |
| 6 | .771293 | 45 | 6 | .776411 | 44 | 6 | .781468 | 43 | 6 | .786467 | 43 | 6 | .791410 | 42 |
| 7 | .771367 | 52 | 7 | .776483 | 51 | 7 | .781540 | 50 | 7 | .786538 | 50 | 7 | .791480 | 49 |
| 8 | .771440 | 59 | 8 | .776556 | 59 | 8 | .781612 | 58 | 8 | .786609 | 57 | 8 | .791550 | 56 |
| 9 | .771514 | 67 | 9 | .776629 | 66 | 9 | .781684 | 65 | 9 | .786680 | 64 | 9 | .791620 | 63 |
| 5910 | .771587 | 00 | 5980 | .776701 | 00 | 6050 | .781755 | 00 | 6120 | .786751 | 00 | 6190 | .791691 | 00 |
| 1 | .771661 | 07 | 1 | .776774 | 07 | 1 | .781827 | 07 | 1 | .786822 | 07 | 1 | .791761 | 07 |
| 2 | .771734 | 15 | 2 | .776846 | 14 | 2 | .781899 | 14 | 2 | .786893 | 14 | 2 | .791831 | 14 |
| 3 | .771808 | 22 | 3 | .776919 | 22 | 3 | .781971 | 22 | 3 | .786964 | 21 | 3 | .791901 | 21 |
| 4 | .771881 | 30 | 4 | .776992 | 29 | 4 | .782042 | 29 | 4 | .787035 | 28 | 4 | .791971 | 28 |
| 5 | .771955 | 37 | 5 | .777064 | 36 | 5 | .782114 | 36 | 5 | .787106 | 36 | 5 | .792041 | 35 |
| 6 | .772028 | 44 | 6 | .777137 | 43 | 6 | .782186 | 43 | 6 | .787177 | 43 | 6 | .792111 | 42 |
| 7 | .772102 | 52 | 7 | .777209 | 51 | 7 | .782258 | 50 | 7 | .787248 | 50 | 7 | .792181 | 49 |
| 8 | .772175 | 59 | 8 | .777282 | 58 | 8 | .782329 | 58 | 8 | .787319 | 57 | 8 | .792252 | 56 |
| 9 | .772248 | 67 | 9 | .777354 | 65 | 9 | .782401 | 65 | 9 | .787390 | 64 | 9 | .792322 | 63 |
| 5920 | .772322 | 00 | 5990 | .777427 | 00 | 6060 | .782473 | 00 | 6130 | .787460 | 00 | 6200 | .792392 | 00 |
| 1 | .772395 | 07 | 1 | .777499 | 07 | 1 | .782544 | 07 | 1 | .787531 | 07 | 1 | .792462 | 07 |
| 2 | .772468 | 15 | 2 | .777572 | 14 | 2 | .782616 | 14 | 2 | .787602 | 14 | 2 | .792532 | 14 |
| 3 | .772542 | 22 | 3 | .777644 | 22 | 3 | .782688 | 21 | 3 | .787673 | 21 | 3 | .792602 | 21 |
| 4 | .772615 | 29 | 4 | .777717 | 29 | 4 | .782759 | 29 | 4 | .787744 | 28 | 4 | .792672 | 28 |
| 5 | .772688 | 37 | 5 | .777789 | 36 | 5 | .782831 | 36 | 5 | .787815 | 35 | 5 | .792742 | 35 |
| 6 | .772762 | 44 | 6 | .777862 | 43 | 6 | .782902 | 43 | 6 | .787885 | 42 | 6 | .792812 | 42 |
| 7 | .772835 | 51 | 7 | .777934 | 51 | 7 | .782974 | 50 | 7 | .787956 | 49 | 7 | .792882 | 49 |
| 8 | .772908 | 59 | 8 | .778006 | 58 | 8 | .783046 | 57 | 8 | .788027 | 56 | 8 | .792952 | 56 |
| 9 | .772981 | 66 | 9 | .778079 | 65 | 9 | .783117 | 64 | 9 | .788098 | 63 | 9 | .793022 | 63 |
| 5930 | .773055 | 00 | 6000 | .778151 | 00 | 6070 | .783189 | 00 | 6140 | .788168 | 00 | 6210 | .793092 | 00 |
| 1 | .773128 | 07 | 1 | .778224 | 07 | 1 | .783260 | 07 | 1 | .788239 | 07 | 1 | .793161 | 07 |
| 2 | .773201 | 15 | 2 | .778296 | 14 | 2 | .783332 | 14 | 2 | .788310 | 14 | 2 | .793231 | 14 |
| 3 | .773274 | 22 | 3 | .778368 | 22 | 3 | .783403 | 21 | 3 | .788380 | 21 | 3 | .793301 | 21 |
| 4 | .773347 | 29 | 4 | .778441 | 29 | 4 | .783475 | 29 | 4 | .788451 | 28 | 4 | .793371 | 28 |
| 5 | .773421 | 37 | 5 | .778513 | 36 | 5 | .783546 | 36 | 5 | .788522 | 35 | 5 | .793441 | 35 |
| 6 | .773494 | 44 | 6 | .778585 | 43 | 6 | .783618 | 43 | 6 | .788593 | 42 | 6 | .793511 | 42 |
| 7 | .773567 | 51 | 7 | .778658 | 51 | 7 | .783689 | 50 | 7 | .788663 | 49 | 7 | .793581 | 49 |
| 8 | .773640 | 59 | 8 | .778730 | 58 | 8 | .783761 | 57 | 8 | .788734 | 56 | 8 | .793651 | 56 |
| 9 | .773713 | 66 | 9 | .778802 | 65 | 9 | .783832 | 64 | 9 | .788804 | 63 | 9 | .793721 | 63 |
| 5940 | .773786 | 00 | 6010 | .778874 | 00 | 6080 | .783904 | 00 | 6150 | .788875 | 00 | 6220 | .793790 | 00 |
| 1 | .773860 | 07 | 1 | .778947 | 07 | 1 | .783975 | 07 | 1 | .788946 | 07 | 1 | .793860 | 07 |
| 2 | .773933 | 15 | 2 | .779019 | 14 | 2 | .784046 | 14 | 2 | .789016 | 14 | 2 | .793930 | 14 |
| 3 | .774006 | 22 | 3 | .779091 | 22 | 3 | .784118 | 21 | 3 | .789087 | 21 | 3 | .794000 | 21 |
| 4 | .774079 | 29 | 4 | .779163 | 29 | 4 | .784189 | 29 | 4 | .789157 | 28 | 4 | .794070 | 28 |
| 5 | .774152 | 37 | 5 | .779236 | 36 | 5 | .784261 | 36 | 5 | .789228 | 35 | 5 | .794139 | 35 |
| 6 | .774225 | 44 | 6 | .779308 | 43 | 6 | .784332 | 43 | 6 | .789299 | 42 | 6 | .794209 | 42 |
| 7 | .774298 | 51 | 7 | .779380 | 51 | 7 | .784403 | 50 | 7 | .789369 | 49 | 7 | .794279 | 49 |
| 8 | .774371 | 59 | 8 | .779452 | 58 | 8 | .784475 | 57 | 8 | .789440 | 56 | 8 | .794349 | 56 |
| 9 | .774444 | 66 | 9 | .779524 | 65 | 9 | .784546 | 64 | 9 | .789510 | 63 | 9 | .794418 | 63 |
| 5950 | .774517 | 00 | 6020 | .779596 | 00 | 6090 | .784617 | 00 | 6160 | .789581 | 00 | 6230 | .794488 | 00 |
| 1 | .774590 | 07 | 1 | .779669 | 07 | 1 | .784689 | 07 | 1 | .789651 | 07 | 1 | .794558 | 07 |
| 2 | .774663 | 15 | 2 | .779741 | 14 | 2 | .784760 | 14 | 2 | .789722 | 14 | 2 | .794627 | 14 |
| 3 | .774736 | 22 | 3 | .779813 | 22 | 3 | .784831 | 21 | 3 | .789792 | 21 | 3 | .794697 | 21 |
| 4 | .774809 | 29 | 4 | .779885 | 29 | 4 | .784902 | 29 | 4 | .789863 | 28 | 4 | .794767 | 28 |
| 5 | .774882 | 37 | 5 | .779957 | 36 | 5 | .784974 | 36 | 5 | .789933 | 35 | 5 | .794836 | 35 |
| 6 | .774955 | 44 | 6 | .780029 | 43 | 6 | .785045 | 43 | 6 | .790003 | 42 | 6 | .794906 | 42 |
| 7 | .775028 | 51 | 7 | .780101 | 50 | 7 | .785116 | 50 | 7 | .790074 | 49 | 7 | .794976 | 49 |
| 8 | .775100 | 59 | 8 | .780173 | 58 | 8 | .785187 | 57 | 8 | .790144 | 56 | 8 | .795045 | 56 |
| 9 | .775173 | 66 | 9 | .780245 | 65 | 9 | .785259 | 64 | 9 | .790215 | 63 | 9 | .795115 | 63 |
| 5960 | .775246 | 00 | 6030 | .780317 | 00 | 6100 | .785330 | 00 | 6170 | .790285 | 00 | 6240 | .795185 | 00 |
| 1 | .775319 | 07 | 1 | .780389 | 07 | 1 | .785401 | 07 | 1 | .790355 | 07 | 1 | .795254 | 07 |
| 2 | .775392 | 15 | 2 | .780461 | 14 | 2 | .785472 | 14 | 2 | .790426 | 14 | 2 | .795324 | 14 |
| 3 | .775465 | 22 | 3 | .780533 | 22 | 3 | .785543 | 21 | 3 | .790496 | 21 | 3 | .795393 | 21 |
| 4 | .775538 | 29 | 4 | .780605 | 29 | 4 | .785614 | 28 | 4 | .790567 | 28 | 4 | .795463 | 28 |
| 5 | .775610 | 37 | 5 | .780677 | 36 | 5 | .785686 | 36 | 5 | .790637 | 35 | 5 | .795532 | 35 |
| 6 | .775683 | 44 | 6 | .780749 | 43 | 6 | .785757 | 43 | 6 | .790707 | 42 | 6 | .795602 | 42 |
| 7 | .775756 | 51 | 7 | .780821 | 50 | 7 | .785828 | 50 | 7 | .790778 | 49 | 7 | .79567. | 49 |
| 8 | .775829 | 59 | 8 | .780893 | 58 | 8 | .785899 | 57 | 8 | .790848 | 56 | 8 | .795741 | 56 |
| 9 | .775902 | 66 | 9 | .780965 | 65 | 9 | .785970 | 64 | 9 | .790918 | 63 | 9 | .795810 | 63 |

## Log. .795880 to .819478 No. 6250 to 6599. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6250 | .795880 | 00 | 6320 | .800717 | 60 | 6390 | .805501 | 00 | 6460 | .810232 | 00 | 6530 | .814913 | 00 |
| 1 | .795949 | 07 | 1 | .800786 | 07 | 1 | .805569 | 07 | 1 | .810300 | 07 | 1 | .814980 | 07 |
| 2 | .796019 | 14 | 2 | .800854 | 14 | 2 | .805637 | 14 | 2 | .810367 | 13 | 2 | .815046 | 13 |
| 3 | .796088 | 21 | 3 | .800923 | 21 | 3 | .805705 | 20 | 3 | .810434 | 20 | 3 | .815113 | 20 |
| 4 | .796158 | 28 | 4 | .800992 | 28 | 4 | .805773 | 27 | 4 | .810501 | 27 | 4 | .815179 | 26 |
| 5 | .796227 | 35 | 5 | .801060 | 34 | 5 | .805840 | 34 | 5 | .810568 | 33 | 5 | .815246 | 33 |
| 6 | .796297 | 42 | 6 | .801129 | 41 | 6 | .805908 | 41 | 6 | .810636 | 40 | 6 | .815312 | 40 |
| 7 | .796366 | 49 | 7 | .801198 | 48 | 7 | .805976 | 48 | 7 | .810703 | 47 | 7 | .815378 | 46 |
| 8 | .796436 | 56 | 8 | .801266 | 55 | 8 | .806044 | 54 | 8 | .810770 | 54 | 8 | .815445 | 53 |
| 9 | .796505 | 63 | 9 | .801335 | 62 | 9 | .806112 | 61 | 9 | .810837 | 60 | 9 | .815511 | 60 |
| 6260 | .796574 | 00 | 6330 | .801404 | 00 | 6400 | .806180 | 00 | 6470 | .810904 | 00 | 6540 | .815578 | 00 |
| 1 | .796644 | 07 | 1 | .801472 | 07 | 1 | .806248 | 07 | 1 | .810971 | 07 | 1 | .815644 | 07 |
| 2 | .796713 | 14 | 2 | .801541 | 14 | 2 | .806316 | 14 | 2 | .811038 | 13 | 2 | .815710 | 13 |
| 3 | .796782 | 21 | 3 | .801609 | 21 | 3 | .806383 | 20 | 3 | .811106 | 20 | 3 | .815777 | 20 |
| 4 | .796852 | 27 | 4 | .801678 | 27 | 4 | .806451 | 27 | 4 | .811173 | 27 | 4 | .815843 | 26 |
| 5 | .796921 | 35 | 5 | .801747 | 34 | 5 | .806519 | 34 | 5 | .811240 | 33 | 5 | .815910 | 33 |
| 6 | .796990 | 42 | 6 | .801815 | 41 | 6 | .806587 | 41 | 6 | .811307 | 40 | 6 | .815976 | 40 |
| 7 | .797060 | 49 | 7 | .801884 | 48 | 7 | .806655 | 48 | 7 | .811374 | 47 | 7 | .816042 | 46 |
| 8 | .797129 | 56 | 8 | .801952 | 55 | 8 | .806722 | 54 | 8 | .811441 | 54 | 8 | .816109 | 53 |
| 9 | .797198 | 62 | 9 | .802021 | 62 | 9 | .806790 | 61 | 9 | .811508 | 60 | 9 | .816175 | 60 |
| 6270 | .797267 | 00 | 6340 | .802089 | 60 | 6410 | .806858 | 00 | 6480 | .811575 | 00 | 6550 | .816241 | 00 |
| 1 | .797337 | 07 | 1 | .802158 | 07 | 1 | .806926 | 07 | 1 | .811642 | 07 | 1 | .816308 | 07 |
| 2 | .797406 | 14 | 2 | .802226 | 14 | 2 | .806993 | 14 | 2 | .811709 | 13 | 2 | .816374 | 13 |
| 3 | .797475 | 21 | 3 | .802295 | 21 | 3 | .807061 | 20 | 3 | .811776 | 20 | 3 | .816440 | 20 |
| 4 | .797544 | 27 | 4 | .802363 | 27 | 4 | .807129 | 27 | 4 | .811843 | 27 | 4 | .816506 | 26 |
| 5 | .797614 | 35 | 5 | .802432 | 34 | 5 | .807197 | 34 | 5 | .811910 | 33 | 5 | .816573 | 33 |
| 6 | .797683 | 42 | 6 | .802500 | 41 | 6 | .807264 | 41 | 6 | .811977 | 40 | 6 | .816639 | 40 |
| 7 | .797752 | 49 | 7 | .802568 | 48 | 7 | .807332 | 48 | 7 | .812044 | 47 | 7 | .816705 | 46 |
| 8 | .797821 | 56 | 8 | .802637 | 55 | 8 | .807400 | 54 | 8 | .812111 | 54 | 8 | .816771 | 53 |
| 9 | .797890 | 62 | 9 | .802705 | 62 | 9 | .807467 | 61 | 9 | .812178 | 60 | 9 | .816838 | 60 |
| 6280 | .797960 | 00 | 6350 | .802774 | 00 | 6420 | .807535 | 00 | 6490 | .812245 | 00 | 6560 | .816904 | 00 |
| 1 | .798029 | 07 | 1 | .802842 | 07 | 1 | .807603 | 07 | 1 | .812312 | 07 | 1 | .816970 | 07 |
| 2 | .798098 | 14 | 2 | .802910 | 14 | 2 | .807670 | 14 | 2 | .812378 | 13 | 2 | .817036 | 13 |
| 3 | .798167 | 21 | 3 | .802979 | 21 | 3 | .807738 | 20 | 3 | .812445 | 20 | 3 | .817102 | 20 |
| 4 | .798236 | 28 | 4 | .803047 | 27 | 4 | .807805 | 27 | 4 | .812512 | 27 | 4 | .817169 | 26 |
| 5 | .798305 | 34 | 5 | .803116 | 34 | 5 | .807873 | 34 | 5 | .812579 | 33 | 5 | .817235 | 33 |
| 6 | .798374 | 41 | 6 | .803184 | 41 | 6 | .807941 | 41 | 6 | .812646 | 40 | 6 | .817301 | 40 |
| 7 | .798443 | 48 | 7 | .803252 | 48 | 7 | .808008 | 48 | 7 | .812713 | 47 | 7 | .817367 | 46 |
| 8 | .798512 | 55 | 8 | .803320 | 55 | 8 | .808076 | 54 | 8 | .812780 | 54 | 8 | .817433 | 53 |
| 9 | .798582 | 62 | 9 | .803389 | 62 | 9 | .808143 | 61 | 9 | .812846 | 60 | 9 | .817499 | 59 |
| 6290 | .798651 | 00 | 6360 | .803457 | 00 | 6430 | .808211 | 00 | 6500 | .812913 | 00 | 6570 | .817565 | 00 |
| 1 | .798720 | 07 | 1 | .803525 | 07 | 1 | .808278 | 07 | 1 | .812980 | 07 | 1 | .817631 | 07 |
| 2 | .798789 | 14 | 2 | .803594 | 14 | 2 | .808346 | 14 | 2 | .813047 | 13 | 2 | .817698 | 13 |
| 3 | .798858 | 21 | 3 | .803662 | 21 | 3 | .808414 | 20 | 3 | .813114 | 20 | 3 | .817764 | 20 |
| 4 | .798927 | 28 | 4 | .803730 | 27 | 4 | .808481 | 27 | 4 | .813180 | 27 | 4 | .817830 | 26 |
| 5 | .798996 | 34 | 5 | .803798 | 34 | 5 | .808549 | 34 | 5 | .813247 | 33 | 5 | .817896 | 33 |
| 6 | .799065 | 41 | 6 | .803867 | 41 | 6 | .808616 | 41 | 6 | .813314 | 40 | 6 | .817962 | 40 |
| 7 | .799134 | 48 | 7 | .803935 | 48 | 7 | .808683 | 48 | 7 | .813381 | 47 | 7 | .818028 | 46 |
| 8 | .799203 | 55 | 8 | .804003 | 55 | 8 | .808751 | 54 | 8 | .813447 | 54 | 8 | .818094 | 53 |
| 9 | .799272 | 62 | 9 | .804071 | 62 | 9 | .808818 | 61 | 9 | .813514 | 60 | 9 | .818160 | 59 |
| 6300 | .799340 | 00 | 6370 | .804139 | 00 | 6440 | .808886 | 00 | 6510 | .813581 | 00 | 6580 | .818226 | 00 |
| 1 | .799409 | 07 | 1 | .804208 | 07 | 1 | .808953 | 07 | 1 | .813648 | 07 | 1 | .818292 | 07 |
| 2 | .799478 | 14 | 2 | .804276 | 14 | 2 | .809021 | 13 | 2 | .813714 | 13 | 2 | .818358 | 13 |
| 3 | .799547 | 21 | 3 | .804344 | 21 | 3 | .809088 | 20 | 3 | .813781 | 20 | 3 | .818424 | 20 |
| 4 | .799616 | 28 | 4 | .804412 | 27 | 4 | .809155 | 27 | 4 | .813848 | 27 | 4 | .818490 | 26 |
| 5 | .799685 | 34 | 5 | .804480 | 34 | 5 | .809223 | 34 | 5 | .813914 | 33 | 5 | .818556 | 33 |
| 6 | .799754 | 41 | 6 | .804548 | 41 | 6 | .809290 | 40 | 6 | .813981 | 40 | 6 | .818622 | 40 |
| 7 | .799823 | 48 | 7 | .804616 | 48 | 7 | .809358 | 47 | 7 | .814048 | 47 | 7 | .818688 | 46 |
| 8 | .799892 | 55 | 8 | .804684 | 55 | 8 | .809425 | 54 | 8 | .814114 | 54 | 8 | .818754 | 53 |
| 9 | .799960 | 62 | 9 | .804753 | 62 | 9 | .809492 | 61 | 9 | .814181 | 60 | 9 | .818819 | 59 |
| 6310 | .800029 | 00 | 6380 | .804821 | 00 | 6450 | .809560 | 00 | 6520 | .814248 | 00 | 6590 | .818885 | 00 |
| 1 | .800098 | 07 | 1 | .804889 | 07 | 1 | .809627 | 07 | 1 | .814314 | 07 | 1 | .818951 | 07 |
| 2 | .800167 | 14 | 2 | .804957 | 14 | 2 | .809694 | 13 | 2 | .814381 | 13 | 2 | .819017 | 13 |
| 3 | .800236 | 21 | 3 | .805025 | 20 | 3 | .809762 | 20 | 3 | .814447 | 20 | 3 | .819083 | 20 |
| 4 | .800305 | 28 | 4 | .805093 | 27 | 4 | .809829 | 27 | 4 | .814514 | 26 | 4 | .819149 | 26 |
| 5 | .800373 | 34 | 5 | .805161 | 34 | 5 | .809896 | 34 | 5 | .814580 | 33 | 5 | .819215 | 33 |
| 6 | .800442 | 41 | 6 | .805229 | 41 | 6 | .809963 | 40 | 6 | .814647 | 40 | 6 | .819281 | 40 |
| 7 | .800511 | 48 | 7 | .805297 | 48 | 7 | .810031 | 47 | 7 | .814714 | 46 | 7 | .819346 | 46 |
| 8 | .800580 | 55 | 8 | .805365 | 54 | 8 | .810098 | 54 | 8 | .814780 | 53 | 8 | .819412 | 53 |
| 9 | .800648 | 62 | 9 | .805433 | 61 | 9 | .810165 | 61 | 9 | .814847 | 60 | 9 | .819478 | 59 |

Log. 819544 to .841922 No. 6600 to 6949. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6600 | .819544 | 00 | 6670 | .824126 | 00 | 6740 | .828660 | 00 | 6810 | .833147 | 00 | 6880 | .837588 | 00 |
| 1 | .819610 | 07 | 1 | .824191 | 06 | 1 | .828724 | 06 | 1 | .833211 | 06 | 1 | .837652 | 06 |
| 2 | .819675 | 13 | 2 | .824256 | 13 | 2 | .828789 | 13 | 2 | .833275 | 13 | 2 | .837715 | 13 |
| 3 | .819741 | 20 | 3 | .824321 | 19 | 3 | .828853 | 19 | 3 | .833338 | 19 | 3 | .837778 | 19 |
| 4 | .819807 | 26 | 4 | .824386 | 26 | 4 | .828918 | 26 | 4 | .833402 | 26 | 4 | .837841 | 25 |
| 5 | .819873 | 33 | 5 | .824451 | 32 | 5 | .828982 | 32 | 5 | .833466 | 32 | 5 | .837904 | 32 |
| 6 | .819939 | 40 | 6 | .824516 | 39 | 6 | .829046 | 39 | 6 | .833530 | 38 | 6 | .837967 | 38 |
| 7 | .820004 | 46 | 7 | .824581 | 45 | 7 | .829111 | 45 | 7 | .833593 | 45 | 7 | .838030 | 44 |
| 8 | .820070 | 53 | 8 | .824646 | 52 | 8 | .829175 | 52 | 8 | .833657 | 51 | 8 | .838093 | 50 |
| 9 | .820136 | 59 | 9 | .824711 | 58 | 9 | .829239 | 58 | 9 | .833721 | 58 | 9 | .838156 | 57 |
| 6610 | .820201 | 00 | 6680 | .824776 | 00 | 6750 | .829304 | 00 | 6820 | .833784 | 00 | 6890 | .838219 | 00 |
| 1 | .820267 | 07 | 1 | .824841 | 06 | 1 | .829368 | 06 | 1 | .833848 | 06 | 1 | .838282 | 06 |
| 2 | .820333 | 13 | 2 | .824906 | 13 | 2 | .829432 | 13 | 2 | .833912 | 13 | 2 | .838345 | 13 |
| 3 | .820398 | 20 | 3 | .824971 | 19 | 3 | .829497 | 19 | 3 | .833975 | 19 | 3 | .838408 | 19 |
| 4 | .820464 | 26 | 4 | .825036 | 26 | 4 | .829561 | 26 | 4 | .834039 | 26 | 4 | .838471 | 25 |
| 5 | .820530 | 33 | 5 | .825101 | 32 | 5 | .829625 | 32 | 5 | .834103 | 32 | 5 | .838534 | 32 |
| 6 | .820595 | 40 | 6 | .825166 | 39 | 6 | .829690 | 39 | 6 | .834166 | 38 | 6 | .838597 | 38 |
| 7 | .820661 | 46 | 7 | .825231 | 45 | 7 | .829754 | 45 | 7 | .834230 | 45 | 7 | .838660 | 44 |
| 8 | .820727 | 53 | 8 | .825296 | 52 | 8 | .829818 | 52 | 8 | .834293 | 51 | 8 | .838723 | 50 |
| 9 | .820792 | 59 | 9 | .825361 | 58 | 9 | .829882 | 58 | 9 | .834357 | 58 | 9 | .838786 | 57 |
| 6620 | .820858 | 00 | 6690 | .825426 | 00 | 6760 | .829947 | 00 | 6830 | .834421 | 00 | 6900 | .838849 | 00 |
| 1 | .820924 | 07 | 1 | .825491 | 06 | 1 | .830011 | 06 | 1 | .834484 | 06 | 1 | .838912 | 06 |
| 2 | .820989 | 13 | 2 | .825556 | 13 | 2 | .830075 | 13 | 2 | .834548 | 13 | 2 | .838975 | 13 |
| 3 | .821055 | 20 | 3 | .825621 | 19 | 3 | .830139 | 19 | 3 | .834611 | 19 | 3 | .839038 | 19 |
| 4 | .821120 | 26 | 4 | .825686 | 26 | 4 | .830204 | 26 | 4 | .834675 | 25 | 4 | .839101 | 25 |
| 5 | .821186 | 33 | 5 | .825751 | 32 | 5 | .830268 | 32 | 5 | .834738 | 32 | 5 | .839164 | 31 |
| 6 | .821251 | 40 | 6 | .825815 | 39 | 6 | .830332 | 38 | 6 | .834802 | 38 | 6 | .839227 | 38 |
| 7 | .821317 | 46 | 7 | .825880 | 45 | 7 | .830396 | 45 | 7 | .834866 | 45 | 7 | .839289 | 44 |
| 8 | .821382 | 53 | 8 | .825945 | 52 | 8 | .830460 | 51 | 8 | .834929 | 51 | 8 | .839352 | 50 |
| 9 | .821448 | 59 | 9 | .826010 | 58 | 9 | .830524 | 58 | 9 | .834993 | 58 | 9 | .839415 | 57 |
| 6630 | .821513 | 00 | 6700 | .826075 | 00 | 6770 | .830589 | 00 | 6840 | .835056 | 00 | 6910 | .839478 | 00 |
| 1 | .821579 | 07 | 1 | .826140 | 06 | 1 | .830653 | 06 | 1 | .835120 | 06 | 1 | .839541 | 06 |
| 2 | .821644 | 13 | 2 | .826204 | 13 | 2 | .830717 | 13 | 2 | .835183 | 13 | 2 | .839604 | 13 |
| 3 | .821710 | 20 | 3 | .826269 | 19 | 3 | .830781 | 19 | 3 | .835246 | 19 | 3 | .839667 | 19 |
| 4 | .821775 | 26 | 4 | .826334 | 26 | 4 | .830845 | 26 | 4 | .835310 | 26 | 4 | .839729 | 25 |
| 5 | .821841 | 33 | 5 | .826399 | 32 | 5 | .830909 | 32 | 5 | .835373 | 32 | 5 | .839792 | 31 |
| 6 | .821906 | 39 | 6 | .826463 | 39 | 6 | .830973 | 38 | 6 | .835437 | 38 | 6 | .839855 | 38 |
| 7 | .821972 | 46 | 7 | .826528 | 45 | 7 | .831037 | 45 | 7 | .835500 | 45 | 7 | .839918 | 44 |
| 8 | .822037 | 52 | 8 | .826593 | 52 | 8 | .831102 | 51 | 8 | .835564 | 51 | 8 | .839981 | 50 |
| 9 | .822103 | 59 | 9 | .826658 | 58 | 9 | .831166 | 58 | 9 | .835627 | 58 | 9 | .840043 | 57 |
| 6640 | .822168 | 00 | 6710 | .826722 | 00 | 6780 | .831230 | 00 | 6850 | .835691 | 00 | 6920 | .840106 | 00 |
| 1 | .822233 | 07 | 1 | .826787 | 06 | 1 | .831294 | 06 | 1 | .835754 | 06 | 1 | .840169 | 06 |
| 2 | .822299 | 13 | 2 | .826852 | 13 | 2 | .831358 | 13 | 2 | .835817 | 13 | 2 | .840232 | 13 |
| 3 | .822364 | 20 | 3 | .826917 | 19 | 3 | .831422 | 19 | 3 | .835881 | 19 | 3 | .840294 | 19 |
| 4 | .822430 | 26 | 4 | .826981 | 26 | 4 | .831486 | 26 | 4 | .835944 | 26 | 4 | .840357 | 25 |
| 5 | .822495 | 33 | 5 | .827046 | 32 | 5 | .831550 | 32 | 5 | .836007 | 32 | 5 | .840420 | 31 |
| 6 | .822560 | 39 | 6 | .827111 | 39 | 6 | .831614 | 38 | 6 | .836071 | 38 | 6 | .840482 | 38 |
| 7 | .822626 | 46 | 7 | .827175 | 45 | 7 | .831678 | 45 | 7 | .836134 | 45 | 7 | .840545 | 44 |
| 8 | .822691 | 52 | 8 | .827240 | 52 | 8 | .831742 | 51 | 8 | .836197 | 51 | 8 | .840608 | 50 |
| 9 | .822756 | 59 | 9 | .827305 | 58 | 9 | .831806 | 58 | 9 | .836261 | 58 | 9 | .840671 | 57 |
| 6650 | .822822 | 00 | 6720 | .827369 | 00 | 6790 | .831870 | 00 | 6860 | .836324 | 00 | 6930 | .840733 | 00 |
| 1 | .822887 | 07 | 1 | .827434 | 06 | 1 | .831934 | 06 | 1 | .836387 | 06 | 1 | .840796 | 06 |
| 2 | .822952 | 13 | 2 | .827498 | 13 | 2 | .831998 | 13 | 2 | .836451 | 13 | 2 | .840859 | 13 |
| 3 | .823017 | 20 | 3 | .827563 | 19 | 3 | .832062 | 19 | 3 | .836514 | 19 | 3 | .840921 | 19 |
| 4 | .823083 | 26 | 4 | .827628 | 26 | 4 | .832125 | 26 | 4 | .836577 | 26 | 4 | .840984 | 25 |
| 5 | .823148 | 33 | 5 | .827692 | 32 | 5 | .832189 | 32 | 5 | .836640 | 32 | 5 | .841046 | 31 |
| 6 | .823213 | 39 | 6 | .827757 | 39 | 6 | .832253 | 38 | 6 | .836704 | 38 | 6 | .841109 | 38 |
| 7 | .823279 | 46 | 7 | .827821 | 45 | 7 | .832317 | 45 | 7 | .836767 | 45 | 7 | .841172 | 44 |
| 8 | .823344 | 52 | 8 | .827886 | 52 | 8 | .832381 | 51 | 8 | .836830 | 51 | 8 | .841234 | 50 |
| 9 | .823409 | 59 | 9 | .827950 | 58 | 9 | .832445 | 58 | 9 | .836893 | 58 | 9 | .841297 | 56 |
| 6660 | .823474 | 00 | 6730 | .828015 | 00 | 6800 | .832509 | 00 | 6870 | .836957 | 00 | 6940 | .841359 | 00 |
| 1 | .823539 | 07 | 1 | .828080 | 06 | 1 | .832573 | 06 | 1 | .837020 | 06 | 1 | .841422 | 06 |
| 2 | .823605 | 13 | 2 | .828144 | 13 | 2 | .832637 | 13 | 2 | .837083 | 13 | 2 | .841485 | 13 |
| 3 | .823670 | 20 | 3 | .828209 | 19 | 3 | .832700 | 19 | 3 | .837146 | 19 | 3 | .841547 | 19 |
| 4 | .823735 | 26 | 4 | .828273 | 26 | 4 | .832764 | 26 | 4 | .837209 | 25 | 4 | .841610 | 25 |
| 5 | .823800 | 33 | 5 | .828338 | 32 | 5 | .832828 | 32 | 5 | .837273 | 32 | 5 | .841672 | 31 |
| 6 | .823865 | 39 | 6 | .828402 | 39 | 6 | .832892 | 38 | 6 | .837336 | 38 | 6 | .841735 | 38 |
| 7 | .823930 | 46 | 7 | .828466 | 45 | 7 | .832956 | 45 | 7 | .837399 | 44 | 7 | .841797 | 44 |
| 8 | .823996 | 52 | 8 | .828531 | 52 | 8 | .833019 | 51 | 8 | .837462 | 51 | 8 | .841860 | 50 |
| 9 | .824061 | 59 | 9 | .828595 | 58 | 9 | .833083 | 58 | 9 | .837525 | 57 | 9 | .841922 | 56 |

Log. .841985 to .863263 No. 6950 to 7299. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6950 | .841985 | 00 | 7020 | .846337 | 00 | 7090 | .850646 | 00 | 7160 | .854913 | 00 | 7230 | .859138 | 00 |
| 1 | .842047 | 06 | 1 | .846399 | 06 | 1 | .850707 | 06 | 1 | .854974 | 06 | 1 | .859198 | 06 |
| 2 | .842110 | 12 | 2 | .846461 | 12 | 2 | .850769 | 12 | 2 | .855034 | 12 | 2 | .859258 | 12 |
| 3 | .842172 | 19 | 3 | .846523 | 19 | 3 | .850830 | 18 | 3 | .855095 | 18 | 3 | .859318 | 18 |
| 4 | .842235 | 25 | 4 | .846584 | 25 | 4 | .850891 | 25 | 4 | .855156 | 24 | 4 | .859378 | 24 |
| 5 | .842297 | 31 | 5 | .846646 | 31 | 5 | .850952 | 31 | 5 | .855216 | 30 | 5 | .859438 | 30 |
| 6 | .842360 | 37 | 6 | .846708 | 37 | 6 | .851014 | 37 | 6 | .855277 | 36 | 6 | .859499 | 36 |
| 7 | .842422 | 44 | 7 | .846770 | 43 | 7 | .851075 | 43 | 7 | .855337 | 42 | 7 | .859559 | 42 |
| 8 | .842484 | 50 | 8 | .846832 | 50 | 8 | .851136 | 49 | 8 | .855398 | 48 | 8 | .859619 | 48 |
| 9 | .842547 | 56 | 9 | .846893 | 56 | 9 | .851197 | 55 | 9 | .855459 | 54 | 9 | .859679 | 54 |
| 6960 | .842609 | 00 | 7030 | .846955 | 00 | 7100 | .851258 | 00 | 7170 | .855519 | 00 | 7240 | .859739 | 00 |
| 1 | .842672 | 06 | 1 | .847017 | 06 | 1 | .851319 | 06 | 1 | .855580 | 06 | 1 | .859798 | 06 |
| 2 | .842734 | 12 | 2 | .847079 | 12 | 2 | .851381 | 12 | 2 | .855640 | 12 | 2 | .859858 | 12 |
| 3 | .842796 | 19 | 3 | .847141 | 19 | 3 | .851442 | 18 | 3 | .855701 | 18 | 3 | .859918 | 18 |
| 4 | .842859 | 25 | 4 | .847202 | 25 | 4 | .851503 | 25 | 4 | .855761 | 24 | 4 | .859978 | 24 |
| 5 | .842921 | 31 | 5 | .847264 | 31 | 5 | .851564 | 31 | 5 | .855822 | 30 | 5 | .860038 | 30 |
| 6 | .842983 | 37 | 6 | .847326 | 37 | 6 | .851625 | 37 | 6 | .855882 | 36 | 6 | .860098 | 36 |
| 7 | .843046 | 44 | 7 | .847388 | 43 | 7 | .851686 | 43 | 7 | .855943 | 42 | 7 | .860158 | 42 |
| 8 | .843108 | 50 | 8 | .847449 | 50 | 8 | .851747 | 49 | 8 | .856003 | 48 | 8 | .860218 | 48 |
| 9 | .843170 | 56 | 9 | .847511 | 56 | 9 | .851808 | 55 | 9 | .856064 | 54 | 9 | .860278 | 54 |
| 6970 | .843233 | 00 | 7040 | .847573 | 00 | 7110 | .851870 | 00 | 7180 | .856124 | 00 | 7250 | .860338 | 00 |
| 1 | .843295 | 06 | 1 | .847634 | 06 | 1 | .851931 | 06 | 1 | .856185 | 06 | 1 | .860398 | 06 |
| 2 | .843357 | 12 | 2 | .847696 | 12 | 2 | .851992 | 12 | 2 | .856245 | 12 | 2 | .860458 | 12 |
| 3 | .843420 | 19 | 3 | .847758 | 18 | 3 | .852053 | 18 | 3 | .856306 | 18 | 3 | .860518 | 18 |
| 4 | .843482 | 25 | 4 | .847819 | 25 | 4 | .852114 | 25 | 4 | .856366 | 24 | 4 | .860578 | 24 |
| 5 | .843544 | 31 | 5 | .847881 | 31 | 5 | .852175 | 31 | 5 | .856427 | 30 | 5 | .860637 | 30 |
| 6 | .843606 | 37 | 6 | .847943 | 37 | 6 | .852236 | 37 | 6 | .856487 | 36 | 6 | .860697 | 36 |
| 7 | .843669 | 43 | 7 | .848004 | 43 | 7 | .852297 | 43 | 7 | .856548 | 42 | 7 | .860757 | 42 |
| 8 | .843731 | 50 | 8 | .848066 | 49 | 8 | .852358 | 49 | 8 | .856608 | 48 | 8 | .860817 | 48 |
| 9 | .843793 | 56 | 9 | .848127 | 55 | 9 | .852419 | 55 | 9 | .856668 | 54 | 9 | .860877 | 54 |
| 6980 | .843855 | 00 | 7050 | .848189 | 00 | 7120 | .852480 | 00 | 7190 | .856729 | 00 | 7260 | .860937 | 00 |
| 1 | .843918 | 06 | 1 | .848251 | 06 | 1 | .852541 | 06 | 1 | .856789 | 06 | 1 | .860996 | 06 |
| 2 | .843980 | 12 | 2 | .848312 | 12 | 2 | .852602 | 12 | 2 | .856850 | 12 | 2 | .861056 | 12 |
| 3 | .844042 | 19 | 3 | .848374 | 18 | 3 | .852663 | 18 | 3 | .856910 | 18 | 3 | .861116 | 18 |
| 4 | .844104 | 25 | 4 | .848435 | 25 | 4 | .852724 | 24 | 4 | .856970 | 24 | 4 | .861176 | 24 |
| 5 | .844166 | 31 | 5 | .848497 | 31 | 5 | .852785 | 30 | 5 | .857031 | 30 | 5 | .861236 | 30 |
| 6 | .844229 | 37 | 6 | .848559 | 37 | 6 | .852846 | 37 | 6 | .857091 | 36 | 6 | .861295 | 36 |
| 7 | .844291 | 43 | 7 | .848620 | 43 | 7 | .852907 | 43 | 7 | .857151 | 42 | 7 | .861355 | 42 |
| 8 | .844353 | 50 | 8 | .848682 | 49 | 8 | .852968 | 49 | 8 | .857212 | 48 | 8 | .861415 | 48 |
| 9 | .844415 | 56 | 9 | .848743 | 55 | 9 | .853029 | 55 | 9 | .857272 | 54 | 9 | .861475 | 54 |
| 6990 | .844477 | 00 | 7060 | .848805 | 00 | 7130 | .853089 | 00 | 7200 | .857332 | 00 | 7270 | .861534 | 00 |
| 1 | .844539 | 06 | 1 | .848866 | 06 | 1 | .853150 | 06 | 1 | .857393 | 06 | 1 | .861594 | 06 |
| 2 | .844601 | 12 | 2 | .848928 | 12 | 2 | .853211 | 12 | 2 | .857453 | 12 | 2 | .861654 | 12 |
| 3 | .844663 | 19 | 3 | .848989 | 18 | 3 | .853272 | 18 | 3 | .857513 | 18 | 3 | .861714 | 18 |
| 4 | .844726 | 25 | 4 | .849051 | 25 | 4 | .853333 | 24 | 4 | .857574 | 24 | 4 | .861773 | 24 |
| 5 | .844788 | 31 | 5 | .849112 | 31 | 5 | .853394 | 30 | 5 | .857634 | 30 | 5 | .861833 | 30 |
| 6 | .844850 | 37 | 6 | .849174 | 37 | 6 | .853455 | 37 | 6 | .857694 | 36 | 6 | .861893 | 36 |
| 7 | .844912 | 43 | 7 | .849235 | 43 | 7 | .853516 | 43 | 7 | .857754 | 42 | 7 | .861952 | 42 |
| 8 | .844974 | 50 | 8 | .849296 | 49 | 8 | .853576 | 49 | 8 | .857815 | 48 | 8 | .862012 | 48 |
| 9 | .845036 | 56 | 9 | .849358 | 55 | 9 | .853637 | 55 | 9 | .857875 | 54 | 9 | .862072 | 54 |
| 7000 | .845098 | 00 | 7070 | .849419 | 00 | 7140 | .853698 | 00 | 7210 | .857935 | 00 | 7280 | .862131 | 00 |
| 1 | .845160 | 06 | 1 | .849481 | 06 | 1 | .853759 | 06 | 1 | .857995 | 06 | 1 | .862191 | 06 |
| 2 | .845222 | 12 | 2 | .849542 | 12 | 2 | .853820 | 12 | 2 | .858056 | 12 | 2 | .862251 | 12 |
| 3 | .845284 | 19 | 3 | .849604 | 18 | 3 | .853881 | 18 | 3 | .858116 | 18 | 3 | .862310 | 18 |
| 4 | .845346 | 25 | 4 | .849665 | 25 | 4 | .853941 | 24 | 4 | .858176 | 24 | 4 | .862370 | 24 |
| 5 | .845408 | 31 | 5 | .849726 | 31 | 5 | .854002 | 30 | 5 | .858236 | 30 | 5 | .862430 | 30 |
| 6 | .845470 | 37 | 6 | .849788 | 37 | 6 | .854063 | 37 | 6 | .858296 | 36 | 6 | .862489 | 36 |
| 7 | .845532 | 43 | 7 | .849849 | 43 | 7 | .854124 | 43 | 7 | .858357 | 42 | 7 | .862549 | 42 |
| 8 | .845594 | 50 | 8 | .849911 | 49 | 8 | .854184 | 49 | 8 | .858417 | 48 | 8 | .862608 | 48 |
| 9 | .845656 | 56 | 9 | .849972 | 55 | 9 | .854245 | 55 | 9 | .858477 | 54 | 9 | .862668 | 54 |
| 7010 | .845718 | 00 | 7080 | .850033 | 00 | 7150 | .854306 | 00 | 7220 | .858537 | 00 | 7290 | .862727 | 00 |
| 1 | .845780 | 06 | 1 | .850095 | 06 | 1 | .854367 | 06 | 1 | .858597 | 06 | 1 | .862787 | 06 |
| 2 | .845842 | 12 | 2 | .850156 | 12 | 2 | .854427 | 12 | 2 | .858657 | 12 | 2 | .862847 | 12 |
| 3 | .845904 | 19 | 3 | .850217 | 18 | 3 | .854488 | 18 | 3 | .858718 | 18 | 3 | .862906 | 18 |
| 4 | .845966 | 25 | 4 | .850279 | 25 | 4 | .854549 | 24 | 4 | .858778 | 24 | 4 | .862966 | 24 |
| 5 | .846028 | 31 | 5 | .850340 | 31 | 5 | .854610 | 30 | 5 | .858838 | 30 | 5 | .863025 | 30 |
| 6 | .846090 | 37 | 6 | .850401 | 37 | 6 | .854670 | 36 | 6 | .858898 | 36 | 6 | .863085 | 36 |
| 7 | .846151 | 43 | 7 | .850462 | 43 | 7 | .854731 | 42 | 7 | .858958 | 42 | 7 | .863144 | 42 |
| 8 | .846213 | 50 | 8 | .850524 | 49 | 8 | .854792 | 48 | 8 | .859018 | 48 | 8 | .863204 | 48 |
| 9 | .846275 | 56 | 9 | .850585 | 55 | 9 | .854852 | 54 | 9 | .859078 | 54 | 9 | .863263 | 54 |

Log. .863323 to .883605 No. 7300 to 7649. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7300 | .863323 | 00 | 7370 | .867467 | 00 | 7440 | .871573 | 00 | 7510 | .875640 | 00 | 7580 | .879669 | 00 |
| 1 | .863382 | 06 | 1 | .867526 | 06 | 1 | .871631 | 06 | 1 | .875698 | 06 | 1 | .879726 | 06 |
| 2 | .863442 | 12 | 2 | .867585 | 12 | 2 | .871690 | 12 | 2 | .875756 | 12 | 2 | .879784 | 11 |
| 3 | .863501 | 18 | 3 | .867644 | 18 | 3 | .871748 | 18 | 3 | .875813 | 17 | 3 | .879841 | 17 |
| 4 | .863561 | 24 | 4 | .867703 | 24 | 4 | .871806 | 23 | 4 | .875871 | 23 | 4 | .879898 | 23 |
| 5 | .863620 | 30 | 5 | .867762 | 29 | 5 | .871865 | 29 | 5 | .875929 | 29 | 5 | .879956 | 28 |
| 6 | .863680 | 36 | 6 | .867821 | 35 | 6 | .871923 | 35 | 6 | .875987 | 35 | 6 | .880013 | 34 |
| 7 | .863739 | 42 | 7 | .867880 | 41 | 7 | .871981 | 41 | 7 | .876045 | 41 | 7 | .880070 | 40 |
| 8 | .863798 | 48 | 8 | .867939 | 47 | 8 | .872040 | 47 | 8 | .876102 | 46 | 8 | .880127 | 46 |
| 9 | .863858 | 54 | 9 | .867997 | 53 | 9 | .872098 | 53 | 9 | .876160 | 52 | 9 | .880185 | 51 |
| 7310 | .863917 | 00 | 7380 | .868056 | 00 | 7450 | .872156 | 00 | 7520 | .876218 | 00 | 7590 | .880242 | 00 |
| 1 | .863977 | 06 | 1 | .868115 | 06 | 1 | .872215 | 06 | 1 | .876276 | 06 | 1 | .880299 | 06 |
| 2 | .864036 | 12 | 2 | .868174 | 12 | 2 | .872273 | 12 | 2 | .876333 | 12 | 2 | .880356 | 11 |
| 3 | .864096 | 18 | 3 | .868233 | 18 | 3 | .872331 | 18 | 3 | .876391 | 17 | 3 | .880413 | 17 |
| 4 | .864155 | 24 | 4 | .868292 | 24 | 4 | .872389 | 23 | 4 | .876449 | 23 | 4 | .880471 | 23 |
| 5 | .864214 | 30 | 5 | .868350 | 29 | 5 | .872448 | 29 | 5 | .876506 | 29 | 5 | .880528 | 28 |
| 6 | .864274 | 36 | 6 | .868409 | 35 | 6 | .872506 | 35 | 6 | .876564 | 34 | 6 | .880585 | 34 |
| 7 | .864333 | 42 | 7 | .868468 | 41 | 7 | .872564 | 41 | 7 | .876622 | 40 | 7 | .880642 | 40 |
| 8 | .864392 | 48 | 8 | .868527 | 47 | 8 | .872622 | 47 | 8 | .876680 | 46 | 8 | .880699 | 46 |
| 9 | .864452 | 54 | 9 | .868586 | 53 | 9 | .872681 | 53 | 9 | .876737 | 52 | 9 | .880756 | 51 |
| 7320 | .864511 | 00 | 7390 | .868644 | 00 | 7460 | .872739 | 00 | 7530 | .876795 | 00 | 7600 | .880814 | 00 |
| 1 | .864570 | 06 | 1 | .868703 | 06 | 1 | .872797 | 06 | 1 | .876853 | 06 | 1 | .880871 | 06 |
| 2 | .864630 | 12 | 2 | .868762 | 12 | 2 | .872855 | 12 | 2 | .876910 | 12 | 2 | .880928 | 11 |
| 3 | .864689 | 18 | 3 | .868821 | 18 | 3 | .872913 | 18 | 3 | .876968 | 17 | 3 | .880985 | 17 |
| 4 | .864748 | 24 | 4 | .868879 | 24 | 4 | .872972 | 23 | 4 | .877026 | 23 | 4 | .881042 | 23 |
| 5 | .864808 | 30 | 5 | .868938 | 29 | 5 | .873030 | 29 | 5 | .877083 | 29 | 5 | .881099 | 28 |
| 6 | .864867 | 36 | 6 | .868997 | 35 | 6 | .873088 | 35 | 6 | .877141 | 34 | 6 | .881156 | 34 |
| 7 | .864926 | 42 | 7 | .869056 | 41 | 7 | .873146 | 41 | 7 | .877198 | 40 | 7 | .881213 | 40 |
| 8 | .864985 | 48 | 8 | .869114 | 47 | 8 | .873204 | 47 | 8 | .877256 | 46 | 8 | .881270 | 46 |
| 9 | .865045 | 54 | 9 | .869173 | 53 | 9 | .873262 | 53 | 9 | .877314 | 52 | 9 | .881328 | 51 |
| 7330 | .865104 | 00 | 7400 | .869232 | 00 | 7470 | .873321 | 00 | 7540 | .877371 | 00 | 7610 | .881385 | 00 |
| 1 | .865163 | 06 | 1 | .869290 | 06 | 1 | .873379 | 06 | 1 | .877429 | 06 | 1 | .881442 | 06 |
| 2 | .865222 | 12 | 2 | .869349 | 12 | 2 | .873437 | 12 | 2 | .877486 | 12 | 2 | .881499 | 11 |
| 3 | .865282 | 18 | 3 | .869408 | 18 | 3 | .873495 | 18 | 3 | .877544 | 17 | 3 | .881556 | 17 |
| 4 | .865341 | 24 | 4 | .869466 | 24 | 4 | .873553 | 23 | 4 | .877602 | 23 | 4 | .881613 | 23 |
| 5 | .865400 | 30 | 5 | .869525 | 29 | 5 | .873611 | 29 | 5 | .877659 | 29 | 5 | .881670 | 28 |
| 6 | .865459 | 36 | 6 | .869584 | 35 | 6 | .873669 | 35 | 6 | .877717 | 34 | 6 | .881727 | 34 |
| 7 | .865518 | 42 | 7 | .869642 | 41 | 7 | .873727 | 41 | 7 | .877774 | 40 | 7 | .881784 | 40 |
| 8 | .865578 | 48 | 8 | .869701 | 47 | 8 | .873785 | 47 | 8 | .877832 | 46 | 8 | .881841 | 46 |
| 9 | .865637 | 54 | 9 | .869760 | 53 | 9 | .873843 | 53 | 9 | .877889 | 52 | 9 | .881898 | 51 |
| 7340 | .865696 | 00 | 7410 | .869818 | 00 | 7480 | .873902 | 00 | 7550 | .877947 | 00 | 7620 | .881955 | 00 |
| 1 | .865755 | 06 | 1 | .869877 | 06 | 1 | .873960 | 06 | 1 | .878004 | 06 | 1 | .882012 | 06 |
| 2 | .865814 | 12 | 2 | .869935 | 12 | 2 | .874018 | 12 | 2 | .878062 | 12 | 2 | .882069 | 11 |
| 3 | .865873 | 18 | 3 | .869994 | 18 | 3 | .874076 | 17 | 3 | .878119 | 17 | 3 | .882126 | 17 |
| 4 | .865933 | 24 | 4 | .870053 | 24 | 4 | .874134 | 23 | 4 | .878177 | 23 | 4 | .882183 | 23 |
| 5 | .865992 | 30 | 5 | .870111 | 29 | 5 | .874192 | 29 | 5 | .878234 | 29 | 5 | .882240 | 28 |
| 6 | .866051 | 36 | 6 | .870170 | 35 | 6 | .874250 | 35 | 6 | .878292 | 34 | 6 | .882297 | 34 |
| 7 | .866110 | 42 | 7 | .870228 | 41 | 7 | .874308 | 41 | 7 | .878349 | 40 | 7 | .882354 | 40 |
| 8 | .866169 | 48 | 8 | .870287 | 47 | 8 | .874366 | 46 | 8 | .878407 | 46 | 8 | .882411 | 46 |
| 9 | .866228 | 54 | 9 | .870345 | 53 | 9 | .874424 | 52 | 9 | .878464 | 52 | 9 | .882468 | 51 |
| 7350 | .866287 | 00 | 7420 | .870404 | 00 | 7490 | .874482 | 00 | 7560 | .878522 | 00 | 7630 | .882524 | 00 |
| 1 | .866346 | 06 | 1 | .870462 | 06 | 1 | .874540 | 06 | 1 | .878579 | 06 | 1 | .882581 | 06 |
| 2 | .866405 | 12 | 2 | .870521 | 12 | 2 | .874598 | 12 | 2 | .878637 | 12 | 2 | .882638 | 11 |
| 3 | .866465 | 18 | 3 | .870579 | 18 | 3 | .874656 | 17 | 3 | .878694 | 17 | 3 | .882695 | 17 |
| 4 | .866524 | 24 | 4 | .870638 | 24 | 4 | .874714 | 23 | 4 | .878751 | 23 | 4 | .882752 | 23 |
| 5 | .866583 | 30 | 5 | .870696 | 29 | 5 | .874772 | 29 | 5 | .878809 | 29 | 5 | .882809 | 28 |
| 6 | .866642 | 35 | 6 | .870755 | 35 | 6 | .874830 | 35 | 6 | .878866 | 34 | 6 | .882866 | 34 |
| 7 | .866701 | 41 | 7 | .870813 | 41 | 7 | .874887 | 41 | 7 | .878924 | 40 | 7 | .882923 | 40 |
| 8 | .866760 | 47 | 8 | .870872 | 47 | 8 | .874945 | 46 | 8 | .878981 | 46 | 8 | .882980 | 46 |
| 9 | .866819 | 53 | 9 | .870930 | 53 | 9 | .875003 | 52 | 9 | .879038 | 52 | 9 | .883036 | 51 |
| 7360 | .866878 | 00 | 7430 | .870989 | 00 | 7500 | .875061 | 00 | 7570 | .879096 | 00 | 7640 | .883093 | 00 |
| 1 | .866937 | 06 | 1 | .871047 | 06 | 1 | .875119 | 06 | 1 | .879153 | 06 | 1 | .883150 | 06 |
| 2 | .866996 | 12 | 2 | .871106 | 12 | 2 | .875177 | 12 | 2 | .879211 | 12 | 2 | .883207 | 11 |
| 3 | .867055 | 18 | 3 | .871164 | 18 | 3 | .875235 | 17 | 3 | .879268 | 17 | 3 | .883264 | 17 |
| 4 | .867114 | 24 | 4 | .871223 | 24 | 4 | .875293 | 23 | 4 | .879325 | 23 | 4 | .883321 | 23 |
| 5 | .867173 | 29 | 5 | .871281 | 29 | 5 | .875351 | 29 | 5 | .879383 | 29 | 5 | .883377 | 28 |
| 6 | .867232 | 35 | 6 | .871339 | 35 | 6 | .875409 | 35 | 6 | .879440 | 34 | 6 | .883434 | 34 |
| 7 | .867291 | 41 | 7 | .871398 | 41 | 7 | .875466 | 41 | 7 | .879497 | 40 | 7 | .883491 | 40 |
| 8 | .867350 | 47 | 8 | .871456 | 47 | 8 | .875524 | 46 | 8 | .879555 | 46 | 8 | .883548 | 46 |
| 9 | .867409 | 53 | 9 | .871515 | 53 | 9 | .875582 | 52 | 9 | .879612 | 52 | 9 | .883605 | 51 |

Log. .883661 to .903036 No. 7650 to 7999. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7650 | .883661 | 00 | 7720 | .887617 | 00 | 7790 | .891537 | 00 | 7860 | .895422 | 00 | 7930 | .899273 | 00 |
| 1 | .883718 | 06 | 1 | .887674 | 06 | 1 | .891593 | 06 | 1 | .895478 | 06 | 1 | .899328 | 05 |
| 2 | .883775 | 11 | 2 | .887730 | 11 | 2 | .891649 | 11 | 2 | .895533 | 11 | 2 | .899383 | 11 |
| 3 | .883832 | 17 | 3 | .887786 | 17 | 3 | .891705 | 17 | 3 | .895588 | 17 | 3 | .899437 | 17 |
| 4 | .883888 | 23 | 4 | .887842 | 23 | 4 | .891760 | 22 | 4 | .895643 | 22 | 4 | .899492 | 22 |
| 5 | .883945 | 28 | 5 | .887898 | 28 | 5 | .891816 | 28 | 5 | .895699 | 27 | 5 | .899547 | 27 |
| 6 | .884002 | 34 | 6 | .887955 | 34 | 6 | .891872 | 33 | 6 | .895754 | 33 | 6 | .899602 | 33 |
| 7 | .884059 | 40 | 7 | .888011 | 39 | 7 | .891927 | 39 | 7 | .895809 | 39 | 7 | .899656 | 38 |
| 8 | .884115 | 46 | 8 | .888067 | 45 | 8 | .891983 | 44 | 8 | .895864 | 44 | 8 | .899711 | 44 |
| 9 | .884172 | 51 | 9 | .888123 | 51 | 9 | .892039 | 50 | 9 | .895919 | 50 | 9 | .899766 | 50 |
| 7660 | .884229 | 00 | 7730 | .888179 | 00 | 7800 | .892095 | 00 | 7870 | .895975 | 00 | 7940 | .899820 | 00 |
| 1 | .884285 | 06 | 1 | .888236 | 06 | 1 | .892150 | 06 | 1 | .896030 | 06 | 1 | .899875 | 05 |
| 2 | .884342 | 11 | 2 | .888292 | 11 | 2 | .892206 | 11 | 2 | .896085 | 11 | 2 | .899930 | 11 |
| 3 | .884399 | 17 | 3 | .888348 | 17 | 3 | .892262 | 17 | 3 | .896140 | 17 | 3 | .899985 | 17 |
| 4 | .884455 | 23 | 4 | .888404 | 22 | 4 | .892317 | 22 | 4 | .896195 | 22 | 4 | .900039 | 22 |
| 5 | .884512 | 28 | 5 | .888460 | 28 | 5 | .892373 | 28 | 5 | .896251 | 27 | 5 | .900094 | 27 |
| 6 | .884569 | 34 | 6 | .888516 | 34 | 6 | .892428 | 33 | 6 | .896306 | 33 | 6 | .900149 | 33 |
| 7 | .884625 | 40 | 7 | .888573 | 39 | 7 | .892484 | 39 | 7 | .896361 | 39 | 7 | .900203 | 38 |
| 8 | .884682 | 46 | 8 | .888629 | 45 | 8 | .892540 | 44 | 8 | .896416 | 44 | 8 | .900258 | 44 |
| 9 | .884739 | 51 | 9 | .888685 | 50 | 9 | .892595 | 50 | 9 | .896471 | 50 | 9 | .900312 | 50 |
| 7670 | .884795 | 00 | 7740 | .888741 | 00 | 7810 | .892651 | 00 | 7880 | .896526 | 00 | 7950 | .900367 | 00 |
| 1 | .884852 | 06 | 1 | .888797 | 06 | 1 | .892707 | 06 | 1 | .896581 | 06 | 1 | .900422 | 05 |
| 2 | .884909 | 11 | 2 | .888853 | 11 | 2 | .892762 | 11 | 2 | .896636 | 11 | 2 | .900476 | 11 |
| 3 | .884965 | 17 | 3 | .888909 | 17 | 3 | .892818 | 17 | 3 | .896691 | 17 | 3 | .900531 | 17 |
| 4 | .885022 | 23 | 4 | .888965 | 22 | 4 | .892873 | 22 | 4 | .896747 | 22 | 4 | .900586 | 22 |
| 5 | .885078 | 28 | 5 | .889021 | 28 | 5 | .892929 | 28 | 5 | .896802 | 27 | 5 | .900640 | 27 |
| 6 | .885135 | 34 | 6 | .889077 | 34 | 6 | .892985 | 33 | 6 | .896857 | 33 | 6 | .900695 | 33 |
| 7 | .885191 | 40 | 7 | .889134 | 39 | 7 | .893040 | 39 | 7 | .896912 | 39 | 7 | .900749 | 38 |
| 8 | .885248 | 46 | 8 | .889190 | 45 | 8 | .893096 | 44 | 8 | .896967 | 44 | 8 | .900804 | 44 |
| 9 | .885305 | 51 | 9 | .889246 | 50 | 9 | .893151 | 50 | 9 | .897022 | 50 | 9 | .900858 | 50 |
| 7680 | .885361 | 00 | 7750 | .889302 | 00 | 7820 | .893207 | 00 | 7890 | .897077 | 00 | 7960 | .900913 | 00 |
| 1 | .885418 | 06 | 1 | .889358 | 06 | 1 | .893262 | 06 | 1 | .897132 | 06 | 1 | .900968 | 05 |
| 2 | .885474 | 11 | 2 | .889414 | 11 | 2 | .893318 | 11 | 2 | .897187 | 11 | 2 | .901022 | 11 |
| 3 | .885531 | 17 | 3 | .889470 | 17 | 3 | .893373 | 17 | 3 | .897242 | 17 | 3 | .901077 | 16 |
| 4 | .885587 | 23 | 4 | .889526 | 22 | 4 | .893429 | 22 | 4 | .897297 | 22 | 4 | .901131 | 22 |
| 5 | .885644 | 28 | 5 | .889582 | 28 | 5 | .893484 | 28 | 5 | .897352 | 27 | 5 | .901186 | 27 |
| 6 | .885700 | 34 | 6 | .889638 | 34 | 6 | .893540 | 33 | 6 | .897407 | 33 | 6 | .901240 | 33 |
| 7 | .885757 | 39 | 7 | .889694 | 39 | 7 | .893595 | 39 | 7 | .897462 | 39 | 7 | .901295 | 38 |
| 8 | .885813 | 45 | 8 | .889750 | 45 | 8 | .893651 | 44 | 8 | .897517 | 44 | 8 | .901349 | 44 |
| 9 | .885870 | 51 | 9 | .889806 | 50 | 9 | .893706 | 50 | 9 | .897572 | 50 | 9 | .901404 | 49 |
| 7690 | .885926 | 00 | 7760 | .889862 | 00 | 7830 | .893762 | 00 | 7900 | .897627 | 00 | 7970 | .901458 | 00 |
| 1 | .885983 | 06 | 1 | .889918 | 06 | 1 | .893817 | 06 | 1 | .897682 | 06 | 1 | .901513 | 05 |
| 2 | .886039 | 11 | 2 | .889974 | 11 | 2 | .893873 | 11 | 2 | .897737 | 11 | 2 | .901567 | 11 |
| 3 | .886096 | 17 | 3 | .890030 | 17 | 3 | .893928 | 17 | 3 | .897792 | 17 | 3 | .901622 | 16 |
| 4 | .886152 | 23 | 4 | .890085 | 22 | 4 | .893984 | 22 | 4 | .897847 | 22 | 4 | .901676 | 22 |
| 5 | .886209 | 28 | 5 | .890141 | 28 | 5 | .894039 | 28 | 5 | .897902 | 27 | 5 | .901731 | 27 |
| 6 | .886265 | 34 | 6 | .890197 | 34 | 6 | .894094 | 33 | 6 | .897957 | 33 | 6 | .901785 | 33 |
| 7 | .886321 | 39 | 7 | .890253 | 39 | 7 | .894150 | 39 | 7 | .898012 | 39 | 7 | .901840 | 38 |
| 8 | .886378 | 45 | 8 | .890309 | 45 | 8 | .894205 | 44 | 8 | .898067 | 44 | 8 | .901894 | 44 |
| 9 | .886434 | 51 | 9 | .890365 | 50 | 9 | .894261 | 50 | 9 | .898122 | 50 | 9 | .901948 | 49 |
| 7700 | .886491 | 00 | 7770 | .890421 | 00 | 7840 | .894316 | 00 | 7910 | .898176 | 00 | 7980 | .902003 | 00 |
| 1 | .886547 | 06 | 1 | .890477 | 06 | 1 | .894371 | 06 | 1 | .898231 | 06 | 1 | .902057 | 05 |
| 2 | .886603 | 11 | 2 | .890533 | 11 | 2 | .894427 | 11 | 2 | .898286 | 11 | 2 | .902112 | 11 |
| 3 | .886660 | 17 | 3 | .890589 | 17 | 3 | .894482 | 17 | 3 | .898341 | 17 | 3 | .902166 | 16 |
| 4 | .886716 | 23 | 4 | .890644 | 22 | 4 | .894538 | 22 | 4 | .898396 | 22 | 4 | .902220 | 22 |
| 5 | .886773 | 28 | 5 | .890700 | 28 | 5 | .894593 | 27 | 5 | .898451 | 27 | 5 | .902275 | 27 |
| 6 | .886829 | 34 | 6 | .890756 | 34 | 6 | .894648 | 33 | 6 | .898506 | 33 | 6 | .902329 | 33 |
| 7 | .886885 | 39 | 7 | .890812 | 39 | 7 | .894704 | 39 | 7 | .898561 | 39 | 7 | .902384 | 38 |
| 8 | .886942 | 45 | 8 | .890868 | 45 | 8 | .894759 | 44 | 8 | .898615 | 44 | 8 | .902438 | 44 |
| 9 | .886998 | 51 | 9 | .890924 | 50 | 9 | .894814 | 50 | 9 | .898670 | 50 | 9 | .902492 | 49 |
| 7710 | .887054 | 00 | 7780 | .890980 | 00 | 7850 | .894870 | 00 | 7920 | .898725 | 00 | 7990 | .902547 | 00 |
| 1 | .887111 | 06 | 1 | .891035 | 06 | 1 | .894925 | 06 | 1 | .898780 | 05 | 1 | .902601 | 05 |
| 2 | .887167 | 11 | 2 | .891091 | 11 | 2 | .894980 | 11 | 2 | .898835 | 11 | 2 | .902655 | 11 |
| 3 | .887223 | 17 | 3 | .891147 | 17 | 3 | .895036 | 17 | 3 | .898890 | 17 | 3 | .902710 | 16 |
| 4 | .887280 | 23 | 4 | .891203 | 22 | 4 | .895091 | 22 | 4 | .898944 | 22 | 4 | .902764 | 22 |
| 5 | .887336 | 28 | 5 | .891259 | 28 | 5 | .895146 | 27 | 5 | .898999 | 27 | 5 | .902818 | 27 |
| 6 | .887392 | 34 | 6 | .891314 | 34 | 6 | .895201 | 33 | 6 | .899054 | 33 | 6 | .902873 | 33 |
| 7 | .887448 | 39 | 7 | .891370 | 39 | 7 | .895257 | 39 | 7 | .899109 | 38 | 7 | .902927 | 38 |
| 8 | .887505 | 45 | 8 | .891426 | 45 | 8 | .895312 | 44 | 8 | .899164 | 44 | 8 | .902981 | 44 |
| 9 | .887561 | 51 | 9 | .891482 | 50 | 9 | .895367 | 50 | 9 | .899218 | 50 | 9 | .903036 | 49 |

Log. .903090 to .921634 No. 8000 to 8349. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8000 | .903090 | 00 | 8070 | .906873 | 00 | 8140 | .910624 | 00 | 8210 | .914343 | 00 | 8280 | .918030 | 00 |
| 1 | .903144 | 05 | 1 | .906927 | 05 | 1 | .910678 | 05 | 1 | .914396 | 05 | 1 | .918083 | 05 |
| 2 | .903198 | 11 | 2 | .906981 | 11 | 2 | .910731 | 11 | 2 | .914449 | 11 | 2 | .918135 | 11 |
| 3 | .903253 | 16 | 3 | .907035 | 16 | 3 | .910784 | 16 | 3 | .914502 | 16 | 3 | .918188 | 16 |
| 4 | .903307 | 22 | 4 | .907089 | 22 | 4 | .910838 | 21 | 4 | .914555 | 21 | 4 | .918240 | 21 |
| 5 | .903361 | 27 | 5 | .907142 | 27 | 5 | .910891 | 27 | 5 | .914608 | 27 | 5 | .918292 | 26 |
| 6 | .903416 | 32 | 6 | .907196 | 32 | 6 | .910944 | 32 | 6 | .914660 | 32 | 6 | .918345 | 31 |
| 7 | .903470 | 38 | 7 | .907250 | 38 | 7 | .910998 | 37 | 7 | .914713 | 37 | 7 | .918397 | 37 |
| 8 | .903524 | 43 | 8 | .907304 | 43 | 8 | .911051 | 43 | 8 | .914766 | 42 | 8 | .918450 | 42 |
| 9 | .903578 | 49 | 9 | .907358 | 49 | 9 | .911104 | 48 | 9 | .914819 | 48 | 9 | .918502 | 47 |
| 8010 | .903632 | 00 | 8080 | .907411 | 00 | 8150 | .911158 | 00 | 8220 | .914872 | 00 | 8290 | .918554 | 00 |
| 1 | .903687 | 05 | 1 | .907465 | 05 | 1 | .911211 | 05 | 1 | .914925 | 05 | 1 | .918607 | 05 |
| 2 | .903741 | 11 | 2 | .907519 | 11 | 2 | .911264 | 11 | 2 | .914977 | 11 | 2 | .918659 | 11 |
| 3 | .903795 | 16 | 3 | .907573 | 16 | 3 | .911317 | 16 | 3 | .915030 | 16 | 3 | .918712 | 16 |
| 4 | .903849 | 22 | 4 | .907626 | 22 | 4 | .911371 | 21 | 4 | .915083 | 21 | 4 | .918764 | 21 |
| 5 | .903903 | 27 | 5 | .907680 | 27 | 5 | .911424 | 27 | 5 | .915136 | 27 | 5 | .918816 | 26 |
| 6 | .903958 | 32 | 6 | .907734 | 32 | 6 | .911477 | 32 | 6 | .915189 | 32 | 6 | .918869 | 31 |
| 7 | .904012 | 38 | 7 | .907787 | 38 | 7 | .911530 | 37 | 7 | .915241 | 37 | 7 | .918921 | 37 |
| 8 | .904066 | 43 | 8 | .907841 | 43 | 8 | .911584 | 42 | 8 | .915294 | 42 | 8 | .918973 | 42 |
| 9 | .904120 | 49 | 9 | .907895 | 49 | 9 | .911637 | 48 | 9 | .915347 | 48 | 9 | .919026 | 47 |
| 8020 | .904174 | 00 | 8090 | .907948 | 00 | 8160 | .911690 | 00 | 8230 | .915400 | 00 | 8300 | .919078 | 00 |
| 1 | .904228 | 05 | 1 | .908002 | 05 | 1 | .911743 | 05 | 1 | .915453 | 05 | 1 | .919130 | 05 |
| 2 | .904283 | 11 | 2 | .908056 | 11 | 2 | .911797 | 11 | 2 | .915505 | 11 | 2 | .919183 | 11 |
| 3 | .904337 | 16 | 3 | .908109 | 16 | 3 | .911850 | 16 | 3 | .915558 | 16 | 3 | .919235 | 16 |
| 4 | .904391 | 22 | 4 | .908163 | 22 | 4 | .911903 | 21 | 4 | .915611 | 21 | 4 | .919287 | 21 |
| 5 | .904445 | 27 | 5 | .908217 | 27 | 5 | .911956 | 27 | 5 | .915664 | 27 | 5 | .919340 | 26 |
| 6 | .904499 | 32 | 6 | .908270 | 32 | 6 | .912009 | 32 | 6 | .915716 | 32 | 6 | .919392 | 31 |
| 7 | .904553 | 38 | 7 | .908324 | 38 | 7 | .912063 | 37 | 7 | .915769 | 37 | 7 | .919444 | 37 |
| 8 | .904607 | 43 | 8 | .908378 | 43 | 8 | .912116 | 42 | 8 | .915822 | 42 | 8 | .919496 | 42 |
| 9 | .904661 | 49 | 9 | .908431 | 49 | 9 | .912169 | 48 | 9 | .915874 | 48 | 9 | .919549 | 47 |
| 8030 | .904715 | 00 | 8100 | .908485 | 00 | 8170 | .912222 | 00 | 8240 | .915927 | 00 | 8310 | .919601 | 00 |
| 1 | .904770 | 05 | 1 | .908539 | 05 | 1 | .912275 | 05 | 1 | .915980 | 05 | 1 | .919653 | 05 |
| 2 | .904824 | 11 | 2 | .908592 | 11 | 2 | .912328 | 11 | 2 | .916033 | 11 | 2 | .919705 | 11 |
| 3 | .904878 | 16 | 3 | .908646 | 16 | 3 | .912381 | 16 | 3 | .916085 | 16 | 3 | .919758 | 16 |
| 4 | .904932 | 22 | 4 | .908699 | 21 | 4 | .912435 | 21 | 4 | .916138 | 21 | 4 | .919810 | 21 |
| 5 | .904986 | 27 | 5 | .908753 | 27 | 5 | .912488 | 27 | 5 | .916191 | 27 | 5 | .919862 | 26 |
| 6 | .905040 | 32 | 6 | .908807 | 32 | 6 | .912541 | 32 | 6 | .916243 | 32 | 6 | .919914 | 31 |
| 7 | .905094 | 38 | 7 | .908860 | 37 | 7 | .912594 | 37 | 7 | .916296 | 37 | 7 | .919967 | 37 |
| 8 | .905148 | 43 | 8 | .908914 | 43 | 8 | .912647 | 42 | 8 | .916349 | 42 | 8 | .920019 | 42 |
| 9 | .905202 | 49 | 9 | .908967 | 48 | 9 | .912700 | 48 | 9 | .916401 | 48 | 9 | .920071 | 47 |
| 8040 | .905256 | 00 | 8110 | .909021 | 00 | 8180 | .912753 | 00 | 8250 | .916454 | 00 | 8320 | .920123 | 00 |
| 1 | .905310 | 05 | 1 | .909074 | 05 | 1 | .912806 | 05 | 1 | .916507 | 05 | 1 | .920175 | 05 |
| 2 | .905364 | 11 | 2 | .909128 | 11 | 2 | .912859 | 11 | 2 | .916559 | 11 | 2 | .920228 | 10 |
| 3 | .905418 | 16 | 3 | .909181 | 16 | 3 | .912913 | 16 | 3 | .916612 | 16 | 3 | .920280 | 16 |
| 4 | .905472 | 22 | 4 | .909235 | 21 | 4 | .912966 | 21 | 4 | .916664 | 21 | 4 | .920332 | 21 |
| 5 | .905526 | 27 | 5 | .909288 | 27 | 5 | .913019 | 27 | 5 | .916717 | 26 | 5 | .920384 | 26 |
| 6 | .905580 | 32 | 6 | .909342 | 32 | 6 | .913072 | 32 | 6 | .916770 | 31 | 6 | .920436 | 31 |
| 7 | .905634 | 38 | 7 | .909395 | 37 | 7 | .913125 | 37 | 7 | .916822 | 37 | 7 | .920489 | 36 |
| 8 | .905688 | 43 | 8 | .909449 | 43 | 8 | .913178 | 42 | 8 | .916875 | 42 | 8 | .920541 | 42 |
| 9 | .905742 | 49 | 9 | .909502 | 48 | 9 | .913231 | 48 | 9 | .916927 | 47 | 9 | .920593 | 47 |
| 8050 | .905796 | 00 | 8120 | .909556 | 00 | 8190 | .913284 | 00 | 8260 | .916980 | 00 | 8330 | .920645 | 00 |
| 1 | .905850 | 05 | 1 | .909609 | 05 | 1 | .913337 | 05 | 1 | .917033 | 05 | 1 | .920697 | 05 |
| 2 | .905904 | 11 | 2 | .909663 | 11 | 2 | .913390 | 11 | 2 | .917085 | 11 | 2 | .920749 | 10 |
| 3 | .905958 | 16 | 3 | .909716 | 16 | 3 | .913443 | 16 | 3 | .917138 | 16 | 3 | .920801 | 16 |
| 4 | .906012 | 22 | 4 | .909770 | 21 | 4 | .913496 | 21 | 4 | .917190 | 21 | 4 | .920853 | 21 |
| 5 | .906065 | 27 | 5 | .909823 | 27 | 5 | .913549 | 27 | 5 | .917243 | 26 | 5 | .920906 | 26 |
| 6 | .906119 | 32 | 6 | .909877 | 32 | 6 | .913602 | 32 | 6 | .917295 | 31 | 6 | .920958 | 31 |
| 7 | .906173 | 38 | 7 | .909930 | 37 | 7 | .913655 | 37 | 7 | .917348 | 37 | 7 | .921010 | 36 |
| 8 | .906227 | 43 | 8 | .909984 | 43 | 8 | .913708 | 42 | 8 | .917400 | 42 | 8 | .921062 | 42 |
| 9 | .906281 | 49 | 9 | .910037 | 48 | 9 | .913761 | 48 | 9 | .917453 | 47 | 9 | .921114 | 47 |
| 8060 | .906335 | 00 | 8130 | .910090 | 00 | 8200 | .913814 | 00 | 8270 | .917505 | 00 | 8340 | .921166 | 00 |
| 1 | .906389 | 05 | 1 | .910144 | 05 | 1 | .913867 | 05 | 1 | .917558 | 05 | 1 | .921218 | 05 |
| 2 | .906443 | 11 | 2 | .910197 | 11 | 2 | .913920 | 11 | 2 | .917610 | 11 | 2 | .921270 | 10 |
| 3 | .906497 | 16 | 3 | .910251 | 16 | 3 | .913973 | 16 | 3 | .917663 | 16 | 3 | .921322 | 16 |
| 4 | .906550 | 22 | 4 | .910304 | 21 | 4 | .914026 | 21 | 4 | .917715 | 21 | 4 | .921374 | 21 |
| 5 | .906604 | 27 | 5 | .910358 | 27 | 5 | .914079 | 27 | 5 | .917768 | 26 | 5 | .921426 | 26 |
| 6 | .906658 | 32 | 6 | .910411 | 32 | 6 | .914131 | 32 | 6 | .917820 | 31 | 6 | .921478 | 31 |
| 7 | .906712 | 38 | 7 | .910464 | 37 | 7 | .914184 | 37 | 7 | .917873 | 37 | 7 | .921530 | 36 |
| 8 | .906766 | 43 | 8 | .910518 | 43 | 8 | .914237 | 42 | 8 | .917925 | 42 | 8 | .921582 | 42 |
| 9 | .906820 | 49 | 9 | .910571 | 48 | 9 | .914290 | 48 | 9 | .917978 | 47 | 9 | .921634 | 47 |

## Log. .921686 to .939469 No. 8350 to 8699. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8350 | .921686 | 00 | 8420 | .925312 | 00 | 8490 | .928908 | 00 | 8560 | .932474 | 00 | 8630 | .936011 | 00 |
| 1 | .921738 | 05 | 1 | .925364 | 05 | 1 | .928959 | 05 | 1 | .932524 | 05 | 1 | .936061 | 05 |
| 2 | .921790 | 10 | 2 | .925415 | 10 | 2 | .929010 | 10 | 2 | .932575 | 10 | 2 | .936111 | 10 |
| 3 | .921842 | 16 | 3 | .925467 | 15 | 3 | .929061 | 15 | 3 | .932626 | 15 | 3 | .936162 | 15 |
| 4 | .921894 | 21 | 4 | .925518 | 21 | 4 | .929112 | 20 | 4 | .932677 | 20 | 4 | .936212 | 20 |
| 5 | .921946 | 26 | 5 | .925570 | 26 | 5 | .929163 | 26 | 5 | .932727 | 25 | 5 | .936262 | 25 |
| 6 | .921998 | 31 | 6 | .925621 | 31 | 6 | .929214 | 31 | 6 | .932778 | 30 | 6 | .936313 | 30 |
| 7 | .922050 | 36 | 7 | .925673 | 36 | 7 | .929266 | 36 | 7 | .932829 | 35 | 7 | .936363 | 35 |
| 8 | .922102 | 42 | 8 | .925724 | 41 | 8 | .929317 | 41 | 8 | .932879 | 40 | 8 | .936413 | 40 |
| 9 | .922154 | 47 | 9 | .925776 | 46 | 9 | .929368 | 46 | 9 | .932930 | 45 | 9 | .936463 | 45 |
| 8360 | .922206 | 00 | 8430 | .925828 | 00 | 8500 | .929419 | 00 | 8570 | .932981 | 00 | 8640 | .936514 | 00 |
| 1 | .922258 | 05 | 1 | .925879 | 05 | 1 | .929470 | 05 | 1 | .933031 | 05 | 1 | .936564 | 05 |
| 2 | .922310 | 10 | 2 | .925931 | 10 | 2 | .929521 | 10 | 2 | .933082 | 10 | 2 | .936614 | 10 |
| 3 | .922362 | 16 | 3 | .925982 | 15 | 3 | .929572 | 15 | 3 | .933133 | 15 | 3 | .936664 | 15 |
| 4 | .922414 | 21 | 4 | .926034 | 21 | 4 | .929623 | 20 | 4 | .933183 | 20 | 4 | .936715 | 20 |
| 5 | .922466 | 26 | 5 | .926085 | 26 | 5 | .929674 | 26 | 5 | .933234 | 25 | 5 | .936765 | 25 |
| 6 | .922518 | 31 | 6 | .926137 | 31 | 6 | .929725 | 31 | 6 | .933285 | 30 | 6 | .936815 | 30 |
| 7 | .922570 | 36 | 7 | .926188 | 36 | 7 | .929776 | 36 | 7 | .933335 | 35 | 7 | .936865 | 35 |
| 8 | .922622 | 42 | 8 | .926239 | 41 | 8 | .929827 | 41 | 8 | .933386 | 40 | 8 | .936916 | 40 |
| 9 | .922674 | 47 | 9 | .926291 | 46 | 9 | .929878 | 46 | 9 | .933437 | 45 | 9 | .936966 | 45 |
| 8370 | .922725 | 00 | 8440 | .926342 | 00 | 8510 | .929930 | 00 | 8580 | .933487 | 00 | 8650 | .937016 | 00 |
| 1 | .922777 | 05 | 1 | .926394 | 05 | 1 | .929981 | 05 | 1 | .933538 | 05 | 1 | .937066 | 05 |
| 2 | .922829 | 10 | 2 | .926445 | 10 | 2 | .930032 | 10 | 2 | .933588 | 10 | 2 | .937116 | 10 |
| 3 | .922881 | 16 | 3 | .926497 | 15 | 3 | .930083 | 15 | 3 | .933639 | 15 | 3 | .937167 | 15 |
| 4 | .922933 | 21 | 4 | .926548 | 21 | 4 | .930134 | 20 | 4 | .933690 | 20 | 4 | .937217 | 20 |
| 5 | .922985 | 26 | 5 | .926600 | 26 | 5 | .930185 | 26 | 5 | .933740 | 25 | 5 | .937267 | 25 |
| 6 | .923037 | 31 | 6 | .926651 | 31 | 6 | .930236 | 31 | 6 | .933791 | 30 | 6 | .937317 | 30 |
| 7 | .923088 | 36 | 7 | .926702 | 36 | 7 | .930287 | 36 | 7 | .933841 | 35 | 7 | .937367 | 35 |
| 8 | .923140 | 42 | 8 | .926754 | 41 | 8 | .930338 | 41 | 8 | .933892 | 40 | 8 | .937418 | 40 |
| 9 | .923192 | 47 | 9 | .926805 | 46 | 9 | .930389 | 46 | 9 | .933943 | 45 | 9 | .937468 | 45 |
| 8380 | .923244 | 00 | 8450 | .926857 | 00 | 8520 | .930440 | 00 | 8590 | .933993 | 00 | 8660 | .937518 | 00 |
| 1 | .923296 | 05 | 1 | .926908 | 05 | 1 | .930491 | 05 | 1 | .934044 | 05 | 1 | .937568 | 05 |
| 2 | .923348 | 10 | 2 | .926959 | 10 | 2 | .930541 | 10 | 2 | .934094 | 10 | 2 | .937618 | 10 |
| 3 | .923399 | 16 | 3 | .927011 | 15 | 3 | .930592 | 15 | 3 | .934145 | 15 | 3 | .937668 | 15 |
| 4 | .923451 | 21 | 4 | .927062 | 21 | 4 | .930643 | 20 | 4 | .934195 | 20 | 4 | .937718 | 20 |
| 5 | .923503 | 26 | 5 | .927114 | 26 | 5 | .930694 | 25 | 5 | .934246 | 25 | 5 | .937769 | 25 |
| 6 | .923555 | 31 | 6 | .927165 | 31 | 6 | .930745 | 31 | 6 | .934296 | 30 | 6 | .937819 | 30 |
| 7 | .923607 | 36 | 7 | .927216 | 36 | 7 | .930796 | 36 | 7 | .934347 | 35 | 7 | .937869 | 35 |
| 8 | .923658 | 42 | 8 | .927268 | 41 | 8 | .930847 | 41 | 8 | .934397 | 40 | 8 | .937919 | 40 |
| 9 | .923710 | 47 | 9 | .927319 | 46 | 9 | .930898 | 46 | 9 | .934448 | 45 | 9 | .937969 | 45 |
| 8390 | .923762 | 00 | 8460 | .927370 | 00 | 8530 | .930949 | 00 | 8600 | .934498 | 00 | 8670 | .938019 | 00 |
| 1 | .923814 | 05 | 1 | .927422 | 05 | 1 | .931000 | 05 | 1 | .934549 | 05 | 1 | .938069 | 05 |
| 2 | .923865 | 10 | 2 | .927473 | 10 | 2 | .931051 | 10 | 2 | .934599 | 10 | 2 | .938119 | 10 |
| 3 | .923917 | 16 | 3 | .927524 | 15 | 3 | .931102 | 15 | 3 | .934650 | 15 | 3 | .938169 | 15 |
| 4 | .923969 | 21 | 4 | .927576 | 21 | 4 | .931153 | 20 | 4 | .934700 | 20 | 4 | .938219 | 20 |
| 5 | .924021 | 26 | 5 | .927627 | 26 | 5 | .931203 | 25 | 5 | .934751 | 25 | 5 | .938269 | 25 |
| 6 | .924072 | 31 | 6 | .927678 | 31 | 6 | .931254 | 31 | 6 | .934801 | 30 | 6 | .938319 | 30 |
| 7 | .924124 | 36 | 7 | .927730 | 36 | 7 | .931305 | 36 | 7 | .934852 | 35 | 7 | .938370 | 35 |
| 8 | .924176 | 42 | 8 | .927781 | 41 | 8 | .931356 | 41 | 8 | .934902 | 40 | 8 | .938420 | 40 |
| 9 | .924228 | 47 | 9 | .927832 | 46 | 9 | .931407 | 46 | 9 | .934953 | 45 | 9 | .938470 | 45 |
| 8400 | .924279 | 00 | 8470 | .927883 | 00 | 8540 | .931458 | 00 | 8610 | .935003 | 00 | 8680 | .938520 | 00 |
| 1 | .924331 | 05 | 1 | .927935 | 05 | 1 | .931509 | 05 | 1 | .935054 | 05 | 1 | .938570 | 05 |
| 2 | .924383 | 10 | 2 | .927986 | 10 | 2 | .931560 | 10 | 2 | .935104 | 10 | 2 | .938620 | 10 |
| 3 | .924434 | 15 | 3 | .928037 | 15 | 3 | .931610 | 15 | 3 | .935154 | 15 | 3 | .938670 | 15 |
| 4 | .924486 | 21 | 4 | .928088 | 21 | 4 | .931661 | 20 | 4 | .935205 | 20 | 4 | .938720 | 20 |
| 5 | .924538 | 26 | 5 | .928140 | 26 | 5 | .931712 | 25 | 5 | .935255 | 25 | 5 | .938770 | 25 |
| 6 | .924589 | 31 | 6 | .928191 | 31 | 6 | .931763 | 31 | 6 | .935306 | 30 | 6 | .938820 | 30 |
| 7 | .924641 | 36 | 7 | .928242 | 36 | 7 | .931814 | 36 | 7 | .935356 | 35 | 7 | .938870 | 35 |
| 8 | .924693 | 41 | 8 | .928293 | 41 | 8 | .931864 | 41 | 8 | .935406 | 40 | 8 | .938920 | 40 |
| 9 | .924744 | 46 | 9 | .928345 | 46 | 9 | .931915 | 46 | 9 | .935457 | 45 | 9 | .938970 | 45 |
| 8410 | .924796 | 00 | 8480 | .928396 | 00 | 8550 | .931966 | 00 | 8620 | .935507 | 00 | 8690 | .939020 | 00 |
| 1 | .924848 | 05 | 1 | .928447 | 05 | 1 | .932017 | 05 | 1 | .935558 | 05 | 1 | .939070 | 05 |
| 2 | .924899 | 10 | 2 | .928498 | 10 | 2 | .932068 | 10 | 2 | .935608 | 10 | 2 | .939120 | 10 |
| 3 | .924951 | 15 | 3 | .928549 | 15 | 3 | .932118 | 15 | 3 | .935658 | 15 | 3 | .939170 | 15 |
| 4 | .925002 | 21 | 4 | .928601 | 21 | 4 | .932169 | 20 | 4 | .935709 | 20 | 4 | .939220 | 20 |
| 5 | .925054 | 26 | 5 | .928652 | 26 | 5 | .932220 | 25 | 5 | .935759 | 25 | 5 | .939270 | 25 |
| 6 | .925106 | 31 | 6 | .928703 | 31 | 6 | .932271 | 30 | 6 | .935809 | 30 | 6 | .939319 | 30 |
| 7 | .925157 | 36 | 7 | .928754 | 36 | 7 | .932321 | 35 | 7 | .935860 | 35 | 7 | .939369 | 35 |
| 8 | .925209 | 41 | 8 | .928805 | 41 | 8 | .932372 | 40 | 8 | .935910 | 40 | 8 | .939419 | 40 |
| 9 | .925260 | 46 | 9 | .928856 | 46 | 9 | .932423 | 45 | 9 | .935960 | 45 | 9 | .939469 | 45 |

Log. .939519 to .956601 No. 8700 to 9049. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8700 | .939519 | 00 | 8770 | .943000 | 00 | 8840 | .946452 | 00 | 8910 | .949878 | 00 | 8980 | .953276 | 00 |
| 1 | .939569 | 05 | 1 | .943049 | 05 | 1 | .946501 | 05 | 1 | .949926 | 05 | 1 | .953325 | 05 |
| 2 | .939619 | 10 | 2 | .943099 | 10 | 2 | .946550 | 10 | 2 | .949975 | 10 | 2 | .953373 | 10 |
| 3 | .939669 | 15 | 3 | .943148 | 15 | 3 | .946600 | 15 | 3 | .950024 | 15 | 3 | .953421 | 15 |
| 4 | .939719 | 20 | 4 | .943198 | 20 | 4 | .946649 | 20 | 4 | .950073 | 20 | 4 | .953470 | 19 |
| 5 | .939769 | 25 | 5 | .943247 | 25 | 5 | .946698 | 25 | 5 | .950121 | 25 | 5 | .953518 | 24 |
| 6 | .939819 | 30 | 6 | .943297 | 30 | 6 | .946747 | 29 | 6 | .950170 | 29 | 6 | .953566 | 29 |
| 7 | .939868 | 35 | 7 | .943346 | 35 | 7 | .946796 | 34 | 7 | .950219 | 34 | 7 | .953615 | 34 |
| 8 | .939918 | 40 | 8 | .943396 | 40 | 8 | .946845 | 39 | 8 | .950267 | 39 | 8 | .953663 | 39 |
| 9 | .939968 | 45 | 9 | .943445 | 45 | 9 | .946894 | 44 | 9 | .950316 | 44 | 9 | .953711 | 44 |
| 8710 | .940018 | 00 | 8780 | .943494 | 00 | 8850 | .946943 | 00 | 8920 | .950365 | 00 | 8990 | .953760 | 00 |
| 1 | .940068 | 05 | 1 | .943544 | 05 | 1 | .946992 | 05 | 1 | .950413 | 05 | 1 | .953808 | 05 |
| 2 | .940118 | 10 | 2 | .943593 | 10 | 2 | .947041 | 10 | 2 | .950462 | 10 | 2 | .953856 | 10 |
| 3 | .940168 | 15 | 3 | .943643 | 15 | 3 | .947090 | 15 | 3 | .950511 | 15 | 3 | .953905 | 15 |
| 4 | .940218 | 20 | 4 | .943692 | 20 | 4 | .947139 | 20 | 4 | .950560 | 19 | 4 | .953953 | 19 |
| 5 | .940267 | 25 | 5 | .943742 | 25 | 5 | .947189 | 25 | 5 | .950608 | 24 | 5 | .954001 | 24 |
| 6 | .940317 | 30 | 6 | .943791 | 30 | 6 | .947238 | 29 | 6 | .950657 | 29 | 6 | .954049 | 29 |
| 7 | .940367 | 35 | 7 | .943841 | 35 | 7 | .947287 | 34 | 7 | .950705 | 34 | 7 | .954098 | 34 |
| 8 | .940417 | 40 | 8 | .943890 | 40 | 8 | .947336 | 39 | 8 | .950754 | 39 | 8 | .954146 | 39 |
| 9 | .940467 | 45 | 9 | .943939 | 45 | 9 | .947385 | 44 | 9 | .950803 | 44 | 9 | .954194 | 44 |
| 8720 | .940516 | 00 | 8790 | .943989 | 00 | 8860 | .947434 | 00 | 8930 | .950851 | 00 | 9000 | .954242 | 00 |
| 1 | .940566 | 05 | 1 | .944038 | 05 | 1 | .947483 | 05 | 1 | .950900 | 05 | 1 | .954291 | 05 |
| 2 | .940616 | 10 | 2 | .944088 | 10 | 2 | .947532 | 10 | 2 | .950949 | 10 | 2 | .954339 | 10 |
| 3 | .940666 | 15 | 3 | .944137 | 15 | 3 | .947581 | 15 | 3 | .950997 | 15 | 3 | .954387 | 14 |
| 4 | .940716 | 20 | 4 | .944186 | 20 | 4 | .947630 | 20 | 4 | .951046 | 19 | 4 | .954435 | 19 |
| 5 | .940765 | 25 | 5 | .944236 | 25 | 5 | .947679 | 25 | 5 | .951095 | 24 | 5 | .954484 | 24 |
| 6 | .940815 | 30 | 6 | .944285 | 30 | 6 | .947728 | 29 | 6 | .951143 | 29 | 6 | .954532 | 29 |
| 7 | .940865 | 35 | 7 | .944335 | 35 | 7 | .947777 | 34 | 7 | .951192 | 34 | 7 | .954580 | 34 |
| 8 | .940915 | 40 | 8 | .944384 | 40 | 8 | .947826 | 39 | 8 | .951240 | 39 | 8 | .954628 | 38 |
| 9 | .940964 | 45 | 9 | .944433 | 45 | 9 | .947875 | 44 | 9 | .951289 | 44 | 9 | .954677 | 43 |
| 8730 | .941014 | 00 | 8800 | .944483 | 00 | 8870 | .947924 | 00 | 8940 | .951337 | 00 | 9010 | .954725 | 00 |
| 1 | .941064 | 05 | 1 | .944532 | 05 | 1 | .947973 | 05 | 1 | .951386 | 05 | 1 | .954773 | 05 |
| 2 | .941114 | 10 | 2 | .944581 | 10 | 2 | .948021 | 10 | 2 | .951435 | 10 | 2 | .954821 | 10 |
| 3 | .941163 | 15 | 3 | .944631 | 15 | 3 | .948070 | 15 | 3 | .951483 | 15 | 3 | .954869 | 14 |
| 4 | .941213 | 20 | 4 | .944680 | 20 | 4 | .948119 | 20 | 4 | .951532 | 19 | 4 | .954918 | 19 |
| 5 | .941263 | 25 | 5 | .944729 | 25 | 5 | .948168 | 25 | 5 | .951580 | 24 | 5 | .954966 | 24 |
| 6 | .941313 | 30 | 6 | .944779 | 30 | 6 | .948217 | 29 | 6 | .951629 | 29 | 6 | .955014 | 29 |
| 7 | .941362 | 35 | 7 | .944828 | 35 | 7 | .948266 | 34 | 7 | .951677 | 34 | 7 | .955062 | 34 |
| 8 | .941412 | 40 | 8 | .944877 | 40 | 8 | .948315 | 39 | 8 | .951726 | 39 | 8 | .955110 | 38 |
| 9 | .941462 | 45 | 9 | .944927 | 45 | 9 | .948364 | 44 | 9 | .951774 | 44 | 9 | .955158 | 43 |
| 8740 | .941511 | 00 | 8810 | .944976 | 00 | 8880 | .948413 | 00 | 8950 | .951823 | 00 | 9020 | .955206 | 00 |
| 1 | .941561 | 05 | 1 | .945025 | 05 | 1 | .948462 | 05 | 1 | .951872 | 05 | 1 | .955255 | 05 |
| 2 | .941611 | 10 | 2 | .945074 | 10 | 2 | .948511 | 10 | 2 | .951920 | 10 | 2 | .955303 | 10 |
| 3 | .941660 | 15 | 3 | .945124 | 15 | 3 | .948560 | 15 | 3 | .951969 | 15 | 3 | .955351 | 14 |
| 4 | .941710 | 20 | 4 | .945173 | 20 | 4 | .948608 | 20 | 4 | .952017 | 19 | 4 | .955399 | 19 |
| 5 | .941760 | 25 | 5 | .945222 | 25 | 5 | .948657 | 25 | 5 | .952066 | 24 | 5 | .955447 | 24 |
| 6 | .941809 | 30 | 6 | .945272 | 30 | 6 | .948706 | 29 | 6 | .952114 | 29 | 6 | .955495 | 29 |
| 7 | .941859 | 35 | 7 | .945321 | 35 | 7 | .948755 | 34 | 7 | .952163 | 34 | 7 | .955543 | 34 |
| 8 | .941909 | 40 | 8 | .945370 | 40 | 8 | .948804 | 39 | 8 | .952211 | 39 | 8 | .955592 | 38 |
| 9 | .941958 | 45 | 9 | .945419 | 45 | 9 | .948853 | 44 | 9 | .952259 | 44 | 9 | .955640 | 43 |
| 8750 | .942008 | 00 | 8820 | .945469 | 00 | 8890 | .948902 | 00 | 8960 | .952308 | 00 | 9030 | .955688 | 00 |
| 1 | .942058 | 05 | 1 | .945518 | 05 | 1 | .948951 | 05 | 1 | .952356 | 05 | 1 | .955736 | 05 |
| 2 | .942107 | 10 | 2 | .945567 | 10 | 2 | .948999 | 10 | 2 | .952405 | 10 | 2 | .955784 | 10 |
| 3 | .942157 | 15 | 3 | .945616 | 15 | 3 | .949048 | 15 | 3 | .952453 | 15 | 3 | .955832 | 14 |
| 4 | .942206 | 20 | 4 | .945665 | 20 | 4 | .949097 | 20 | 4 | .952502 | 19 | 4 | .955880 | 19 |
| 5 | .942256 | 25 | 5 | .945715 | 25 | 5 | .949146 | 25 | 5 | .952550 | 24 | 5 | .955928 | 24 |
| 6 | .942306 | 30 | 6 | .945764 | 29 | 6 | .949195 | 29 | 6 | .952599 | 29 | 6 | .955976 | |
| 7 | .942355 | 35 | 7 | .945813 | 34 | 7 | .949244 | 34 | 7 | .952647 | 34 | 7 | .956024 | 34 |
| 8 | .942405 | 40 | 8 | .945862 | 39 | 8 | .949292 | 39 | 8 | .952696 | 39 | 8 | .956072 | 38 |
| 9 | .942454 | 45 | 9 | .945911 | 44 | 9 | .949341 | 44 | 9 | .952744 | 44 | 9 | .956120 | 43 |
| 8760 | .942504 | 00 | 8830 | .945961 | 00 | 8900 | .949390 | 00 | 8970 | .952792 | 00 | 9040 | .956168 | 00 |
| 1 | .942554 | 05 | 1 | .946010 | 05 | 1 | .949439 | 05 | 1 | .952841 | 05 | 1 | .956216 | 05 |
| 2 | .942603 | 10 | 2 | .946059 | 10 | 2 | .949488 | 10 | 2 | .952889 | 10 | 2 | .956264 | 10 |
| 3 | .942653 | 15 | 3 | .946108 | 15 | 3 | .949536 | 15 | 3 | .952938 | 15 | 3 | .956312 | 14 |
| 4 | .942702 | 20 | 4 | .946157 | 20 | 4 | .949585 | 20 | 4 | .952986 | 19 | 4 | .956361 | 19 |
| 5 | .942752 | 25 | 5 | .946207 | 25 | 5 | .949634 | 25 | 5 | .953034 | 24 | 5 | .956409 | 24 |
| 6 | .942801 | 30 | 6 | .946256 | 29 | 6 | .949683 | 29 | 6 | .953083 | 29 | 6 | .956457 | 29 |
| 7 | .942851 | 35 | 7 | .946305 | 34 | 7 | .949731 | 34 | 7 | .953131 | 34 | 7 | .956505 | 34 |
| 8 | .942900 | 40 | 8 | .946354 | 39 | 8 | .949780 | 39 | 8 | .953180 | 39 | 8 | .956553 | 38 |
| 9 | .942950 | 45 | 9 | .946403 | 44 | 9 | .949829 | 44 | 9 | .953228 | 44 | 9 | .956601 | 43 |

## Log. .956649 to .973082 No. 9050 to 9399 (u.)

| No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9050 | .956649 | 00 | 9120 | .959995 | 00 | 9190 | .963315 | 00 | 9260 | .966611 | 00 | 9330 | .969882 | 00 |
| 1 | .956697 | 05 | 1 | .960042 | 05 | 1 | .963363 | 05 | 1 | .966658 | 05 | 1 | .969928 | 05 |
| 2 | .956744 | 10 | 2 | .960090 | 10 | 2 | .963410 | 09 | 2 | .966705 | 09 | 2 | .969975 | 09 |
| 3 | .956792 | 14 | 3 | .960138 | 14 | 3 | .963457 | 14 | 3 | .966752 | 14 | 3 | .970021 | 14 |
| 4 | .956840 | 19 | 4 | .960185 | 19 | 4 | .963504 | 19 | 4 | .966798 | 19 | 4 | .970068 | 19 |
| 5 | .956888 | 24 | 5 | .960233 | 24 | 5 | .963552 | 24 | 5 | .966845 | 24 | 5 | .970114 | 23 |
| 6 | .956936 | 29 | 6 | .960280 | 28 | 6 | .963599 | 28 | 6 | .966892 | 28 | 6 | .970161 | 28 |
| 7 | .956984 | 34 | 7 | .960328 | 33 | 7 | .963646 | 33 | 7 | .966939 | 33 | 7 | .970207 | 33 |
| 8 | .957032 | 38 | 8 | .960376 | 38 | 8 | .963693 | 38 | 8 | .966986 | 38 | 8 | .970254 | 37 |
| 9 | .957080 | 43 | 9 | .960423 | 43 | 9 | .963741 | 42 | 9 | .967033 | 42 | 9 | .970300 | 42 |
| 9060 | .957128 | 00 | 9130 | .960471 | 00 | 9200 | .963788 | 00 | 9270 | .967080 | 00 | 9340 | .970347 | 00 |
| 1 | .957176 | 05 | 1 | .960518 | 05 | 1 | .963835 | 05 | 1 | .967127 | 05 | 1 | .970393 | 05 |
| 2 | .957224 | 10 | 2 | .960566 | 10 | 2 | .963882 | 09 | 2 | .967173 | 09 | 2 | .970440 | 09 |
| 3 | .957272 | 14 | 3 | .960613 | 14 | 3 | .963929 | 14 | 3 | .967220 | 14 | 3 | .970486 | 14 |
| 4 | .957320 | 19 | 4 | .960661 | 19 | 4 | .963977 | 19 | 4 | .967267 | 19 | 4 | .970533 | 19 |
| 5 | .957368 | 24 | 5 | .960709 | 24 | 5 | .964024 | 24 | 5 | .967314 | 24 | 5 | .970579 | 23 |
| 6 | .957416 | 29 | 6 | .960756 | 28 | 6 | .964071 | 28 | 6 | .967361 | 28 | 6 | .970626 | 28 |
| 7 | .957464 | 34 | 7 | .960804 | 33 | 7 | .964118 | 33 | 7 | .967408 | 33 | 7 | .970672 | 33 |
| 8 | .957511 | 38 | 8 | .960851 | 38 | 8 | .964165 | 38 | 8 | .967454 | 38 | 8 | .970719 | 37 |
| 9 | .957559 | 43 | 9 | .960899 | 43 | 9 | .964212 | 42 | 9 | .967501 | 42 | 9 | .970765 | 42 |
| 9070 | .957607 | 00 | 9140 | .960946 | 00 | 9210 | .964260 | 00 | 9280 | .967548 | 00 | 9350 | .970812 | 00 |
| 1 | .957655 | 05 | 1 | .960994 | 05 | 1 | .964307 | 05 | 1 | .967595 | 05 | 1 | .970858 | 05 |
| 2 | .957703 | 10 | 2 | .961041 | 10 | 2 | .964354 | 09 | 2 | .967642 | 09 | 2 | .970904 | 09 |
| 3 | .957751 | 14 | 3 | .961089 | 14 | 3 | .964401 | 14 | 3 | .967688 | 14 | 3 | .970951 | 14 |
| 4 | .957799 | 19 | 4 | .961136 | 19 | 4 | .964448 | 19 | 4 | .967735 | 19 | 4 | .970997 | 19 |
| 5 | .957847 | 24 | 5 | .961184 | 24 | 5 | .964495 | 24 | 5 | .967782 | 23 | 5 | .971044 | 23 |
| 6 | .957894 | 29 | 6 | .961231 | 28 | 6 | .964542 | 28 | 6 | .967829 | 28 | 6 | .971090 | 28 |
| 7 | .957942 | 34 | 7 | .961279 | 33 | 7 | .964590 | 33 | 7 | .967875 | 33 | 7 | .971137 | 33 |
| 8 | .957990 | 38 | 8 | .961326 | 38 | 8 | .964637 | 38 | 8 | .967922 | 38 | 8 | .971183 | 37 |
| 9 | .958038 | 43 | 9 | .961374 | 43 | 9 | .964684 | 42 | 9 | .967969 | 42 | 9 | .971229 | 42 |
| 9080 | .958086 | 00 | 9150 | .961421 | 00 | 9220 | .964731 | 00 | 9290 | .968016 | 00 | 9360 | .971276 | 00 |
| 1 | .958134 | 05 | 1 | .961469 | 05 | 1 | .964778 | 05 | 1 | .968062 | 05 | 1 | .971322 | 05 |
| 2 | .958181 | 10 | 2 | .961516 | 10 | 2 | .964825 | 09 | 2 | .968109 | 09 | 2 | .971369 | 09 |
| 3 | .958229 | 14 | 3 | .961563 | 14 | 3 | .964872 | 14 | 3 | .968156 | 14 | 3 | .971415 | 14 |
| 4 | .958277 | 19 | 4 | .961611 | 19 | 4 | .964919 | 19 | 4 | .968203 | 19 | 4 | .971461 | 19 |
| 5 | .958325 | 24 | 5 | .961658 | 24 | 5 | .964966 | 24 | 5 | .968249 | 23 | 5 | .971508 | 23 |
| 6 | .958373 | 29 | 6 | .961706 | 28 | 6 | .965013 | 28 | 6 | .968296 | 28 | 6 | .971554 | 28 |
| 7 | .958420 | 34 | 7 | .961753 | 33 | 7 | .965060 | 33 | 7 | .968343 | 33 | 7 | .971600 | 33 |
| 8 | .958468 | 38 | 8 | .961801 | 38 | 8 | .965108 | 38 | 8 | .968389 | 38 | 8 | .971647 | 37 |
| 9 | .958516 | 43 | 9 | .961848 | 43 | 9 | .965155 | 42 | 9 | .968436 | 42 | 9 | .971693 | 42 |
| 9090 | .958564 | 00 | 9160 | .961895 | 00 | 9230 | .965202 | 00 | 9300 | .968483 | 00 | 9370 | .971740 | 00 |
| 1 | .958612 | 05 | 1 | .961943 | 05 | 1 | .965249 | 05 | 1 | .968530 | 05 | 1 | .971786 | 05 |
| 2 | .958659 | 10 | 2 | .961990 | 10 | 2 | .965296 | 09 | 2 | .968576 | 09 | 2 | .971832 | 09 |
| 3 | .958707 | 14 | 3 | .962038 | 14 | 3 | .965343 | 14 | 3 | .968623 | 14 | 3 | .971879 | 14 |
| 4 | .958755 | 19 | 4 | .962085 | 19 | 4 | .965390 | 19 | 4 | .968670 | 19 | 4 | .971925 | 19 |
| 5 | .958803 | 24 | 5 | .962132 | 24 | 5 | .965437 | 24 | 5 | .968716 | 23 | 5 | .971971 | 23 |
| 6 | .958850 | 29 | 6 | .962180 | 28 | 6 | .965484 | 28 | 6 | .968763 | 28 | 6 | .972018 | 28 |
| 7 | .958898 | 34 | 7 | .962227 | 33 | 7 | .965531 | 33 | 7 | .968810 | 33 | 7 | .972064 | 33 |
| 8 | .958946 | 38 | 8 | .962275 | 38 | 8 | .965578 | 38 | 8 | .968856 | 37 | 8 | .972110 | 37 |
| 9 | .958994 | 43 | 9 | .962322 | 43 | 9 | .965625 | 42 | 9 | .968903 | 42 | 9 | .972156 | 42 |
| 9100 | .959041 | 00 | 9170 | .962369 | 00 | 9240 | .965672 | 00 | 9310 | .968950 | 00 | 9380 | .972203 | 00 |
| 1 | .959089 | 05 | 1 | .962417 | 05 | 1 | .965719 | 05 | 1 | .968996 | 05 | 1 | .972249 | 05 |
| 2 | .959137 | 10 | 2 | .962464 | 09 | 2 | .965766 | 09 | 2 | .969043 | 09 | 2 | .972295 | 09 |
| 3 | .959184 | 14 | 3 | .962511 | 14 | 3 | .965813 | 14 | 3 | .969090 | 14 | 3 | .972342 | 14 |
| 4 | .959232 | 19 | 4 | .962559 | 19 | 4 | .965860 | 19 | 4 | .969136 | 19 | 4 | .972388 | 18 |
| 5 | .959280 | 24 | 5 | .962606 | 24 | 5 | .965907 | 24 | 5 | .969183 | 23 | 5 | .972434 | 23 |
| 6 | .959328 | 29 | 6 | .962653 | 28 | 6 | .965954 | 28 | 6 | .969229 | 28 | 6 | .972480 | 28 |
| 7 | .959375 | 34 | 7 | .962701 | 33 | 7 | .966001 | 33 | 7 | .969276 | 33 | 7 | .972527 | 32 |
| 8 | .959423 | 38 | 8 | .962748 | 38 | 8 | .966048 | 38 | 8 | .969323 | 37 | 8 | .972573 | 37 |
| 9 | .959471 | 43 | 9 | .962795 | 42 | 9 | .966095 | 42 | 9 | .969369 | 42 | 9 | .972619 | 41 |
| 9110 | .959518 | 00 | 9180 | .962843 | 00 | 9250 | .966142 | 00 | 9320 | .969416 | 00 | 9390 | .972666 | 00 |
| 1 | .959566 | 05 | 1 | .962890 | 05 | 1 | .966189 | 05 | 1 | .969462 | 05 | 1 | .972712 | 05 |
| 2 | .959614 | 10 | 2 | .962937 | 09 | 2 | .966236 | 09 | 2 | .969509 | 09 | 2 | .972758 | 09 |
| 3 | .959661 | 14 | 3 | .962985 | 14 | 3 | .966283 | 14 | 3 | .969556 | 14 | 3 | .972804 | 14 |
| 4 | .959709 | 19 | 4 | .963032 | 19 | 4 | .966329 | 19 | 4 | .969602 | 19 | 4 | .972851 | 18 |
| 5 | .959757 | 24 | 5 | .963079 | 24 | 5 | .966376 | 24 | 5 | .969649 | 23 | 5 | .972897 | 23 |
| 6 | .959804 | 29 | 6 | .963126 | 28 | 6 | .966423 | 28 | 6 | .969695 | 28 | 6 | .972943 | 28 |
| 7 | .959852 | 34 | 7 | .963174 | 33 | 7 | .966470 | 33 | 7 | .969742 | 33 | 7 | .972989 | 32 |
| 8 | .959900 | 38 | 8 | .963221 | 38 | 8 | .966517 | 38 | 8 | .969788 | 37 | 8 | .973035 | 37 |
| 9 | .959947 | 43 | 9 | .963268 | 42 | 9 | .966564 | 42 | 9 | .969835 | 42 | 9 | .973082 | 41 |

Log. 973128 to .988960 No. 9400 to 9749. (u.)

| No. | Log. | Part. | No. | Log. | Part. | No | Log. | Part. | No. | Log. | Part. | No. | Log. | Part. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9400 | .973128 | 00 | 9470 | .976350 | 00 | 9540 | .979548 | 00 | 9610 | .982723 | 00 | 9680 | .985875 | 00 |
| 1 | .973174 | 05 | 1 | .976396 | 05 | 1 | .979594 | 05 | 1 | .982769 | 05 | 1 | .985920 | 04 |
| 2 | .973220 | 09 | 2 | .976442 | 09 | 2 | .979639 | 09 | 2 | .982814 | 09 | 2 | .985965 | 09 |
| 3 | .973266 | 14 | 3 | .976487 | 14 | 3 | .979685 | 14 | 3 | .982859 | 14 | 3 | .986010 | 13 |
| 4 | .973313 | 18 | 4 | .976533 | 18 | 4 | .979730 | 18 | 4 | .982904 | 18 | 4 | .986055 | 18 |
| 5 | .973359 | 23 | 5 | .976579 | 23 | 5 | .979776 | 23 | 5 | .982949 | 23 | 5 | .986100 | 22 |
| 6 | .973405 | 28 | 6 | .976625 | 28 | 6 | .979821 | 27 | 6 | .982994 | 27 | 6 | .986144 | 27 |
| 7 | .973451 | 32 | 7 | .976671 | 32 | 7 | .979867 | 32 | 7 | .983040 | 32 | 7 | .986189 | 31 |
| 8 | .973497 | 37 | 8 | .976717 | 37 | 8 | .979912 | 36 | 8 | .983085 | 36 | 8 | .986234 | 36 |
| 9 | .973543 | 41 | 9 | .976762 | 41 | 9 | .979958 | 41 | 9 | .983130 | 41 | 9 | .986279 | 40 |
| 9410 | .973590 | 00 | 9480 | .976808 | 00 | 9550 | .980003 | 00 | 9620 | .983175 | 00 | 9690 | .986324 | 00 |
| 1 | .973636 | 05 | 1 | .976854 | 05 | 1 | .980049 | 05 | 1 | .983220 | 05 | 1 | .986369 | 04 |
| 2 | .973682 | 09 | 2 | .976900 | 09 | 2 | .980094 | 09 | 2 | .983265 | 09 | 2 | .986413 | 09 |
| 3 | .973728 | 14 | 3 | .976946 | 14 | 3 | .980140 | 14 | 3 | .983310 | 14 | 3 | .986458 | 13 |
| 4 | .973774 | 18 | 4 | .976991 | 18 | 4 | .980185 | 18 | 4 | .983356 | 18 | 4 | .986503 | 18 |
| 5 | .973820 | 23 | 5 | .977037 | 23 | 5 | .980231 | 23 | 5 | .983401 | 23 | 5 | .986548 | 22 |
| 6 | .973866 | 28 | 6 | .977083 | 27 | 6 | .980276 | 27 | 6 | .983446 | 27 | 6 | .986593 | 27 |
| 7 | .973913 | 32 | 7 | .977129 | 32 | 7 | .980322 | 32 | 7 | .983491 | 32 | 7 | .986637 | 31 |
| 8 | .973959 | 37 | 8 | .977175 | 37 | 8 | .980367 | 36 | 8 | .983536 | 36 | 8 | .986682 | 36 |
| 9 | .974005 | 41 | 9 | .977220 | 41 | 9 | .980412 | 41 | 9 | .983581 | 41 | 9 | .986727 | 40 |
| 9420 | .974051 | 00 | 9490 | .977266 | 00 | 9560 | .980458 | 00 | 9630 | .983626 | 00 | 9700 | .986772 | 00 |
| 1 | .974097 | 05 | 1 | .977312 | 05 | 1 | .980503 | 05 | 1 | .983671 | 05 | 1 | .986816 | 04 |
| 2 | .974143 | 09 | 2 | .977358 | 09 | 2 | .980549 | 09 | 2 | .983716 | 09 | 2 | .986861 | 09 |
| 3 | .974189 | 14 | 3 | .977403 | 14 | 3 | .980594 | 14 | 3 | .983762 | 14 | 3 | .986906 | 13 |
| 4 | .974235 | 18 | 4 | .977449 | 18 | 4 | .980640 | 18 | 4 | .983807 | 18 | 4 | .986951 | 18 |
| 5 | .974281 | 23 | 5 | .977495 | 23 | 5 | .980685 | 23 | 5 | .983852 | 23 | 5 | .986995 | 22 |
| 6 | .974327 | 28 | 6 | .977541 | 27 | 6 | .980730 | 27 | 6 | .983897 | 27 | 6 | .987040 | 27 |
| 7 | .974373 | 32 | 7 | .977586 | 32 | 7 | .980776 | 32 | 7 | .983942 | 32 | 7 | .987085 | 31 |
| 8 | .974420 | 37 | 8 | .977632 | 37 | 8 | .980821 | 36 | 8 | .983987 | 36 | 8 | .987130 | 36 |
| 9 | .974466 | 41 | 9 | .977678 | 41 | 9 | .980867 | 41 | 9 | .984032 | 41 | 9 | .987174 | 40 |
| 9430 | .974512 | 00 | 9500 | .977724 | 00 | 9570 | .980912 | 00 | 9640 | .984077 | 00 | 9710 | .987219 | 00 |
| 1 | .974558 | 05 | 1 | .977769 | 05 | 1 | .980957 | 05 | 1 | .984122 | 05 | 1 | .987264 | 04 |
| 2 | .974604 | 09 | 2 | .977815 | 09 | 2 | .981003 | 09 | 2 | .984167 | 09 | 2 | .987309 | 09 |
| 3 | .974650 | 14 | 3 | .977861 | 14 | 3 | .981048 | 14 | 3 | .984212 | 14 | 3 | .987353 | 13 |
| 4 | .974696 | 18 | 4 | .977906 | 18 | 4 | .981093 | 18 | 4 | .984257 | 18 | 4 | .987398 | 18 |
| 5 | .974742 | 23 | 5 | .977952 | 23 | 5 | .981139 | 23 | 5 | .984302 | 23 | 5 | .987443 | 22 |
| 6 | .974788 | 28 | 6 | .977998 | 27 | 6 | .981184 | 27 | 6 | .984347 | 27 | 6 | .987487 | 27 |
| 7 | .974834 | 32 | 7 | .978043 | 32 | 7 | .981229 | 32 | 7 | .984392 | 32 | 7 | .987532 | 31 |
| 8 | .974880 | 37 | 8 | .978089 | 37 | 8 | .981275 | 36 | 8 | .984437 | 36 | 8 | .987577 | 36 |
| 9 | .974926 | 41 | 9 | .978135 | 41 | 9 | .981320 | 41 | 9 | .984482 | 41 | 9 | .987622 | 40 |
| 9440 | .974972 | 00 | 9510 | .978180 | 00 | 9580 | .981365 | 00 | 9650 | .984527 | 00 | 9720 | .987666 | 00 |
| 1 | .975018 | 05 | 1 | .978226 | 05 | 1 | .981411 | 05 | 1 | .984572 | 05 | 1 | .987711 | 04 |
| 2 | .975064 | 09 | 2 | .978272 | 09 | 2 | .981456 | 09 | 2 | .984617 | 09 | 2 | .987756 | 09 |
| 3 | .975110 | 14 | 3 | .978317 | 14 | 3 | .981501 | 14 | 3 | .984662 | 14 | 3 | .987800 | 13 |
| 4 | .975156 | 18 | 4 | .978363 | 18 | 4 | .981547 | 18 | 4 | .984707 | 18 | 4 | .987845 | 18 |
| 5 | .975202 | 23 | 5 | .978409 | 23 | 5 | .981592 | 23 | 5 | .984752 | 23 | 5 | .987890 | 22 |
| 6 | .975248 | 28 | 6 | .978454 | 27 | 6 | .981637 | 27 | 6 | .984797 | 27 | 6 | .987934 | 27 |
| 7 | .975294 | 32 | 7 | .978500 | 32 | 7 | .981683 | 32 | 7 | .984842 | 32 | 7 | .987979 | 31 |
| 8 | .975340 | 37 | 8 | .978546 | 37 | 8 | .981728 | 36 | 8 | .984887 | 36 | 8 | .988024 | 36 |
| 9 | .975386 | 41 | 9 | .978591 | 41 | 9 | .981773 | 41 | 9 | .984932 | 41 | 9 | .988068 | 40 |
| 9450 | .975432 | 00 | 9520 | .978637 | 00 | 9590 | .981819 | 00 | 9660 | .984977 | 00 | 9730 | .988113 | 00 |
| 1 | .975478 | 05 | 1 | .978683 | 05 | 1 | .981864 | 05 | 1 | .985022 | 05 | 1 | .988157 | 04 |
| 2 | .975524 | 09 | 2 | .978728 | 09 | 2 | .981909 | 09 | 2 | .985067 | 09 | 2 | .988202 | 09 |
| 3 | .975570 | 14 | 3 | .978774 | 14 | 3 | .981954 | 14 | 3 | .985112 | 14 | 3 | .988247 | 13 |
| 4 | .975616 | 18 | 4 | .978819 | 18 | 4 | .982000 | 18 | 4 | .985157 | 18 | 4 | .988291 | 18 |
| 5 | .975661 | 23 | 5 | .978865 | 23 | 5 | .982045 | 23 | 5 | .985202 | 23 | 5 | .988336 | 22 |
| 6 | .975707 | 28 | 6 | .978911 | 27 | 6 | .982090 | 27 | 6 | .985247 | 27 | 6 | .988381 | 27 |
| 7 | .975753 | 32 | 7 | .978956 | 32 | 7 | .982135 | 32 | 7 | .985292 | 32 | 7 | .988425 | 31 |
| 8 | .975799 | 37 | 8 | .979002 | 36 | 8 | .982181 | 36 | 8 | .985337 | 36 | 8 | .988470 | 36 |
| 9 | .975845 | 41 | 9 | .979047 | 41 | 9 | .982226 | 41 | 9 | .985382 | 41 | 9 | .988514 | 40 |
| 9460 | .975891 | 00 | 9530 | .979093 | 00 | 9600 | .982271 | 00 | 9670 | .985426 | 00 | 9740 | .988559 | 00 |
| 1 | .975937 | 05 | 1 | .979138 | 05 | 1 | .982316 | 05 | 1 | .985471 | 04 | 1 | .988603 | 04 |
| 2 | .975983 | 09 | 2 | .979184 | 09 | 2 | .982362 | 09 | 2 | .985516 | 09 | 2 | .988648 | 09 |
| 3 | .976029 | 14 | 3 | .979230 | 14 | 3 | .982407 | 14 | 3 | .985561 | 13 | 3 | .988693 | 13 |
| 4 | .976075 | 18 | 4 | .979275 | 18 | 4 | .982452 | 18 | 4 | .985606 | 18 | 4 | .988737 | 18 |
| 5 | .976121 | 23 | 5 | .979321 | 23 | 5 | .982497 | 23 | 5 | .985651 | 22 | 5 | .988782 | 22 |
| 6 | .976166 | 28 | 6 | .979366 | 27 | 6 | .982543 | 27 | 6 | .985696 | 27 | 6 | .988826 | 27 |
| 7 | .976212 | 32 | 7 | .979412 | 32 | 7 | .982588 | 32 | 7 | .985741 | 31 | 7 | .988871 | 31 |
| 8 | .976258 | 37 | 8 | .979457 | 36 | 8 | .982633 | 36 | 8 | .985786 | 36 | 8 | .988915 | 36 |
| 9 | .976304 | 41 | 9 | .979503 | 41 | 9 | .982678 | 41 | 9 | .985830 | 40 | 9 | .988960 | 40 |

## Nat. Versines. (V.)

| ′ | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0000000 | 0000152 | 0000609 | 0001370 | 0002436 | 0003805 | 0005478 | 0007454 | 0009732 | 0012312 | 0 |
| 1 | 0000000 | 0000157 | 0000619 | 0001386 | 0002456 | 0003831 | 0005509 | 0007489 | 0009772 | 0012357 | 1 |
| 2 | 00000 | 00163 | 00630 | 01401 | 02477 | 03856 | 05539 | 07525 | 09813 | 12403 | 2 |
| 3 | 00000 | 00168 | 00640 | 01416 | 02497 | 03882 | 05570 | 07561 | 09854 | 12449 | 3 |
| 4 | 0000001 | 0000173 | 0000650 | 0001432 | 0002518 | 0003907 | 0005600 | 0007596 | 0009894 | 0012494 | 4 |
| 5 | 00001 | 00179 | 00661 | 01448 | 02538 | 03933 | 05631 | 07632 | 09935 | 12540 | 5 |
| 6 | 00001 | 00184 | 00672 | 01463 | 02559 | 03959 | 05662 | 07668 | 09976 | 12586 | 6 |
| 7 | 0000002 | 0000190 | 0000682 | 0001479 | 0002580 | 0003985 | 0005693 | 0007704 | 0010017 | 0012632 | 7 |
| 8 | 00003 | 00196 | 00693 | 01495 | 02601 | 04011 | 05724 | 07740 | 10058 | 12678 | 8 |
| 9 | 00003 | 00201 | 00704 | 01511 | 02622 | 04037 | 05755 | 07776 | 10100 | 12725 | 9 |
| 10 | 0000004 | 0000207 | 0000715 | 0001527 | 0002643 | 0004063 | 0005786 | 0007813 | 0010141 | 0012771 | 10 |
| 11 | 00005 | 00213 | 00726 | 01543 | 02664 | 04089 | 05818 | 07849 | 10182 | 12817 | 11 |
| 12 | 00006 | 00219 | 00737 | 01559 | 02685 | 04116 | 05849 | 07885 | 10224 | 12864 | 12 |
| 13 | 0000007 | 0000226 | 0000748 | 0001575 | 0002707 | 0004142 | 0005880 | 0007922 | 0010265 | 0012910 | 13 |
| 14 | 00008 | 00232 | 00760 | 01592 | 02728 | 04168 | 05912 | 07958 | 10307 | 12957 | 14 |
| 15 | 00009 | 00238 | 00771 | 01608 | 02750 | 04195 | 05944 | 07995 | 10349 | 13004 | 15 |
| 16 | 0000011 | 0000244 | 0000782 | 0001625 | 0002771 | 0004222 | 0005975 | 0008032 | 0010390 | 0013050 | 16 |
| 17 | 00012 | 00251 | 00794 | 01641 | 02793 | 04248 | 06007 | 08069 | 10432 | 13097 | 17 |
| 18 | 00014 | 00257 | 00806 | 01658 | 02815 | 04275 | 06039 | 08106 | 10474 | 13144 | 18 |
| 19 | 0000015 | 0000264 | 0000817 | 0001675 | 0002837 | 0004302 | 0006071 | 0008143 | 0010516 | 0013191 | 19 |
| 20 | 00017 | 00271 | 00829 | 01692 | 02859 | 04329 | 06103 | 08180 | 10558 | 13238 | 20 |
| 21 | 00019 | 00278 | 00841 | 01709 | 02881 | 04356 | 06135 | 08217 | 10601 | 13286 | 21 |
| 22 | 0000020 | 0000284 | 0000853 | 0001726 | 0002903 | 0004383 | 0006167 | 0008254 | 0010643 | 0013333 | 22 |
| 23 | 00022 | 00291 | 00865 | 01743 | 02925 | 04411 | 06200 | 08291 | 10685 | 13380 | 23 |
| 24 | 00024 | 00299 | 00877 | 01760 | 02947 | 04438 | 06232 | 08329 | 10728 | 13428 | 24 |
| 25 | 0000026 | 0000306 | 0000889 | 0001777 | 0002970 | 0004465 | 0006264 | 0008366 | 0010770 | 0013475 | 25 |
| 26 | 00029 | 00313 | 00902 | 01795 | 02992 | 04493 | 06297 | 08404 | 10813 | 13523 | 26 |
| 27 | 00031 | 00320 | 00914 | 01812 | 03015 | 04520 | 06330 | 08442 | 10855 | 13571 | 27 |
| 28 | 0000033 | 0000328 | 0000927 | 0001830 | 0003037 | 0004548 | 0006362 | 0008479 | 0010898 | 0013618 | 28 |
| 29 | 00036 | 00335 | 00939 | 01847 | 03060 | 04576 | 06395 | 08517 | 10941 | 13666 | 29 |
| 30 | 00038 | 00343 | 00952 | 01865 | 03083 | 04604 | 06428 | 08555 | 10984 | 13714 | 30 |
| 31 | 0000041 | 0000350 | 0000964 | 0001883 | 0003105 | 0004632 | 0006461 | 0008593 | 0011027 | 0013762 | 31 |
| 32 | 00043 | 00358 | 00977 | 01901 | 03128 | 04660 | 06494 | 08631 | 11070 | 13811 | 32 |
| 33 | 00046 | 00366 | 00990 | 01919 | 03151 | 04688 | 06527 | 08669 | 11113 | 13859 | 33 |
| 34 | 0000049 | 0000374 | 0001003 | 0001937 | 0003175 | 0004716 | 0006560 | 0008708 | 0011157 | 0013907 | 34 |
| 35 | 00052 | 00382 | 01016 | 01955 | 03198 | 04744 | 06594 | 08746 | 11200 | 13955 | 35 |
| 36 | 00055 | 00390 | 01029 | 01973 | 03221 | 04773 | 06627 | 08784 | 11244 | 14004 | 36 |
| 37 | 0000058 | 0000398 | 0001043 | 0001992 | 0003244 | 0004801 | 0006661 | 0008823 | 0011287 | 0014052 | 37 |
| 38 | 00061 | 00406 | 01056 | 02010 | 03268 | 04829 | 06694 | 08862 | 11331 | 14101 | 38 |
| 39 | 00064 | 00415 | 01069 | 02028 | 03291 | 04858 | 06728 | 08900 | 11374 | 14150 | 39 |
| 40 | 0000068 | 0000423 | 0001083 | 0002047 | 0003315 | 0004887 | 0006762 | 0008939 | 0011418 | 0014199 | 40 |
| 41 | 00071 | 00432 | 01096 | 02066 | 03339 | 04916 | 06795 | 08978 | 11462 | 14248 | 41 |
| 42 | 00075 | 00440 | 01110 | 02084 | 03363 | 04944 | 06829 | 09017 | 11506 | 14296 | 42 |
| 43 | 0000078 | 0000449 | 0001124 | 0002103 | 0003386 | 0004973 | 0006863 | 0009056 | 0011550 | 0014346 | 43 |
| 44 | 00082 | 00458 | 01138 | 02122 | 03410 | 05002 | 06897 | 09095 | 11594 | 14395 | 44 |
| 45 | 00086 | 00466 | 01152 | 02141 | 03434 | 05031 | 06931 | 09134 | 11638 | 14444 | 45 |
| 46 | 0000089 | 0000475 | 0001166 | 0002160 | 0003459 | 0005061 | 0006966 | 0009173 | 0011683 | 0014493 | 46 |
| 47 | 00093 | 00484 | 01180 | 02179 | 03483 | 05090 | 07000 | 09213 | 11727 | 14543 | 47 |
| 48 | 00097 | 00493 | 01194 | 02198 | 03507 | 05119 | 07034 | 09252 | 11772 | 14592 | 48 |
| 49 | 0000102 | 0000503 | 0001208 | 0002218 | 0003531 | 0005149 | 0007069 | 0009292 | 0011816 | 0014642 | 49 |
| 50 | 00106 | 00512 | 01222 | 02237 | 03556 | 05178 | 07103 | 09331 | 11861 | 14691 | 50 |
| 51 | 00110 | 00521 | 01237 | 02257 | 03580 | 05208 | 07138 | 09371 | 11905 | 14741 | 51 |
| 52 | 0000114 | 0000531 | 0001251 | 0002276 | 0003605 | 0005237 | 0007173 | 0009411 | 0011950 | 0014791 | 52 |
| 53 | 00119 | 00540 | 01266 | 02296 | 03630 | 05267 | 07208 | 09451 | 11995 | 14841 | 53 |
| 54 | 00123 | 00550 | 01281 | 02316 | 03655 | 05297 | 07243 | 09490 | 12040 | 14891 | 54 |
| 55 | 0000128 | 0000559 | 0001295 | 0002335 | 0003680 | 0005327 | 0007278 | 0009531 | 0012085 | 0014941 | 55 |
| 56 | 00133 | 00569 | 01310 | 02355 | 03705 | 05357 | 07313 | 09571 | 12130 | 14991 | 56 |
| 57 | 00137 | 00579 | 01325 | 02375 | 03730 | 05387 | 07348 | 09611 | 12175 | 15041 | 57 |
| 58 | 0000142 | 0000589 | 0001340 | 0002395 | 0003755 | 0005417 | 0007383 | 0009651 | 0012221 | 0015091 | 58 |
| 59 | 00147 | 00599 | 01355 | 02416 | 03780 | 05448 | 07418 | 09691 | 12266 | 15142 | 59 |
| 60 | 00152 | 00609 | 01370 | 02436 | 03805 | 05478 | 07454 | 09732 | 12312 | 15192 | 60 |

## Parts for Seconds. (v.)

| | 0° | | 1° | | 2° | | 3° | | 4° | | 5° | | 6° | | 7° | | 8° | | 9° | | 10° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| 3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 |
| 4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 |
| 5 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 |
| 6 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 5 | 5 | 6 |
| 7 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 7 |
| 8 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 6 | 7 | 8 |
| 9 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 3 | 4 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 8 | 9 |
| 10 | 0 | 0 | 1 | 1 | 2 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 8 | 8 | 10 |
| 11 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 7 | 7 | 8 | 8 | 9 | 9 | 11 |
| 12 | 0 | 0 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 12 |
| 13 | 0 | 0 | 1 | 2 | 2 | 3 | 3 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 8 | 9 | 9 | 10 | 10 | 11 | 13 |
| 14 | 0 | 0 | 1 | 2 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 11 | 11 | 12 | 14 |
| 15 | 0 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 5 | 6 | 6 | 7 | 8 | 8 | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 15 |
| 16 | 0 | 1 | 1 | 2 | 3 | 3 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 13 | 16 |
| 17 | 0 | 1 | 1 | 2 | 3 | 4 | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 14 | 17 |
| 18 | 0 | 1 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 14 | 15 | 18 |
| 19 | 0 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 10 | 10 | 11 | 12 | 13 | 14 | 14 | 15 | 16 | 19 |
| 20 | 0 | 1 | 2 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 8 | 9 | 10 | 11 | 12 | 13 | 13 | 14 | 15 | 16 | 17 | 20 |
| 21 | 0 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 21 |
| 22 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 22 |
| 23 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 14 | 15 | 16 | 17 | 18 | 19 | 23 |
| 24 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 24 |
| 25 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 25 |
| 26 | 0 | 1 | 2 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 22 | 26 |
| 27 | 0 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 22 | 23 | 27 |
| 28 | 0 | 1 | 2 | 3 | 5 | 6 | 7 | 8 | 9 | 11 | 12 | 13 | 14 | 15 | 16 | 18 | 19 | 20 | 21 | 22 | 24 | 28 |
| 29 | 0 | 1 | 2 | 4 | 5 | 6 | 7 | 9 | 10 | 11 | 12 | 13 | 15 | 16 | 17 | 18 | 19 | 21 | 22 | 23 | 24 | 29 |
| 30 | 0 | 1 | 2 | 4 | 5 | 6 | 8 | 9 | 10 | 11 | 13 | 14 | 15 | 16 | 18 | 19 | 20 | 21 | 23 | 24 | 25 | 30 |
| 31 | 0 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 10 | 12 | 13 | 14 | 16 | 17 | 18 | 20 | 21 | 22 | 23 | 25 | 26 | 31 |
| 32 | 0 | 1 | 3 | 4 | 5 | 7 | 8 | 9 | 11 | 12 | 13 | 15 | 16 | 17 | 19 | 20 | 22 | 23 | 24 | 26 | 27 | 32 |
| 33 | 0 | 1 | 3 | 4 | 6 | 7 | 8 | 10 | 11 | 12 | 14 | 15 | 17 | 18 | 19 | 21 | 22 | 24 | 25 | 26 | 28 | 33 |
| 34 | 0 | 1 | 3 | 4 | 6 | 7 | 9 | 10 | 11 | 13 | 14 | 16 | 17 | 19 | 20 | 21 | 23 | 24 | 26 | 27 | 29 | 34 |
| 35 | 0 | 1 | 3 | 4 | 6 | 7 | 9 | 10 | 12 | 13 | 15 | 16 | 18 | 19 | 21 | 22 | 24 | 25 | 26 | 28 | 29 | 35 |
| 36 | 0 | 1 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 14 | 15 | 17 | 18 | 20 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 36 |
| 37 | 0 | 1 | 3 | 5 | 6 | 8 | 9 | 11 | 12 | 14 | 16 | 17 | 19 | 20 | 22 | 23 | 25 | 26 | 28 | 30 | 31 | 37 |
| 38 | 0 | 2 | 3 | 5 | 6 | 8 | 10 | 11 | 13 | 14 | 16 | 18 | 19 | 21 | 22 | 24 | 26 | 27 | 29 | 30 | 32 | 38 |
| 39 | 0 | 2 | 3 | 5 | 7 | 8 | 10 | 11 | 13 | 15 | 16 | 18 | 20 | 21 | 23 | 25 | 26 | 28 | 30 | 31 | 33 | 39 |
| 40 | 0 | 2 | 3 | 5 | 7 | 8 | 10 | 12 | 13 | 15 | 17 | 18 | 20 | 22 | 24 | 25 | 27 | 29 | 30 | 32 | 34 | 40 |
| 41 | 0 | 2 | 3 | 5 | 7 | 9 | 10 | 12 | 14 | 16 | 17 | 19 | 21 | 22 | 24 | 26 | 28 | 29 | 31 | 33 | 35 | 41 |
| 42 | 0 | 2 | 3 | 5 | 7 | 9 | 11 | 12 | 14 | 16 | 18 | 19 | 21 | 23 | 25 | 27 | 28 | 30 | 32 | 34 | 35 | 42 |
| 43 | 0 | 2 | 4 | 5 | 7 | 9 | 11 | 13 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 27 | 29 | 31 | 33 | 34 | 36 | 43 |
| 44 | 0 | 2 | 4 | 6 | 7 | 9 | 11 | 13 | 15 | 17 | 19 | 20 | 22 | 24 | 26 | 28 | 30 | 31 | 33 | 35 | 37 | 44 |
| 45 | 0 | 2 | 4 | 6 | 8 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 28 | 30 | 32 | 34 | 36 | 38 | 45 |
| 46 | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 46 |
| 47 | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 47 |
| 48 | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 48 |
| 49 | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 19 | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 49 |
| 50 | 0 | 2 | 4 | 6 | 8 | 10 | 13 | 15 | 17 | 19 | 21 | 23 | 25 | 27 | 29 | 32 | 34 | 36 | 38 | 40 | 42 | 50 |
| 51 | 0 | 2 | 4 | 6 | 9 | 11 | 13 | 15 | 17 | 19 | 21 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 39 | 41 | 43 | 51 |
| 52 | 0 | 2 | 4 | 7 | 9 | 11 | 13 | 15 | 18 | 20 | 22 | 24 | 26 | 28 | 31 | 33 | 35 | 37 | 39 | 42 | 44 | 52 |
| 53 | 0 | 2 | 4 | 7 | 9 | 11 | 13 | 16 | 18 | 20 | 22 | 25 | 27 | 29 | 31 | 33 | 36 | 38 | 40 | 42 | 45 | 53 |
| 54 | 0 | 2 | 4 | 7 | 9 | 11 | 14 | 16 | 18 | 20 | 23 | 25 | 27 | 30 | 32 | 34 | 36 | 39 | 41 | 43 | 45 | 54 |
| 55 | 0 | 2 | 5 | 7 | 9 | 12 | 14 | 16 | 19 | 21 | 23 | 25 | 28 | 30 | 32 | 35 | 37 | 39 | 42 | 44 | 46 | 55 |
| 56 | 0 | 2 | 5 | 7 | 9 | 12 | 14 | 17 | 19 | 21 | 24 | 26 | 28 | 31 | 33 | 35 | 38 | 40 | 42 | 45 | 47 | 56 |
| 57 | 0 | 2 | 5 | 7 | 10 | 12 | 14 | 17 | 19 | 22 | 24 | 26 | 29 | 31 | 34 | 36 | 38 | 41 | 43 | 46 | 48 | 57 |
| 58 | 0 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 22 | 24 | 27 | 29 | 32 | 34 | 37 | 39 | 42 | 44 | 46 | 49 | 58 |
| 59 | 0 | 2 | 5 | 7 | 10 | 12 | 15 | 17 | 20 | 22 | 25 | 27 | 30 | 32 | 35 | 37 | 40 | 42 | 45 | 47 | 50 | 59 |
| 60 | 0 | 2 | 5 | 8 | 10 | 13 | 15 | 18 | 20 | 23 | 25 | 28 | 30 | 33 | 35 | 38 | 40 | 43 | 45 | 48 | 50½ | 60 |

## Nat. Versines. (v.)

| ′ | 10° | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0015192 | 0018373 | 0021852 | 0025630 | 0029704 | 0034074 | 0038738 | 0043695 | 0048943 | 0054481 | 0 |
| 1 | 0015243 | 0018428 | 0021913 | 0025695 | 0029775 | 0034149 | 0038818 | 0043780 | 0049033 | 0054576 | 1 |
| 2 | 15293 | 18484 | 21973 | 25761 | 29845 | 34225 | 38899 | 43865 | 49123 | 54671 | 2 |
| 3 | 15344 | 18540 | 22034 | 25827 | 29916 | 34300 | 38979 | 43951 | 49213 | 54766 | 3 |
| 4 | 0015395 | 0018595 | 0022095 | 0025892 | 0029986 | 0034376 | 0039060 | 0044036 | 0049304 | 0054861 | 4 |
| 5 | 15446 | 18651 | 22156 | 25958 | 30057 | 34452 | 39140 | 44121 | 49394 | 54956 | 5 |
| 6 | 15497 | 18707 | 22217 | 26024 | 30128 | 34527 | 39221 | 44207 | 49484 | 55051 | 6 |
| 7 | 0015548 | 0018763 | 0022278 | 0026090 | 0030199 | 0034603 | 0039302 | 0044293 | 0049575 | 0055146 | 7 |
| 8 | 15599 | 18819 | 22339 | 26156 | 30270 | 34679 | 39382 | 44378 | 49665 | 55242 | 8 |
| 9 | 15650 | 18876 | 22400 | 26222 | 30341 | 34755 | 39463 | 44464 | 49756 | 55337 | 9 |
| 10 | 0015701 | 0018932 | 0022461 | 0026288 | 0030412 | 0034831 | 0039544 | 0044550 | 0049846 | 0055432 | 10 |
| 11 | 15753 | 18988 | 22523 | 26355 | 30483 | 34907 | 39625 | 44636 | 49937 | 55528 | 11 |
| 12 | 15804 | 19045 | 22584 | 26421 | 30555 | 34983 | 39706 | 44722 | 50028 | 55624 | 12 |
| 13 | 0015856 | 0019101 | 0022646 | 0026488 | 0030626 | 0035060 | 0039787 | 0044808 | 0050119 | 0055719 | 13 |
| 14 | 15908 | 19158 | 22707 | 26554 | 30697 | 35136 | 39869 | 44894 | 50210 | 55815 | 14 |
| 15 | 15959 | 19215 | 22769 | 26621 | 30769 | 35213 | 39950 | 44980 | 50301 | 55911 | 15 |
| 16 | 0016011 | 0019271 | 0022831 | 0026687 | 0030841 | 0035289 | 0040032 | 0045066 | 0050392 | 0056007 | 16 |
| 17 | 16063 | 19328 | 22892 | 26754 | 30912 | 35366 | 40113 | 45153 | 50483 | 56103 | 17 |
| 18 | 16115 | 19385 | 22954 | 26821 | 30984 | 35443 | 40195 | 45239 | 50574 | 56199 | 18 |
| 19 | 0016167 | 0019442 | 0023016 | 0026888 | 0031056 | 0035519 | 0040276 | 0045326 | 0050666 | 0056295 | 19 |
| 20 | 16219 | 19499 | 23078 | 26955 | 31128 | 35596 | 40358 | 45412 | 50757 | 56391 | 20 |
| 21 | 16271 | 19557 | 23141 | 27022 | 31200 | 35673 | 40440 | 45499 | 50849 | 56488 | 21 |
| 22 | 0016324 | 0019614 | 0023203 | 0027089 | 0031272 | 0035750 | 0040522 | 0045586 | 0050940 | 0056584 | 22 |
| 23 | 16376 | 19671 | 23265 | 27157 | 31344 | 35827 | 40604 | 45673 | 51032 | 56681 | 23 |
| 24 | 16428 | 19729 | 23328 | 27224 | 31417 | 35905 | 40686 | 45760 | 51124 | 56777 | 24 |
| 25 | 0016481 | 0019786 | 0023390 | 0027292 | 0031489 | 0035982 | 0040768 | 0045847 | 0051216 | 0056874 | 25 |
| 26 | 16534 | 19844 | 23453 | 27359 | 31562 | 36059 | 40850 | 45934 | 51308 | 56971 | 26 |
| 27 | 16586 | 19902 | 23515 | 27427 | 31634 | 36137 | 40933 | 46021 | 51400 | 57068 | 27 |
| 28 | 0016639 | 0019959 | 0023578 | 0027494 | 0031707 | 0036214 | 0041015 | 0046108 | 0051492 | 0057164 | 28 |
| 29 | 16692 | 20017 | 23641 | 27562 | 31780 | 36292 | 41098 | 46196 | 51584 | 57261 | 29 |
| 30 | 16745 | 20075 | 23704 | 27630 | 31852 | 36369 | 41180 | 46283 | 51676 | 57358 | 30 |
| 31 | 0016798 | 0020133 | 0023767 | 0027698 | 0031925 | 0036447 | 0041263 | 0046371 | 0051769 | 0057456 | 31 |
| 32 | 16851 | 20191 | 23830 | 27766 | 31998 | 36525 | 41346 | 46458 | 51861 | 57553 | 32 |
| 33 | 16904 | 20250 | 23893 | 27834 | 32071 | 36603 | 41428 | 46546 | 51954 | 57650 | 33 |
| 34 | 0016958 | 0020308 | 0023956 | 0027902 | 0032144 | 0036681 | 0041511 | 0046634 | 0052046 | 0057747 | 34 |
| 35 | 17011 | 20366 | 24020 | 27971 | 32217 | 36759 | 41594 | 46721 | 52139 | 57845 | 35 |
| 36 | 17065 | 20425 | 24083 | 28039 | 32291 | 36837 | 41677 | 46809 | 52232 | 57942 | 36 |
| 37 | 0017118 | 0020483 | 0024147 | 0028107 | 0032364 | 0036916 | 0041761 | 0046897 | 0052324 | 0058040 | 37 |
| 38 | 17172 | 20542 | 24210 | 28176 | 32438 | 36994 | 41844 | 46985 | 52417 | 58138 | 38 |
| 39 | 17226 | 20601 | 24274 | 28245 | 32511 | 37072 | 41927 | 47074 | 52510 | 58236 | 39 |
| 40 | 0017279 | 0020659 | 0024338 | 0028313 | 0032585 | 0037151 | 0042010 | 0047162 | 0052603 | 0058333 | 40 |
| 41 | 17333 | 20718 | 24401 | 28382 | 32658 | 37230 | 42094 | 47250 | 52696 | 58431 | 41 |
| 42 | 17387 | 20777 | 24465 | 28451 | 32732 | 37308 | 42177 | 47338 | 52790 | 58529 | 42 |
| 43 | 0017441 | 0020836 | 0024529 | 0028520 | 0032806 | 0037387 | 0042261 | 0047427 | 0052883 | 0058628 | 43 |
| 44 | 17495 | 20895 | 24593 | 28589 | 32880 | 37466 | 42345 | 47516 | 52976 | 58726 | 44 |
| 45 | 17550 | 20954 | 24658 | 28658 | 32954 | 37545 | 42429 | 47604 | 53070 | 58824 | 45 |
| 46 | 0017604 | 0021014 | 0024722 | 0028727 | 0033028 | 0037624 | 0042512 | 0047693 | 0053163 | 0058922 | 46 |
| 47 | 17658 | 21073 | 24786 | 28796 | 33102 | 37703 | 42596 | 47782 | 53257 | 59021 | 47 |
| 48 | 17713 | 21133 | 24851 | 28866 | 33177 | 37782 | 42680 | 47871 | 53351 | 59119 | 48 |
| 49 | 0017767 | 0021192 | 0024915 | 0028935 | 0033251 | 0037861 | 0042765 | 0047960 | 0053444 | 0059218 | 49 |
| 50 | 17822 | 21252 | 24980 | 29005 | 33325 | 37941 | 42849 | 48049 | 53538 | 59316 | 50 |
| 51 | 17877 | 21311 | 25044 | 29074 | 33400 | 38020 | 42933 | 48138 | 53632 | 59415 | 51 |
| 52 | 0017931 | 0021371 | 0025109 | 0029144 | 0033474 | 0038099 | 0043017 | 0048227 | 0053726 | 0059514 | 52 |
| 53 | 17986 | 21431 | 25174 | 29214 | 33549 | 38179 | 43102 | 48316 | 53820 | 59613 | 53 |
| 54 | 18041 | 21491 | 25239 | 29283 | 33624 | 38259 | 43186 | 48406 | 53915 | 59712 | 54 |
| 55 | 0018096 | 0021551 | 0025304 | 0029353 | 0033699 | 0038338 | 0043271 | 0048495 | 0054009 | 0059811 | 55 |
| 56 | 18151 | 21611 | 25369 | 29423 | 33774 | 38418 | 43356 | 48585 | 54103 | 59910 | 56 |
| 57 | 18207 | 21671 | 25434 | 29493 | 33849 | 38498 | 43440 | 48674 | 54198 | 60009 | 57 |
| 58 | 0018262 | 0021732 | 0025499 | 0029564 | 0033924 | 0038578 | 0043525 | 0048764 | 0054292 | 0060109 | 58 |
| 59 | 18317 | 21792 | 25564 | 29634 | 33999 | 38658 | 43610 | 48854 | 54387 | 60208 | 59 |
| 60 | 18373 | 21852 | 25630 | 29704 | 34074 | 38738 | 43695 | 48943 | 54481 | 60307 | 60 |

## Parts for Seconds. (v.)

| | 10° | | 11° | | 12° | | 13° | | 14° | | 15° | | 16° | | 17° | | 18° | | 19° | | 20° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | ″ |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 1 |
| 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 3 |
| 4 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 4 |
| 5 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 5 |
| 6 | 5 | 5 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 10 | 10 | 6 |
| 7 | 6 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 12 | 7 |
| 8 | 7 | 7 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 11 | 12 | 12 | 12 | 13 | 13 | 13 | 8 |
| 9 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 | 11 | 11 | 11 | 11 | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 15 | 15 | 9 |
| 10 | 8 | 9 | 9 | 10 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 15 | 15 | 15 | 16 | 16 | 17 | 10 |
| 11 | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 12 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 16 | 17 | 17 | 18 | 18 | 11 |
| 12 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 17 | 17 | 17 | 18 | 18 | 19 | 19 | 20 | 12 |
| 13 | 11 | 11 | 12 | 13 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 13 |
| 14 | 12 | 12 | 13 | 14 | 14 | 15 | 15 | 16 | 16 | 17 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 22 | 22 | 23 | 23 | 14 |
| 15 | 13 | 13 | 14 | 15 | 15 | 16 | 16 | 17 | 18 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 22 | 23 | 24 | 24 | 25 | 15 |
| 16 | 13 | 14 | 15 | 15½ | 16 | 17 | 17 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 23 | 23 | 24 | 25 | 25 | 26 | 27 | 16 |
| 17 | 14 | 15 | 16 | 16 | 17 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 23 | 23 | 24 | 25 | 25 | 26 | 27 | 28 | 28 | 17 |
| 18 | 15 | 16 | 17 | 17 | 18 | 19 | 20 | 20 | 21 | 22 | 23 | 23 | 24 | 25 | 26 | 26 | 27 | 28 | 28 | 29 | 30 | 18 |
| 19 | 16 | 17 | 18 | 18 | 19 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 25 | 26 | 27 | 28 | 28 | 29 | 30 | 31 | 32 | 19 |
| 20 | 17 | 18 | 19 | 19 | 20 | 21 | 22 | 23 | 23 | 24 | 25 | 26 | 27 | 28 | 28 | 29 | 30 | 31 | 32 | 32 | 33 | 20 |
| 21 | 18 | 19 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 31 | 32 | 33 | 34 | 35 | 21 |
| 22 | 19 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 36 | 22 |
| 23 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 34 | 35 | 36 | 37 | 38 | 23 |
| 24 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 24 |
| 25 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 25 |
| 26 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 26 |
| 27 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 41 | 42 | 43 | 44 | 45 | 27 |
| 28 | 24 | 25 | 26 | 27 | 28 | 29 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 28 |
| 29 | 24 | 26 | 27 | 28 | 29 | 30 | 32 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 42 | 43 | 45 | 46 | 47 | 48 | 29 |
| 30 | 25 | 27 | 28 | 29 | 30 | 31 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 43 | 43 | 45 | 46 | 47 | 49 | 50 | 30 |
| 31 | 26 | 27 | 29 | 30 | 31 | 33 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 43 | 44 | 45 | 46 | 48 | 49 | 50 | 51 | 31 |
| 32 | 27 | 28 | 30 | 31 | 32 | 34 | 35 | 36 | 38 | 39 | 40 | 41 | 43 | 44 | 45 | 47 | 48 | 49 | 51 | 52 | 53 | 32 |
| 33 | 28 | 29 | 31 | 32 | 33 | 35 | 36 | 37 | 39 | 40 | 41 | 43 | 44 | 46 | 47 | 48 | 49 | 51 | 52 | 53 | 55 | 33 |
| 34 | 29 | 30 | 31 | 33 | 34 | 36 | 37 | 38 | 40 | 41 | 43 | 44 | 45 | 47 | 48 | 50 | 51 | 52 | 54 | 55 | 56 | 34 |
| 35 | 29 | 31 | 32 | 34 | 35 | 37 | 38 | 40 | 41 | 42 | 44 | 45 | 47 | 48 | 50 | 51 | 52 | 54 | 55 | 57 | 58 | 35 |
| 36 | 30 | 32 | 33 | 35 | 36 | 38 | 39 | 41 | 42 | 44 | 45 | 47 | 48 | 50 | 51 | 52 | 54 | 55 | 57 | 58 | 60 | 36 |
| 37 | 31 | 33 | 34 | 36 | 37 | 39 | 40 | 42 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 54 | 55 | 57 | 58 | 60 | 61 | 37 |
| 38 | 32 | 34 | 35 | 37 | 38 | 40 | 41 | 43 | 45 | 46 | 48 | 49 | 51 | 52 | 54 | 55 | 57 | 58 | 60 | 61 | 63 | 38 |
| 39 | 33 | 34 | 36 | 38 | 39 | 41 | 43 | 44 | 46 | 47 | 49 | 50 | 52 | 54 | 55 | 57 | 58 | 60 | 62 | 63 | 65 | 39 |
| 40 | 34 | 35 | 37 | 39 | 40 | 42 | 44 | 45 | 47 | 49 | 50 | 52 | 53 | 55 | 57 | 58 | 60 | 62 | 63 | 65 | 66 | 40 |
| 41 | 35 | 36 | 38 | 40 | 41 | 43 | 45 | 46 | 48 | 50 | 51 | 53 | 55 | 56 | 58 | 60 | 61 | 63 | 65 | 66 | 68 | 41 |
| 42 | 35 | 37 | 39 | 41 | 42 | 44 | 46 | 48 | 49 | 51 | 53 | 54 | 56 | 58 | 60 | 61 | 63 | 65 | 66 | 68 | 70 | 42 |
| 43 | 36 | 38 | 40 | 42 | 43 | 45 | 47 | 49 | 50 | 52 | 54 | 56 | 57 | 59 | 61 | 63 | 65 | 66 | 68 | 70 | 71 | 43 |
| 44 | 37 | 39 | 41 | 43 | 44 | 46 | 48 | 50 | 52 | 53 | 55 | 57 | 59 | 61 | 62 | 64 | 66 | 68 | 69 | 71 | 73 | 44 |
| 45 | 38 | 40 | 42 | 44 | 45 | 47 | 49 | 51 | 53 | 55 | 56 | 58 | 60 | 62 | 64 | 66 | 67 | 69 | 71 | 73 | 75 | 45 |
| 46 | 39 | 41 | 43 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 61 | 63 | 65 | 67 | 69 | 71 | 73 | 74 | 76 | 46 |
| 47 | 40 | 42 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 67 | 69 | 70 | 72 | 74 | 76 | 78 | 47 |
| 48 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 48 |
| 49 | 41 | 43 | 45 | 47 | 49 | 51 | 53 | 55 | 57 | 59 | 61 | 63 | 65 | 68 | 69 | 71 | 73 | 75 | 77 | 79 | 81 | 49 |
| 50 | 42 | 44 | 46 | 48 | 50 | 52 | 55 | 57 | 59 | 61 | 63 | 65 | 67 | 69 | 71 | 73 | 75 | 77 | 79 | 80 | 83 | 50 |
| 51 | 43 | 45 | 46 | 49 | 51 | 54 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 83 | 85 | 51 |
| 52 | 44 | 46 | 47 | 50 | 52 | 55 | 57 | 59 | 61 | 63 | 65 | 67 | 69 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 52 |
| 53 | 45 | 47 | 48 | 51 | 53 | 56 | 58 | 60 | 62 | 64 | 67 | 69 | 71 | 73 | 75 | 77 | 79 | 82 | 84 | 86 | 88 | 53 |
| 54 | 45 | 48 | 49 | 52 | 54 | 57 | 59 | 61 | 63 | 66 | 68 | 70 | 72 | 74 | 77 | 79 | 80 | 83 | 85 | 87 | 90 | 54 |
| 55 | 46 | 49 | 50 | 53 | 55 | 58 | 60 | 62 | 65 | 67 | 69 | 71 | 73 | 76 | 78 | 80 | 82 | 85 | 87 | 89 | 91 | 55 |
| 56 | 47 | 49 | 51 | 54 | 56 | 59 | 61 | 63 | 66 | 68 | 70 | 73 | 74 | 77 | 79 | 82 | 84 | 86 | 88 | 91 | 93 | 56 |
| 57 | 48 | 50 | 52 | 55 | 57 | 60 | 62 | 65 | 67 | 69 | 72 | 74 | 76 | 78 | 81 | 83 | 85 | 88 | 90 | 92 | 95 | 57 |
| 58 | 49 | 51 | 53 | 56 | 58 | 61 | 63 | 66 | 68 | 70 | 73 | 75 | 77 | 80 | 82 | 85 | 87 | 89 | 92 | 94 | 96 | 58 |
| 59 | 50 | 52 | 54 | 57 | 59 | 62 | 64 | 67 | 69 | 72 | 74 | 76 | 79 | 81 | 84 | 86 | 88 | 91 | 93 | 95 | 98 | 59 |
| 60 | 50½ | 53 | 55½ | 58 | 60½ | 63 | 65½ | 68 | 70 | 73 | 75 | 78 | 80 | 83 | 85 | 87½ | 90 | 92 | 95 | 97 | 99½ | 60 |

## Nat. Versines. (v.)

| ′ | 20° | 21° | 22° | 23° | 24° | 25° | 26° | 27° | 28° | 29° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0060307 | 0066420 | 0072816 | 0079495 | 0086454 | 0093692 | 0101206 | 0108993 | 0117052 | 0125380 | 0 |
| 1 | 0060407 | 0066524 | 0072925 | 0079609 | 0086573 | 0093815 | 0101333 | 0109126 | 0117189 | 0125521 | 1 |
| 2 | 60506 | 66628 | 73034 | 79723 | 86691 | 93938 | 01461 | 09258 | 17326 | 25662 | 2 |
| 3 | 60606 | 66735 | 73143 | 79836 | 86810 | 94061 | 01589 | 09390 | 17462 | 25804 | 3 |
| 4 | 0060706 | 0066837 | 0073253 | 0079950 | 0086928 | 0094185 | 0101717 | 0109522 | 0117599 | 0125945 | 4 |
| 5 | 60806 | 66942 | 73362 | 80064 | 87047 | 94308 | 01844 | 09655 | 17736 | 26086 | 5 |
| 6 | 60906 | 67046 | 73471 | 80178 | 87166 | 94431 | 01972 | 09787 | 17873 | 26228 | 6 |
| 7 | 0061006 | 0067151 | 0073581 | 0080293 | 0087285 | 0094555 | 0102100 | 0109920 | 0118010 | 0126369 | 7 |
| 8 | 61106 | 67256 | 73690 | 80407 | 87403 | 94678 | 02228 | 10052 | 18147 | 26511 | 8 |
| 9 | 61206 | 67361 | 73800 | 80521 | 87522 | 94802 | 02357 | 10185 | 18284 | 26652 | 9 |
| 10 | 0061306 | 0067466 | 0073910 | 0080636 | 0087642 | 0094925 | 0102485 | 0110318 | 0118422 | 0126794 | 10 |
| 11 | 61407 | 67571 | 74019 | 80750 | 87761 | 95049 | 02613 | 10454 | 18559 | 26936 | 11 |
| 12 | 61507 | 67676 | 74129 | 80865 | 87880 | 95173 | 02742 | 10584 | 18696 | 27078 | 12 |
| 13 | 0061607 | 0067781 | 0074239 | 0080979 | 0087999 | 0095297 | 0102870 | 0110717 | 0118834 | 0127220 | 13 |
| 14 | 61708 | 67887 | 74349 | 81094 | 88118 | 95421 | 02999 | 10850 | 18972 | 27362 | 14 |
| 15 | 61809 | 67992 | 74459 | 81209 | 88238 | 95545 | 03127 | 10983 | 19109 | 27504 | 15 |
| 16 | 0061909 | 0068098 | 0074570 | 0081324 | 0088357 | 0095669 | 0103256 | 0111116 | 0119247 | 0127646 | 16 |
| 17 | 62010 | 68203 | 74680 | 81439 | 88477 | 95793 | 03385 | 11249 | 19385 | 27788 | 17 |
| 18 | 62111 | 68309 | 74790 | 81554 | 88597 | 95917 | 03514 | 11383 | 19523 | 27934 | 18 |
| 19 | 0062212 | 0068414 | 0074901 | 0081669 | 0088716 | 0096042 | 0103642 | 0111516 | 0119661 | 0128073 | 19 |
| 20 | 62313 | 68520 | 75011 | 81784 | 88836 | 96166 | 03771 | 11650 | 19799 | 28216 | 20 |
| 21 | 62414 | 68626 | 75122 | 81899 | 88956 | 96291 | 03901 | 11783 | 19937 | 28358 | 21 |
| 22 | 0062515 | 0068732 | 0075232 | 0082014 | 0089076 | 0096415 | 0104030 | 0111917 | 0120075 | 0128501 | 22 |
| 23 | 62617 | 68838 | 75343 | 82130 | 89196 | 96540 | 04159 | 12051 | 20213 | 28643 | 23 |
| 24 | 62718 | 68944 | 75454 | 82246 | 89316 | 96665 | 04288 | 12185 | 20351 | 28786 | 24 |
| 25 | 0062819 | 0069050 | 0075565 | 0082361 | 0089436 | 0096789 | 0104418 | 0112318 | 0120490 | 0128929 | 25 |
| 26 | 62921 | 69157 | 75676 | 82477 | 89557 | 96914 | 04547 | 12452 | 20628 | 29072 | 26 |
| 27 | 63023 | 69263 | 75787 | 82592 | 89677 | 97039 | 04677 | 12587 | 20767 | 29215 | 27 |
| 28 | 0063124 | 0069369 | 0075898 | 0082708 | 0089798 | 0097164 | 0104806 | 0112721 | 0120905 | 0129358 | 28 |
| 29 | 63226 | 69476 | 76009 | 82824 | 89918 | 97289 | 04936 | 12855 | 21044 | 29501 | 29 |
| 30 | 63328 | 69582 | 76120 | 82940 | 90039 | 97415 | 05066 | 12989 | 21183 | 29644 | 30 |
| 31 | 0063430 | 0069689 | 0076232 | 0083056 | 0090159 | 0097540 | 0105195 | 0113123 | 0121322 | 0129788 | 31 |
| 32 | 63533 | 69796 | 76343 | 83172 | 90280 | 97665 | 05325 | 13258 | 21461 | 29934 | 32 |
| 33 | 63634 | 69903 | 76455 | 83288 | 90401 | 97791 | 05455 | 13392 | 21600 | 30074 | 33 |
| 34 | 0063736 | 0070009 | 0076566 | 0083404 | 0090522 | 0097916 | 0105585 | 0113527 | 0121739 | 0130218 | 34 |
| 35 | 63838 | 70116 | 76678 | 83521 | 90643 | 98042 | 05716 | 13662 | 21878 | 30361 | 35 |
| 36 | 63940 | 70223 | 76790 | 83637 | 90764 | 98167 | 05846 | 13796 | 22017 | 30505 | 36 |
| 37 | 0064043 | 0070331 | 0076902 | 0083754 | 0090885 | 0098293 | 0105976 | 0113931 | 0122156 | 0130649 | 37 |
| 38 | 64145 | 70438 | 77013 | 83870 | 91006 | 98419 | 06106 | 14066 | 22296 | 30793 | 38 |
| 39 | 64248 | 70545 | 77125 | 83987 | 91127 | 98545 | 06237 | 14201 | 22435 | 30936 | 39 |
| 40 | 0064350 | 0070652 | 0077238 | 0084104 | 0091249 | 0098671 | 0106367 | 0114336 | 0122575 | 0131080 | 40 |
| 41 | 64453 | 70760 | 77350 | 84220 | 91370 | 98797 | 06498 | 14471 | 22714 | 31224 | 41 |
| 42 | 64556 | 70867 | 77462 | 84337 | 91492 | 98923 | 06629 | 14606 | 22854 | 31368 | 42 |
| 43 | 0064659 | 0070975 | 0077574 | 0084454 | 0091613 | 0099049 | 0106759 | 0114742 | 0122994 | 0131513 | 43 |
| 44 | 64762 | 71083 | 77687 | 84571 | 91735 | 99175 | 06890 | 14877 | 23133 | 31657 | 44 |
| 45 | 64865 | 71190 | 77799 | 84688 | 91857 | 99302 | 07021 | 15012 | 23273 | 31801 | 45 |
| 46 | 0064968 | 0071298 | 0077912 | 0084806 | 0091979 | 0099428 | 0107152 | 0115148 | 0123413 | 0131946 | 46 |
| 47 | 65071 | 71406 | 78024 | 84923 | 92100 | 99555 | 07283 | 15283 | 23553 | 32090 | 47 |
| 48 | 65174 | 71514 | 78137 | 85040 | 92222 | 99681 | 07414 | 15419 | 23693 | 32234 | 48 |
| 49 | 0065278 | 0071622 | 0078250 | 0085158 | 0092345 | 0099808 | 0107545 | 0115555 | 0123833 | 0132379 | 49 |
| 50 | 65381 | 71730 | 78362 | 85275 | 92467 | 99935 | 07677 | 15690 | 23974 | 32524 | 50 |
| 51 | 65485 | 71839 | 78475 | 85393 | 92589 | 100061 | 07808 | 15826 | 24114 | 32669 | 51 |
| 52 | 0065588 | 0071947 | 0078588 | 0085510 | 0092711 | 0100188 | 0107939 | 0115962 | 0124254 | 0132813 | 52 |
| 53 | 65692 | 72055 | 78701 | 85628 | 92833 | 00316 | 08071 | 16098 | 24395 | 32958 | 53 |
| 54 | 65795 | 72164 | 78815 | 85746 | 92956 | 00442 | 08202 | 16234 | 24535 | 33103 | 54 |
| 55 | 0065899 | 0072272 | 0078928 | 0085864 | 0093078 | 0100569 | 0108334 | 0116370 | 0124676 | 0133248 | 55 |
| 56 | 66003 | 72381 | 79041 | 85982 | 93201 | 00696 | 08466 | 16507 | 24817 | 33393 | 56 |
| 57 | 66107 | 72490 | 79154 | 86100 | 93324 | 00824 | 08598 | 16643 | 24957 | 33539 | 57 |
| 58 | 0066211 | 0072598 | 0079268 | 0086218 | 0093446 | 0100951 | 0108729 | 0116779 | 0125098 | 0133684 | 58 |
| 59 | 66315 | 72707 | 79381 | 86336 | 93569 | 01078 | 08861 | 16916 | 25239 | 33829 | 59 |
| 60 | 66420 | 72816 | 79495 | 86454 | 93692 | 01206 | 08993 | 17052 | 25380 | 33975 | 60 |

## Parts for Seconds. (v.)

| | 20° | | 21° | | 22° | | 23° | | 24° | | 25° | | 26° | | 27° | | 28° | | 29° | | 30° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| 2 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 2 |
| 3 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 3 |
| 4 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 10 | 10 | 4 |
| 5 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 12 | 12 | 12 | 12 | 5 |
| 6 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 12 | 12 | 12 | 12 | 13 | 13 | 13 | 13 | 13 | 14 | 14 | 14 | 14 | 15 | 6 |
| 7 | 12 | 12 | 12 | 12 | 13 | 13 | 13 | 14 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 16 | 16 | 16 | 16 | 17 | 17 | 7 |
| 8 | 13 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 16 | 16 | 16 | 17 | 17 | 17 | 18 | 18 | 18 | 19 | 19 | 19 | 19 | 8 |
| 9 | 15 | 15 | 16 | 16 | 16 | 17 | 17 | 17 | 18 | 18 | 18 | 19 | 19 | 19 | 20 | 20 | 20 | 21 | 21 | 21 | 22 | 9 |
| 10 | 17 | 17 | 17 | 18 | 18 | 19 | 19 | 19 | 20 | 20 | 20 | 21 | 21 | 22 | 22 | 22 | 23 | 23 | 24 | 24 | 24 | 10 |
| 11 | 18 | 19 | 19 | 20 | 20 | 20 | 21 | 21 | 22 | 22 | 23 | 23 | 23 | 24 | 24 | 25 | 25 | 25 | 26 | 26 | 27 | 11 |
| 12 | 20 | 20 | 21 | 21 | 22 | 22 | 23 | 23 | 24 | 24 | 25 | 25 | 25 | 26 | 26 | 27 | 27 | 28 | 28 | 29 | 29 | 12 |
| 13 | 22 | 22 | 23 | 23 | 24 | 24 | 25 | 25 | 26 | 26 | 27 | 27 | 28 | 28 | 29 | 29 | 30 | 30 | 31 | 31 | 32 | 13 |
| 14 | 23 | 24 | 24 | 25 | 25 | 26 | 27 | 27 | 28 | 28 | 29 | 29 | 30 | 30 | 31 | 31 | 32 | 32 | 33 | 33 | 34 | 14 |
| 15 | 25 | 25 | 26 | 27 | 27 | 28 | 28 | 29 | 30 | 30 | 31 | 31 | 32 | 32 | 33 | 34 | 34 | 35 | 35 | 36 | 36 | 15 |
| 16 | 27 | 27 | 28 | 28 | 29 | 30 | 30 | 31 | 32 | 32 | 33 | 33 | 34 | 35 | 35 | 36 | 36 | 37 | 38 | 38 | 39 | 16 |
| 17 | 28 | 29 | 30 | 30 | 31 | 32 | 32 | 33 | 34 | 34 | 35 | 35 | 36 | 37 | 37 | 38 | 39 | 39 | 40 | 41 | 41 | 17 |
| 18 | 30 | 31 | 31 | 32 | 33 | 33 | 34 | 35 | 35 | 36 | 37 | 38 | 38 | 39 | 40 | 40 | 41 | 42 | 42 | 43 | 44 | 18 |
| 19 | 32 | 32 | 33 | 34 | 35 | 35 | 36 | 37 | 37 | 38 | 39 | 40 | 40 | 41 | 42 | 43 | 43 | 44 | 45 | 45 | 46 | 19 |
| 20 | 33 | 34 | 35 | 36 | 36 | 37 | 38 | 39 | 39 | 40 | 41 | 42 | 42 | 43 | 44 | 45 | 46 | 46 | 47 | 48 | 48 | 20 |
| 21 | 35 | 36 | 36 | 37 | 38 | 39 | 40 | 41 | 41 | 42 | 43 | 44 | 45 | 45 | 46 | 47 | 48 | 49 | 49 | 50 | 51 | 21 |
| 22 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 43 | 44 | 45 | 46 | 47 | 48 | 48 | 49 | 50 | 51 | 52 | 53 | 53 | 22 |
| 23 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 51 | 52 | 53 | 54 | 55 | 56 | 23 |
| 24 | 40 | 41 | 42 | 43 | 44 | 45 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 56 | 57 | 58 | 24 |
| 25 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 25 |
| 26 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 61 | 63 | 26 |
| 27 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 63 | 65 | 27 |
| 28 | 46 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 28 |
| 29 | 48 | 49 | 50 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 29 |
| 30 | 50 | 51 | 52 | 53 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 73 | 30 |
| 31 | 51 | 53 | 54 | 55 | 56 | 58 | 59 | 60 | 61 | 62 | 64 | 65 | 66 | 67 | 68 | 69 | 71 | 72 | 73 | 74 | 75 | 31 |
| 32 | 53 | 54 | 56 | 57 | 58 | 59 | 61 | 62 | 63 | 64 | 66 | 67 | 68 | 69 | 70 | 72 | 73 | 74 | 75 | 76 | 78 | 32 |
| 33 | 55 | 56 | 57 | 59 | 60 | 61 | 63 | 64 | 65 | 66 | 68 | 69 | 70 | 71 | 73 | 74 | 75 | 76 | 78 | 79 | 80 | 33 |
| 34 | 56 | 58 | 59 | 60 | 62 | 63 | 64 | 66 | 67 | 68 | 70 | 71 | 72 | 74 | 75 | 76 | 77 | 79 | 80 | 81 | 82 | 34 |
| 35 | 58 | 59 | 61 | 62 | 64 | 65 | 66 | 68 | 69 | 70 | 72 | 73 | 74 | 76 | 77 | 78 | 80 | 81 | 82 | 84 | 85 | 35 |
| 36 | 60 | 61 | 63 | 64 | 65 | 67 | 68 | 70 | 71 | 72 | 74 | 75 | 76 | 78 | 79 | 81 | 82 | 83 | 85 | 86 | 87 | 36 |
| 37 | 61 | 63 | 64 | 66 | 67 | 69 | 70 | 72 | 73 | 74 | 76 | 77 | 79 | 80 | 81 | 83 | 84 | 86 | 87 | 88 | 90 | 37 |
| 38 | 63 | 65 | 66 | 68 | 69 | 70 | 72 | 73 | 75 | 76 | 78 | 79 | 81 | 82 | 84 | 85 | 86 | 88 | 89 | 91 | 92 | 38 |
| 39 | 65 | 66 | 68 | 69 | 71 | 72 | 74 | 75 | 77 | 78 | 80 | 81 | 83 | 84 | 86 | 87 | 89 | 90 | 92 | 93 | 95 | 39 |
| 40 | 66 | 68 | 70 | 71 | 73 | 74 | 76 | 77 | 79 | 80 | 82 | 83 | 85 | 87 | 88 | 90 | 91 | 93 | 94 | 95 | 97 | 40 |
| 41 | 68 | 70 | 71 | 73 | 74 | 76 | 78 | 79 | 81 | 82 | 84 | 86 | 87 | 89 | 90 | 92 | 93 | 95 | 96 | 98 | 99 | 41 |
| 42 | 70 | 71 | 73 | 75 | 76 | 78 | 80 | 81 | 83 | 84 | 86 | 88 | 89 | 91 | 92 | 94 | 96 | 97 | 99 | 100 | 102 | 42 |
| 43 | 71 | 73 | 74 | 76 | 78 | 80 | 81 | 83 | 85 | 86 | 88 | 90 | 91 | 93 | 95 | 96 | 98 | 99 | 101 | 103 | 104 | 43 |
| 44 | 73 | 75 | 76 | 78 | 80 | 82 | 83 | 85 | 87 | 88 | 90 | 92 | 93 | 95 | 97 | 98 | 100 | 102 | 103 | 105 | 107 | 44 |
| 45 | 75 | 76 | 78 | 80 | 82 | 83 | 85 | 87 | 89 | 90 | 92 | 94 | 96 | 97 | 99 | 101 | 102 | 104 | 106 | 107 | 109 | 45 |
| 46 | 76 | 78 | 80 | 82 | 84 | 85 | 87 | 89 | 91 | 92 | 94 | 96 | 98 | 100 | 101 | 103 | 105 | 106 | 108 | 110 | 112 | 46 |
| 47 | 78 | 80 | 82 | 84 | 85 | 87 | 89 | 91 | 93 | 95 | 96 | 98 | 100 | 102 | 103 | 105 | 107 | 109 | 110 | 112 | 114 | 47 |
| 48 | 80 | 81 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 98 | 100 | 102 | 104 | 106 | 107 | 109 | 111 | 113 | 115 | 116 | 48 |
| 49 | 81 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 99 | 100 | 102 | 104 | 106 | 108 | 110 | 112 | 113 | 115 | 117 | 119 | 49 |
| 50 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 99 | 101 | 102 | 104 | 106 | 108 | 110 | 112 | 114 | 116 | 118 | 119 | 121 | 50 |
| 51 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 99 | 101 | 103 | 105 | 106 | 108 | 110 | 112 | 114 | 116 | 118 | 120 | 122 | 124 | 51 |
| 52 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 101 | 103 | 105 | 107 | 109 | 110 | 112 | 114 | 116 | 118 | 120 | 122 | 124 | 126 | 52 |
| 53 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 105 | 107 | 109 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 128 | 53 |
| 54 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 | 106 | 109 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 129 | 131 | 54 |
| 55 | 91 | 93 | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 129 | 131 | 133 | 55 |
| 56 | 93 | 95 | 97 | 99 | 102 | 104 | 106 | 108 | 110 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | 130 | 132 | 134 | 136 | 56 |
| 57 | 95 | 97 | 99 | 101 | 104 | 106 | 108 | 110 | 112 | 115 | 117 | 119 | 121 | 123 | 125 | 128 | 130 | 132 | 134 | 136 | 138 | 57 |
| 58 | 96 | 98 | 101 | 103 | 105 | 108 | 110 | 112 | 114 | 117 | 119 | 121 | 123 | 125 | 128 | 130 | 132 | 134 | 136 | 138 | 141 | 58 |
| 59 | 98 | 100 | 103 | 105 | 107 | 109 | 112 | 114 | 116 | 119 | 121 | 123 | 125 | 128 | 130 | 131 | 134 | 137 | 139 | 141 | 143 | 59 |
| 60 | 99 | 102 | 104 | 107 | 109 | 111 | 114 | 116 | 118 | 121 | 123 | 125 | 127 | 130 | 132 | 134 | 136 | 139 | 141 | 143 | 145 | 60 |

## Nat. Versines. (v.)

| ′ | 30° | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | 39° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0133975 | 0142833 | 0151952 | 0161329 | 0170962 | 0180848 | 0190983 | 0201364 | 0211989 | 0222854 | 0 |
| 1 | 0134120 | 0142983 | 0152106 | 0161488 | 0171125 | 0181015 | 0191154 | 0201546 | 0212168 | 0223037 | 1 |
| 2 | 34266 | 43132 | 52260 | 61646 | 71288 | 81182 | 91325 | 01715 | 12348 | 23220 | 2 |
| 3 | 34411 | 43282 | 52415 | 61805 | 71451 | 81349 | 91496 | 01890 | 12527 | 23403 | 3 |
| 4 | 0134557 | 0143433 | 0152569 | 0161964 | 0171614 | 0181516 | 0191667 | 0202065 | 0212706 | 0223587 | 4 |
| 5 | 34703 | 48583 | 52723 | 62122 | 71777 | 81683 | 91839 | 02241 | 12885 | 23770 | 5 |
| 6 | 34849 | 43733 | 52878 | 62281 | 71940 | 81850 | 92010 | 02416 | 13065 | 23954 | 6 |
| 7 | 0134994 | 0143883 | 0153033 | 0162440 | 0172103 | 0182018 | 0192181 | 0202592 | 0213244 | 0224137 | 7 |
| 8 | 35140 | 44034 | 53187 | 62599 | 72266 | 82185 | 92353 | 02767 | 13424 | 24321 | 8 |
| 9 | 35287 | 44184 | 53342 | 62758 | 72429 | 82352 | 92525 | 02943 | 13604 | 24504 | 9 |
| 10 | 0135433 | 0144334 | 0153497 | 0162917 | 0172593 | 0182520 | 0192696 | 0203119 | 0213783 | 0224688 | 10 |
| 11 | 35579 | 44485 | 53652 | 63076 | 72756 | 82687 | 92868 | 03294 | 13963 | 24872 | 11 |
| 12 | 35725 | 44636 | 53807 | 63236 | 72919 | 82855 | 93040 | 03470 | 14143 | 25055 | 12 |
| 13 | 0135872 | 0144786 | 0153962 | 0163395 | 0173083 | 0183023 | 0193211 | 0203646 | 0214323 | 0225239 | 13 |
| 14 | 36018 | 44937 | 54117 | 63554 | 73247 | 83191 | 93383 | 03822 | 14503 | 25423 | 14 |
| 15 | 36164 | 45088 | 54272 | 63714 | 73410 | 83358 | 93555 | 03998 | 14683 | 25607 | 15 |
| 16 | 0136311 | 0145239 | 0154427 | 0163873 | 0173574 | 0183526 | 0193727 | 0204174 | 0214863 | 0225791 | 16 |
| 17 | 36458 | 45390 | 54583 | 64033 | 73738 | 83694 | 93899 | 04350 | 15043 | 25976 | 17 |
| 18 | 36604 | 45541 | 54738 | 64193 | 73902 | 83862 | 94072 | 04526 | 15224 | 26160 | 18 |
| 19 | 0136751 | 0145692 | 0154894 | 0164352 | 0174066 | 0184030 | 0194244 | 0204703 | 0215404 | 0226344 | 19 |
| 20 | 36898 | 45844 | 55049 | 64512 | 74230 | 84199 | 94416 | 04879 | 15584 | 26528 | 20 |
| 21 | 37045 | 45995 | 55205 | 64672 | 74394 | 84367 | 94589 | 05056 | 15765 | 26713 | 21 |
| 22 | 0137192 | 0146146 | 0155360 | 0164832 | 0174558 | 0184535 | 0194761 | 0205232 | 0215945 | 0226897 | 22 |
| 23 | 37339 | 46298 | 55516 | 64992 | 74722 | 84704 | 94934 | 05409 | 16126 | 27082 | 23 |
| 24 | 37486 | 46449 | 55672 | 65152 | 74886 | 84872 | 95106 | 05585 | 16306 | 27266 | 24 |
| 25 | 0137634 | 0146601 | 0155828 | 0165312 | 0175051 | 0185041 | 0195279 | 0205762 | 0216487 | 0227451 | 25 |
| 26 | 37781 | 46752 | 55984 | 65473 | 75215 | 85209 | 95452 | 05939 | 16668 | 27636 | 26 |
| 27 | 37928 | 46904 | 56140 | 65633 | 75380 | 85378 | 95624 | 06116 | 16849 | 27821 | 27 |
| 28 | 0138076 | 0147056 | 0156296 | 0165793 | 0175544 | 0185547 | 0195797 | 0206293 | 0217030 | 0228005 | 28 |
| 29 | 38223 | 47208 | 56452 | 65954 | 75709 | 85716 | 95970 | 06470 | 17211 | 28190 | 29 |
| 30 | 38371 | 47360 | 56609 | 66114 | 75874 | 85884 | 96143 | 06647 | 17392 | 28375 | 30 |
| 31 | 0138518 | 0147512 | 0156765 | 0166275 | 0176039 | 0186053 | 0196316 | 0206824 | 0217573 | 0228560 | 31 |
| 32 | 38666 | 47664 | 56921 | 66435 | 76203 | 86222 | 96489 | 07001 | 17754 | 28745 | 32 |
| 33 | 38814 | 47816 | 57078 | 66596 | 76368 | 86392 | 96662 | 07178 | 17935 | 28931 | 33 |
| 34 | 0138962 | 0147968 | 0157234 | 0166757 | 0176533 | 0186561 | 0196836 | 0207355 | 0218117 | 0229116 | 34 |
| 35 | 39110 | 48121 | 57391 | 66918 | 76698 | 86730 | 97009 | 07533 | 18298 | 29301 | 35 |
| 36 | 39258 | 48273 | 57548 | 67079 | 76864 | 86899 | 97182 | 07710 | 18479 | 29487 | 36 |
| 37 | 0139406 | 0148425 | 0157704 | 0167240 | 0177029 | 0187069 | 0197356 | 0207888 | 0218661 | 0229672 | 37 |
| 38 | 39554 | 48578 | 57861 | 67401 | 77194 | 87238 | 97529 | 08065 | 18843 | 29858 | 38 |
| 39 | 39702 | 48731 | 58018 | 67562 | 77359 | 87407 | 97703 | 08243 | 19024 | 30043 | 39 |
| 40 | 0139850 | 0148883 | 0158175 | 0167723 | 0177525 | 0187577 | 0197877 | 0208421 | 0219206 | 0230229 | 40 |
| 41 | 39999 | 49036 | 58332 | 67884 | 77690 | 87747 | 98050 | 08599 | 19388 | 30415 | 41 |
| 42 | 40148 | 49189 | 58489 | 68046 | 77856 | 87916 | 98224 | 08776 | 19570 | 30600 | 42 |
| 43 | 0140296 | 0149342 | 0158646 | 0168207 | 0178022 | 0188086 | 0198398 | 0208954 | 0219751 | 0230786 | 43 |
| 44 | 40445 | 49495 | 58804 | 68369 | 78187 | 88256 | 98572 | 09132 | 19933 | 30972 | 44 |
| 45 | 40594 | 49648 | 58961 | 68530 | 78353 | 88426 | 98746 | 09310 | 20115 | 31158 | 45 |
| 46 | 0140742 | 0149801 | 0159118 | 0168692 | 0178519 | 0188596 | 0198920 | 0209488 | 0220298 | 0231344 | 46 |
| 47 | 40891 | 49954 | 59276 | 68854 | 78685 | 88766 | 99094 | 09667 | 20480 | 31530 | 47 |
| 48 | 41040 | 50107 | 59433 | 69015 | 78851 | 88936 | 99269 | 09845 | 20662 | 31716 | 48 |
| 49 | 0141189 | 0150261 | 0159591 | 0169177 | 0179017 | 0189106 | 0199443 | 0210023 | 0220844 | 0231903 | 49 |
| 50 | 41338 | 50414 | 59749 | 69339 | 79183 | 89277 | 99617 | 10202 | 21027 | 32089 | 50 |
| 51 | 41487 | 50567 | 59906 | 69501 | 79349 | 89447 | 99792 | 10380 | 21209 | 32275 | 51 |
| 52 | 0141636 | 0150721 | 0160064 | 0169663 | 0179515 | 0189617 | 0199966 | 0210559 | 0221392 | 0232461 | 52 |
| 53 | 41786 | 50875 | 60222 | 69825 | 79682 | 89788 | 200141 | 10737 | 21574 | 32648 | 53 |
| 54 | 41935 | 51028 | 60380 | 69988 | 79848 | 89958 | 00315 | 10916 | 21757 | 32835 | 54 |
| 55 | 0142084 | 0151182 | 0160538 | 0170150 | 0180015 | 0190129 | 0200490 | 0211095 | 0221940 | 0233021 | 55 |
| 56 | 42234 | 51336 | 60696 | 70312 | 80181 | 90300 | 00665 | 11273 | 22122 | 33208 | 56 |
| 57 | 42384 | 51490 | 60854 | 70475 | 80348 | 90470 | 00840 | 11452 | 22305 | 33395 | 57 |
| 58 | 0142533 | 0151644 | 0161013 | 0170637 | 0180514 | 0190641 | 0201014 | 0211631 | 0222488 | 0233582 | 58 |
| 59 | 42683 | 51798 | 61171 | 70800 | 80681 | 90812 | 01189 | 11810 | 22671 | 33769 | 59 |
| 60 | 42833 | 51952 | 61329 | 70962 | 80848 | 90983 | 01364 | 11989 | 22854 | 33956 | 60 |

## Parts for Seconds. (v.)

| | 30° | | 31° | | 32° | | 33° | | 34° | | 35° | | 36° | | 37° | | 38° | | 39° | | 40° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 2 |
| 3 | 7 | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 3 |
| 4 | 10 | 10 | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 4 |
| 5 | 12 | 12 | 12 | 13 | 13 | 13 | 13 | 13 | 14 | 14 | 14 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 15 | 15 | 16 | 5 |
| 6 | 15 | 15 | 15 | 15 | 15 | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 | 17 | 18 | 18 | 18 | 18 | 18 | 19 | 19 | 6 |
| 7 | 17 | 17 | 17 | 18 | 18 | 18 | 18 | 19 | 19 | 19 | 19 | 20 | 20 | 20 | 20 | 21 | 21 | 21 | 21 | 22 | 22 | 7 |
| 8 | 19 | 20 | 20 | 20 | 21 | 21 | 21 | 21 | 22 | 22 | 22 | 23 | 23 | 23 | 23 | 24 | 24 | 24 | 24 | 25 | 25 | 8 |
| 9 | 22 | 22 | 22 | 23 | 23 | 23 | 24 | 24 | 24 | 25 | 25 | 25 | 26 | 26 | 26 | 27 | 27 | 27 | 27 | 28 | 28 | 9 |
| 10 | 24 | 25 | 25 | 25 | 26 | 26 | 26 | 27 | 27 | 27 | 28 | 28 | 28 | 29 | 29 | 30 | 30 | 30 | 31 | 31 | 31 | 10 |
| 11 | 27 | 27 | 27 | 28 | 28 | 29 | 29 | 29 | 30 | 30 | 31 | 31 | 31 | 32 | 32 | 32 | 33 | 33 | 34 | 34 | 34 | 11 |
| 12 | 29 | 30 | 30 | 30 | 31 | 31 | 32 | 32 | 33 | 33 | 33 | 34 | 34 | 35 | 35 | 35 | 36 | 36 | 37 | 37 | 37 | 12 |
| 13 | 32 | 32 | 32 | 33 | 33 | 34 | 34 | 35 | 35 | 36 | 36 | 37 | 37 | 37 | 38 | 38 | 39 | 39 | 40 | 40 | 41 | 13 |
| 14 | 34 | 34 | 35 | 35 | 36 | 36 | 37 | 37 | 38 | 38 | 39 | 39 | 40 | 40 | 41 | 41 | 42 | 42 | 43 | 43 | 44 | 14 |
| 15 | 36 | 37 | 37 | 38 | 39 | 39 | 40 | 40 | 41 | 41 | 42 | 42 | 43 | 43 | 44 | 41 | 45 | 45 | 46 | 46 | 47 | 15 |
| 16 | 39 | 39 | 40 | 41 | 41 | 42 | 42 | 43 | 44 | 44 | 44 | 45 | 46 | 46 | 47 | 47 | 48 | 48 | 49 | 49 | 50 | 16 |
| 17 | 41 | 42 | 42 | 43 | 44 | 44 | 45 | 45 | 46 | 47 | 47 | 48 | 48 | 49 | 50 | 50 | 51 | 51 | 52 | 52 | 53 | 17 |
| 18 | 44 | 44 | 45 | 46 | 46 | 47 | 48 | 48 | 49 | 49 | 50 | 51 | 51 | 52 | 53 | 53 | 54 | 54 | 55 | 56 | 56 | 18 |
| 19 | 46 | 47 | 47 | 48 | 49 | 49 | 50 | 51 | 52 | 52 | 53 | 53 | 54 | 55 | 55 | 56 | 57 | 57 | 58 | 59 | 59 | 19 |
| 20 | 48 | 49 | 50 | 51 | 51 | 52 | 53 | 54 | 54 | 55 | 56 | 56 | 57 | 58 | 58 | 59 | 60 | 60 | 61 | 62 | 62 | 20 |
| 21 | 51 | 52 | 52 | 53 | 54 | 55 | 55 | 56 | 57 | 58 | 58 | 59 | 60 | 60 | 61 | 62 | 63 | 63 | 64 | 65 | 65 | 21 |
| 22 | 53 | 54 | 55 | 56 | 57 | 57 | 58 | 59 | 60 | 60 | 61 | 62 | 63 | 63 | 64 | 65 | 66 | 66 | 67 | 68 | 69 | 22 |
| 23 | 56 | 57 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 63 | 64 | 65 | 66 | 66 | 67 | 68 | 69 | 69 | 70 | 71 | 72 | 23 |
| 24 | 58 | 59 | 60 | 61 | 62 | 63 | 63 | 64 | 65 | 66 | 67 | 68 | 68 | 69 | 70 | 71 | 72 | 72 | 73 | 74 | 75 | 24 |
| 25 | 61 | 62 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 70 | 71 | 72 | 73 | 74 | 75 | 75 | 76 | 77 | 78 | 25 |
| 26 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 78 | 79 | 80 | 81 | 26 |
| 27 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 81 | 82 | 83 | 84 | 27 |
| 28 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 84 | 85 | 86 | 87 | 28 |
| 29 | 70 | 71 | 72 | 73 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 87 | 88 | 89 | 90 | 29 |
| 30 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 82 | 82 | 83 | 84 | 85 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 93 | 30 |
| 31 | 75 | 76 | 77 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 93 | 94 | 95 | 96 | 97 | 31 |
| 32 | 78 | 79 | 80 | 81 | 82 | 83 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 96 | 97 | 98 | 99 | 100 | 32 |
| 33 | 80 | 81 | 82 | 84 | 85 | 86 | 87 | 88 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 100 | 101 | 102 | 103 | 33 |
| 34 | 82 | 84 | 85 | 86 | 87 | 89 | 90 | 91 | 92 | 93 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 103 | 104 | 105 | 106 | 34 |
| 35 | 85 | 86 | 87 | 89 | 90 | 91 | 92 | 94 | 95 | 96 | 97 | 99 | 100 | 101 | 102 | 103 | 104 | 106 | 107 | 108 | 109 | 35 |
| 36 | 87 | 89 | 90 | 91 | 92 | 94 | 95 | 96 | 98 | 99 | 100 | 101 | 103 | 104 | 105 | 106 | 107 | 109 | 110 | 111 | 112 | 36 |
| 37 | 90 | 91 | 92 | 94 | 95 | 96 | 98 | 99 | 101 | 102 | 103 | 104 | 105 | 107 | 108 | 109 | 110 | 112 | 113 | 114 | 115 | 37 |
| 38 | 92 | 94 | 95 | 96 | 98 | 99 | 100 | 102 | 103 | 104 | 106 | 107 | 108 | 110 | 111 | 112 | 113 | 115 | 116 | 117 | 118 | 38 |
| 39 | 95 | 96 | 97 | 99 | 100 | 102 | 103 | 104 | 106 | 107 | 108 | 110 | 111 | 112 | 114 | 115 | 116 | 118 | 119 | 120 | 122 | 39 |
| 40 | 97 | 98 | 100 | 101 | 103 | 104 | 106 | 107 | 109 | 110 | 111 | 113 | 114 | 115 | 117 | 118 | 119 | 121 | 122 | 123 | 125 | 40 |
| 41 | 99 | 101 | 102 | 104 | 105 | 107 | 108 | 110 | 111 | 113 | 114 | 115 | 117 | 118 | 120 | 121 | 122 | 124 | 125 | 126 | 128 | 41 |
| 42 | 102 | 103 | 105 | 106 | 108 | 109 | 111 | 112 | 114 | 115 | 117 | 118 | 120 | 121 | 123 | 124 | 125 | 127 | 128 | 130 | 131 | 42 |
| 43 | 104 | 106 | 107 | 109 | 110 | 112 | 114 | 115 | 117 | 118 | 120 | 121 | 123 | 124 | 125 | 127 | 128 | 130 | 131 | 133 | 134 | 43 |
| 44 | 107 | 108 | 110 | 111 | 113 | 115 | 116 | 118 | 120 | 121 | 122 | 124 | 125 | 127 | 128 | 130 | 131 | 133 | 134 | 136 | 137 | 44 |
| 45 | 109 | 111 | 112 | 114 | 116 | 117 | 119 | 120 | 122 | 124 | 125 | 127 | 128 | 130 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 45 |
| 46 | 112 | 113 | 115 | 117 | 118 | 120 | 121 | 123 | 125 | 126 | 128 | 130 | 131 | 133 | 134 | 136 | 137 | 139 | 140 | 142 | 143 | 46 |
| 47 | 114 | 116 | 117 | 119 | 121 | 122 | 124 | 126 | 128 | 129 | 131 | 132 | 134 | 136 | 137 | 139 | 140 | 142 | 143 | 145 | 146 | 47 |
| 48 | 116 | 118 | 120 | 122 | 123 | 125 | 127 | 128 | 131 | 132 | 133 | 135 | 137 | 138 | 140 | 142 | 143 | 145 | 146 | 148 | 150 | 48 |
| 49 | 119 | 121 | 122 | 124 | 126 | 128 | 129 | 131 | 133 | 135 | 136 | 138 | 140 | 141 | 143 | 145 | 146 | 148 | 149 | 151 | 153 | 49 |
| 50 | 121 | 123 | 125 | 127 | 128 | 130 | 132 | 134 | 136 | 137 | 139 | 141 | 142 | 144 | 146 | 148 | 149 | 151 | 152 | 154 | 156 | 50 |
| 51 | 124 | 126 | 127 | 129 | 131 | 133 | 135 | 136 | 139 | 140 | 142 | 144 | 145 | 147 | 149 | 150 | 152 | 154 | 156 | 157 | 159 | 51 |
| 52 | 126 | 128 | 130 | 132 | 134 | 135 | 137 | 139 | 141 | 143 | 145 | 146 | 148 | 150 | 152 | 153 | 155 | 157 | 159 | 160 | 162 | 52 |
| 53 | 128 | 130 | 132 | 134 | 136 | 138 | 140 | 142 | 144 | 146 | 147 | 149 | 151 | 153 | 155 | 156 | 158 | 160 | 162 | 163 | 165 | 53 |
| 54 | 131 | 133 | 135 | 137 | 139 | 141 | 143 | 144 | 147 | 148 | 150 | 152 | 154 | 156 | 158 | 159 | 161 | 163 | 165 | 167 | 168 | 54 |
| 55 | 133 | 135 | 137 | 139 | 141 | 143 | 145 | 147 | 150 | 151 | 153 | 155 | 157 | 159 | 160 | 162 | 164 | 166 | 168 | 170 | 171 | 55 |
| 56 | 136 | 138 | 140 | 142 | 144 | 146 | 148 | 150 | 152 | 154 | 156 | 158 | 160 | 162 | 163 | 165 | 167 | 169 | 171 | 173 | 174 | 56 |
| 57 | 138 | 140 | 142 | 144 | 146 | 148 | 151 | 153 | 155 | 157 | 159 | 160 | 162 | 164 | 166 | 168 | 170 | 172 | 174 | 176 | 178 | 57 |
| 58 | 141 | 143 | 145 | 147 | 149 | 151 | 153 | 155 | 158 | 159 | 161 | 163 | 165 | 167 | 169 | 171 | 173 | 175 | 177 | 179 | 181 | 58 |
| 59 | 143 | 145 | 147 | 150 | 152 | 154 | 156 | 158 | 160 | 162 | 164 | 166 | 168 | 170 | 172 | 174 | 176 | 178 | 180 | 182 | 184 | 59 |
| 60 | 145 | 148 | 150 | 152 | 154 | 156 | 158 | 161 | 163 | 165 | 167 | 169 | 171 | 173 | 175 | 177 | 179 | 181 | 183 | 185 | 187 | 60 |

## Nat. Versines. (v.)

| ′ | 40° | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0233956 | 0245290 | 0256855 | 0268646 | 0280660 | 0292893 | 0305342 | 0318002 | 0330869 | 0343941 | 0 |
| 1 | 0234143 | 0245481 | 0257050 | 0268845 | 0280862 | 0293099 | 0305551 | 0318214 | 0331086 | 0344160 | 1 |
| 2 | 34330 | 45672 | 57245 | 69043 | 81064 | 93305 | 05760 | 18427 | 31302 | 44380 | 2 |
| 3 | 34517 | 45863 | 57439 | 69242 | 81267 | 93511 | 05970 | 18640 | 31518 | 44600 | 3 |
| 4 | 0234704 | 0246054 | 0257634 | 0269440 | 0281469 | 0293716 | 0306179 | 0318853 | 0331734 | 0344820 | 4 |
| 5 | 34891 | 46245 | 57829 | 69639 | 81671 | 93922 | 06389 | 19066 | 31951 | 45039 | 5 |
| 6 | 35079 | 46437 | 58024 | 69838 | 81874 | 94128 | 06598 | 19279 | 32167 | 45259 | 6 |
| 7 | 0235266 | 0246628 | 0258219 | 0270036 | 0282076 | 0294334 | 0306808 | 0319492 | 0332384 | 0345479 | 7 |
| 8 | 35453 | 46819 | 58414 | 70235 | 82279 | 94541 | 07017 | 19705 | 32601 | 45699 | 8 |
| 9 | 35641 | 47011 | 58609 | 70434 | 82481 | 94747 | 07227 | 19919 | 32817 | 45919 | 9 |
| 10 | 0235829 | 0247202 | 0258805 | 0270633 | 0282684 | 0294953 | 0307437 | 0320132 | 0333034 | 0346139 | 10 |
| 11 | 36016 | 47393 | 59000 | 70832 | 82887 | 95159 | 07647 | 20345 | 33251 | 46359 | 11 |
| 12 | 36204 | 47585 | 59195 | 71031 | 83089 | 95366 | 07857 | 20559 | 33467 | 46579 | 12 |
| 13 | 0236392 | 0247777 | 0259391 | 0271230 | 0283292 | 0295572 | 0308067 | 0320772 | 0333684 | 0346800 | 13 |
| 14 | 36580 | 47968 | 59586 | 71430 | 83495 | 95779 | 08277 | 20986 | 33901 | 47020 | 14 |
| 15 | 36767 | 48160 | 59782 | 71629 | 83698 | 95985 | 08487 | 21199 | 34118 | 47240 | 15 |
| 16 | 0236955 | 0248352 | 0259977 | 0271828 | 0283901 | 0296192 | 0308697 | 0321413 | 0334335 | 0347461 | 16 |
| 17 | 37144 | 48544 | 60173 | 72028 | 84104 | 96399 | 08907 | 21627 | 34552 | 47681 | 17 |
| 18 | 37332 | 48736 | 60369 | 72227 | 84307 | 96605 | 09118 | 21840 | 34770 | 47902 | 18 |
| 19 | 0237520 | 0248928 | 0260565 | 0272427 | 0284510 | 0296812 | 0309328 | 0322054 | 0334987 | 0348122 | 19 |
| 20 | 37708 | 49120 | 60761 | 72626 | 84714 | 97019 | 09538 | 22268 | 35204 | 48343 | 20 |
| 21 | 37896 | 49312 | 60956 | 72826 | 84917 | 97226 | 09749 | 22482 | 35421 | 48563 | 21 |
| 22 | 0238085 | 0249504 | 0261152 | 0273026 | 0285120 | 0297433 | 0309959 | 0322696 | 0335639 | 0348784 | 22 |
| 23 | 38273 | 49697 | 61348 | 73225 | 85324 | 97640 | 10170 | 22910 | 35856 | 49005 | 23 |
| 24 | 38462 | 49889 | 61545 | 73425 | 85527 | 97847 | 10380 | 23124 | 36074 | 49226 | 24 |
| 25 | 0238650 | 0250081 | 0261741 | 0273625 | 0285731 | 0298054 | 0310591 | 0323338 | 0336291 | 0349447 | 25 |
| 26 | 38839 | 50274 | 61937 | 73825 | 85934 | 98261 | 10802 | 23552 | 36509 | 49668 | 26 |
| 27 | 39028 | 50466 | 62133 | 74025 | 86138 | 98469 | 11013 | 23767 | 36727 | 49889 | 27 |
| 28 | 0239216 | 0250659 | 0262330 | 0274225 | 0286342 | 0298676 | 0311223 | 0323981 | 0336944 | 0350110 | 28 |
| 29 | 39405 | 50852 | 62526 | 74425 | 86546 | 98883 | 11434 | 24195 | 37162 | 50331 | 29 |
| 30 | 39594 | 51044 | 62723 | 74626 | 86750 | 99091 | 11645 | 24410 | 37380 | 50552 | 30 |
| 31 | 0239783 | 0251237 | 0262919 | 0274826 | 0286953 | 0299298 | 0311856 | 0324624 | 0337598 | 0350773 | 31 |
| 32 | 39972 | 51430 | 63116 | 75026 | 87157 | 99506 | 12067 | 24839 | 37816 | 50994 | 32 |
| 33 | 40161 | 51623 | 63312 | 75227 | 87361 | 99713 | 12279 | 25053 | 38034 | 51216 | 33 |
| 34 | 0240350 | 0251816 | 0263509 | 0275427 | 0287566 | 0299921 | 0312490 | 0325268 | 0338252 | 0351437 | 34 |
| 35 | 40539 | 52009 | 63706 | 75628 | 87770 | 300129 | 12701 | 25483 | 38470 | 51659 | 35 |
| 36 | 40729 | 52202 | 63903 | 75828 | 87974 | 00337 | 12912 | 25698 | 38688 | 51880 | 36 |
| 37 | 0240918 | 0252395 | 0264100 | 0276029 | 0288178 | 0300544 | 0313124 | 0325912 | 0338906 | 0352102 | 37 |
| 38 | 41107 | 52588 | 64297 | 76229 | 88383 | 00752 | 13335 | 26127 | 39125 | 52323 | 38 |
| 39 | 41297 | 52782 | 64494 | 76430 | 88587 | 00960 | 13547 | 26342 | 39343 | 52545 | 39 |
| 40 | 0241486 | 0252975 | 0264691 | 0276631 | 0288791 | 0301168 | 0313758 | 0326557 | 0339561 | 0352767 | 40 |
| 41 | 41676 | 53168 | 64888 | 76832 | 88996 | 01377 | 13970 | 26772 | 39780 | 52988 | 41 |
| 42 | 41866 | 53362 | 65085 | 77033 | 89200 | 01585 | 14182 | 26987 | 39998 | 53210 | 42 |
| 43 | 0242055 | 0253555 | 0265283 | 0277234 | 0289405 | 0301793 | 0314393 | 0327203 | 0340217 | 0353432 | 43 |
| 44 | 42245 | 53749 | 65480 | 77435 | 89610 | 02001 | 14605 | 27418 | 40435 | 53654 | 44 |
| 45 | 42435 | 53943 | 65677 | 77636 | 89815 | 02209 | 14817 | 27633 | 40654 | 53876 | 45 |
| 46 | 0242625 | 0254136 | 0265875 | 0277837 | 0290019 | 0302418 | 0315029 | 0327848 | 0340873 | 0354098 | 46 |
| 47 | 42815 | 54330 | 66072 | 78038 | 90224 | 02626 | 15241 | 28064 | 41092 | 54320 | 47 |
| 48 | 43005 | 54524 | 66270 | 78240 | 90429 | 02835 | 15453 | 28279 | 41310 | 54542 | 48 |
| 49 | 0243195 | 0254718 | 0266468 | 0278441 | 0290634 | 0303043 | 0315665 | 0328495 | 0341529 | 0354764 | 49 |
| 50 | 43385 | 54912 | 66665 | 78643 | 90839 | 03252 | 15877 | 28710 | 41748 | 54987 | 50 |
| 51 | 43575 | 55106 | 66863 | 78844 | 91044 | 03461 | 16089 | 28926 | 41967 | 55209 | 51 |
| 52 | 0243766 | 0255300 | 0267061 | 0279046 | 0291250 | 0303669 | 0316302 | 0329142 | 0342186 | 0355431 | 52 |
| 53 | 43956 | 55494 | 67259 | 79247 | 91455 | 03878 | 16514 | 29358 | 42406 | 55654 | 53 |
| 54 | 44146 | 55688 | 67457 | 79449 | 91660 | 04087 | 16726 | 29573 | 42625 | 55876 | 54 |
| 55 | 0244337 | 0255883 | 0267655 | 0279651 | 0291865 | 0304296 | 0316939 | 0329789 | 0342844 | 0356099 | 55 |
| 56 | 44528 | 56077 | 67853 | 79852 | 92071 | 04505 | 17151 | 30005 | 43063 | 56321 | 56 |
| 57 | 44718 | 56271 | 68051 | 80054 | 92276 | 04714 | 17364 | 30221 | 43283 | 56544 | 57 |
| 58 | 0244909 | 0256466 | 0268250 | 0280256 | 0292482 | 0304923 | 0317576 | 0330437 | 0343502 | 0356767 | 58 |
| 59 | 45100 | 56661 | 68448 | 80458 | 92688 | 05132 | 17789 | 30653 | 43721 | 56990 | 59 |
| 60 | 45290 | 56855 | 68646 | 80660 | 92893 | 05342 | 18002 | 30869 | 43941 | 57212 | 60 |

## Parts for Seconds. (x.)

| | 40° | | 41° | | 42° | | 43° | | 44° | | 45° | | 46° | | 47° | | 48° | | 49° | | 50° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 |
| 2 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 2 |
| 3 | 9 | 9 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 3 |
| 4 | 12 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 4 |
| 5 | 16 | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 19 | 5 |
| 6 | 19 | 19 | 19 | 19 | 19 | 20 | 20 | 20 | 20 | 20 | 21 | 21 | 21 | 21 | 21 | 21 | 22 | 22 | 22 | 22 | 22 | 6 |
| 7 | 22 | 22 | 22 | 22 | 23 | 23 | 23 | 23 | 24 | 24 | 24 | 24 | 24 | 25 | 25 | 25 | 25 | 25 | 26 | 26 | 26 | 7 |
| 8 | 25 | 25 | 25 | 26 | 26 | 26 | 26 | 27 | 27 | 27 | 27 | 28 | 28 | 28 | 28 | 29 | 29 | 29 | 29 | 29 | 30 | 8 |
| 9 | 28 | 28 | 29 | 29 | 29 | 29 | 30 | 30 | 30 | 31 | 31 | 31 | 31 | 32 | 32 | 32 | 32 | 33 | 33 | 33 | 33 | 9 |
| 10 | 31 | 31 | 32 | 32 | 32 | 33 | 33 | 33 | 34 | 34 | 34 | 35 | 35 | 35 | 35 | 36 | 36 | 36 | 37 | 37 | 37 | 10 |
| 11 | 34 | 35 | 35 | 35 | 36 | 36 | 36 | 37 | 37 | 37 | 38 | 38 | 38 | 39 | 39 | 39 | 40 | 40 | 40 | 41 | 41 | 11 |
| 12 | 37 | 38 | 38 | 39 | 39 | 39 | 40 | 40 | 40 | 41 | 41 | 41 | 42 | 42 | 43 | 43 | 43 | 44 | 44 | 44 | 45 | 12 |
| 13 | 41 | 41 | 41 | 42 | 42 | 43 | 43 | 43 | 44 | 44 | 45 | 45 | 45 | 46 | 46 | 46 | 47 | 47 | 48 | 48 | 48 | 13 |
| 14 | 44 | 44 | 45 | 45 | 45 | 46 | 46 | 47 | 47 | 47 | 48 | 48 | 49 | 49 | 50 | 50 | 50 | 51 | 51 | 52 | 52 | 14 |
| 15 | 47 | 47 | 48 | 48 | 49 | 49 | 50 | 50 | 51 | 51 | 51 | 52 | 52 | 53 | 53 | 54 | 54 | 54 | 55 | 55 | 56 | 15 |
| 16 | 50 | 50 | 51 | 51 | 52 | 52 | 53 | 53 | 54 | 54 | 55 | 55 | 56 | 56 | 57 | 57 | 58 | 58 | 59 | 59 | 59 | 16 |
| 17 | 53 | 54 | 54 | 55 | 55 | 56 | 56 | 57 | 57 | 58 | 58 | 59 | 59 | 60 | 60 | 61 | 61 | 62 | 62 | 63 | 63 | 17 |
| 18 | 56 | 57 | 57 | 58 | 58 | 59 | 60 | 60 | 61 | 61 | 62 | 62 | 63 | 63 | 64 | 64 | 65 | 65 | 66 | 66 | 67 | 18 |
| 19 | 59 | 60 | 60 | 61 | 62 | 62 | 63 | 63 | 64 | 65 | 65 | 66 | 66 | 67 | 67 | 68 | 68 | 69 | 70 | 70 | 71 | 19 |
| 20 | 62 | 63 | 64 | 64 | 65 | 65 | 66 | 67 | 67 | 68 | 69 | 69 | 70 | 70 | 71 | 71 | 72 | 73 | 73 | 74 | 74 | 20 |
| 21 | 65 | 66 | 67 | 67 | 68 | 69 | 69 | 70 | 70 | 71 | 72 | 73 | 73 | 74 | 74 | 75 | 76 | 76 | 77 | 77 | 78 | 21 |
| 22 | 69 | 69 | 70 | 71 | 71 | 72 | 73 | 73 | 74 | 75 | 75 | 76 | 77 | 77 | 78 | 79 | 79 | 80 | 80 | 81 | 82 | 22 |
| 23 | 72 | 72 | 73 | 74 | 75 | 75 | 76 | 77 | 77 | 78 | 79 | 80 | 80 | 81 | 82 | 82 | 83 | 84 | 84 | 85 | 85 | 23 |
| 24 | 75 | 76 | 76 | 77 | 78 | 79 | 79 | 80 | 81 | 82 | 82 | 83 | 84 | 84 | 85 | 86 | 86 | 87 | 88 | 88 | 89 | 24 |
| 25 | 78 | 79 | 80 | 80 | 81 | 82 | 83 | 83 | 84 | 85 | 86 | 86 | 87 | 88 | 89 | 89 | 90 | 91 | 91 | 92 | 93 | 25 |
| 26 | 81 | 82 | 83 | 84 | 84 | 85 | 86 | 87 | 87 | 88 | 89 | 90 | 91 | 91 | 92 | 93 | 94 | 94 | 95 | 96 | 97 | 26 |
| 27 | 84 | 85 | 86 | 87 | 88 | 88 | 89 | 90 | 91 | 92 | 92 | 93 | 94 | 95 | 96 | 97 | 97 | 98 | 99 | 100 | 100 | 27 |
| 28 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 93 | 94 | 96 | 96 | 97 | 98 | 98 | 99 | 100 | 101 | 102 | 102 | 103 | 104 | 28 |
| 29 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 99 | 100 | 101 | 102 | 103 | 104 | 104 | 105 | 106 | 107 | 108 | 29 |
| 30 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 104 | 105 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 111 | 30 |
| 31 | 97 | 98 | 99 | 100 | 101 | 102 | 103 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 113 | 114 | 115 | 31 |
| 32 | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 32 |
| 33 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 33 |
| 34 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 116 | 117 | 118 | 119 | 120 | 121 | 121 | 123 | 123 | 124 | 125 | 126 | 34 |
| 35 | 109 | 110 | 111 | 112 | 114 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 35 |
| 36 | 112 | 113 | 115 | 116 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 124 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 36 |
| 37 | 115 | 117 | 118 | 119 | 120 | 121 | 122 | 123 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 37 |
| 38 | 118 | 120 | 121 | 122 | 123 | 124 | 126 | 127 | 128 | 129 | 130 | 131 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 | 141 | 38 |
| 39 | 122 | 123 | 124 | 125 | 126 | 128 | 129 | 130 | 131 | 132 | 134 | 135 | 136 | 137 | 138 | 139 | 141 | 142 | 143 | 144 | 145 | 39 |
| 40 | 125 | 126 | 127 | 128 | 130 | 131 | 132 | 133 | 135 | 136 | 137 | 138 | 139 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 149 | 40 |
| 41 | 128 | 129 | 130 | 132 | 133 | 134 | 136 | 137 | 138 | 139 | 141 | 142 | 143 | 144 | 145 | 147 | 148 | 149 | 150 | 151 | 152 | 41 |
| 42 | 131 | 132 | 134 | 135 | 136 | 138 | 139 | 140 | 141 | 143 | 144 | 145 | 146 | 148 | 149 | 150 | 151 | 152 | 154 | 155 | 156 | 42 |
| 43 | 134 | 135 | 137 | 138 | 139 | 141 | 142 | 144 | 145 | 146 | 147 | 149 | 150 | 151 | 152 | 154 | 155 | 156 | 157 | 159 | 160 | 43 |
| 44 | 137 | 139 | 140 | 141 | 143 | 144 | 145 | 147 | 148 | 150 | 151 | 152 | 153 | 155 | 156 | 157 | 159 | 160 | 161 | 162 | 163 | 44 |
| 45 | 140 | 142 | 143 | 145 | 146 | 147 | 149 | 150 | 152 | 153 | 154 | 156 | 157 | 158 | 160 | 161 | 162 | 163 | 165 | 166 | 167 | 45 |
| 46 | 143 | 145 | 146 | 148 | 149 | 151 | 152 | 154 | 155 | 156 | 158 | 159 | 160 | 162 | 163 | 164 | 166 | 167 | 168 | 170 | 171 | 46 |
| 47 | 146 | 148 | 150 | 151 | 152 | 154 | 155 | 157 | 158 | 160 | 161 | 163 | 164 | 165 | 167 | 168 | 169 | 171 | 172 | 173 | 175 | 47 |
| 48 | 150 | 151 | 153 | 154 | 156 | 157 | 159 | 160 | 162 | 163 | 165 | 166 | 167 | 169 | 170 | 172 | 173 | 174 | 176 | 177 | 178 | 48 |
| 49 | 153 | 154 | 156 | 157 | 159 | 160 | 162 | 164 | 165 | 167 | 168 | 169 | 171 | 172 | 174 | 175 | 177 | 178 | 179 | 181 | 182 | 49 |
| 50 | 156 | 157 | 160 | 161 | 162 | 164 | 165 | 167 | 168 | 170 | 171 | 173 | 174 | 176 | 177 | 179 | 180 | 182 | 183 | 184 | 186 | 50 |
| 51 | 159 | 161 | 162 | 164 | 165 | 167 | 169 | 170 | 172 | 173 | 175 | 176 | 178 | 179 | 181 | 182 | 184 | 185 | 187 | 188 | 189 | 51 |
| 52 | 162 | 164 | 165 | 167 | 169 | 170 | 172 | 174 | 175 | 177 | 178 | 180 | 181 | 183 | 184 | 186 | 187 | 189 | 190 | 192 | 193 | 52 |
| 53 | 165 | 167 | 169 | 170 | 172 | 174 | 175 | 177 | 178 | 180 | 182 | 183 | 185 | 186 | 188 | 189 | 191 | 192 | 194 | 195 | 197 | 53 |
| 54 | 168 | 170 | 172 | 173 | 175 | 177 | 179 | 180 | 182 | 184 | 185 | 187 | 188 | 190 | 191 | 193 | 195 | 196 | 198 | 199 | 201 | 54 |
| 55 | 171 | 173 | 175 | 177 | 178 | 180 | 182 | 184 | 185 | 187 | 189 | 190 | 192 | 193 | 195 | 197 | 198 | 200 | 201 | 203 | 204 | 55 |
| 56 | 174 | 176 | 178 | 180 | 182 | 183 | 185 | 187 | 189 | 190 | 192 | 194 | 195 | 197 | 199 | 200 | 202 | 203 | 205 | 206 | 208 | 56 |
| 57 | 178 | 180 | 181 | 183 | 185 | 187 | 188 | 190 | 192 | 194 | 195 | 197 | 199 | 200 | 202 | 204 | 205 | 207 | 209 | 210 | 212 | 57 |
| 58 | 181 | 183 | 184 | 186 | 188 | 190 | 192 | 194 | 195 | 197 | 199 | 200 | 202 | 204 | 206 | 207 | 209 | 211 | 212 | 214 | 215 | 58 |
| 59 | 184 | 186 | 188 | 190 | 191 | 193 | 195 | 197 | 199 | 201 | 202 | 204 | 206 | 207 | 209 | 211 | 213 | 214 | 216 | 218 | 219 | 59 |
| 60 | 187 | 189 | 190 | 193 | 195 | 196 | 198 | 200 | 202 | 204 | 206 | 207 | 209 | 211 | 213 | 214 | 216 | 219 | 219 | 221 | 223 | 60 |

## Nat. Versines. (v.)

| ′ | 50° | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0357212 | 0370680 | 0384338 | 0398185 | 0412215 | 0426424 | 0440807 | 0455361 | 0470081 | 0484962 | 0 |
| 1 | 0357435 | 0370906 | 0384568 | 0398417 | 0412450 | 0426662 | 0441048 | 0455605 | 0470327 | 0485211 | 1 |
| 2 | 57658 | 71132 | 84797 | 98650 | 12685 | 26900 | 41289 | 55849 | 70574 | 85461 | 2 |
| 3 | 57881 | 71358 | 85026 | 98882 | 12921 | 27139 | 41531 | 56093 | 70821 | 85710 | 3 |
| 4 | 0358104 | 0371584 | 0385256 | 0399115 | 0413156 | 0427377 | 0441772 | 0456337 | 0471068 | 0485960 | 4 |
| 5 | 58327 | 71811 | 85485 | 99347 | 13392 | 27616 | 42013 | 56581 | 71315 | 86209 | 5 |
| 6 | 58550 | 72037 | 85715 | 99580 | 13628 | 27854 | 42255 | 56826 | 71562 | 86459 | 6 |
| 7 | 0358774 | 0372263 | 0385944 | 0399812 | 0413863 | 0428093 | 0442496 | 0457070 | 0471809 | 0486708 | 7 |
| 8 | 58997 | 72490 | 86174 | 400045 | 14099 | 28331 | 42738 | 57314 | 72056 | 86958 | 8 |
| 9 | 59220 | 72716 | 86404 | 00278 | 14335 | 28570 | 42979 | 57558 | 72303 | 87208 | 9 |
| 10 | 0359443 | 0372943 | 0386633 | 0400511 | 0414571 | 0428809 | 0443221 | 0457803 | 0472550 | 0487457 | 10 |
| 11 | 59667 | 73169 | 86863 | 00743 | 14806 | 29048 | 43463 | 58047 | 72797 | 87707 | 11 |
| 12 | 59890 | 73396 | 87093 | 00976 | 15042 | 29286 | 43704 | 58292 | 73044 | 87957 | 12 |
| 13 | 0360114 | 0373623 | 0387323 | 0401209 | 0415278 | 0429525 | 0443946 | 0458536 | 0473291 | 0488207 | 13 |
| 14 | 60337 | 73850 | 87553 | 01442 | 15514 | 29764 | 44188 | 58781 | 73539 | 88457 | 14 |
| 15 | 60561 | 74076 | 87783 | 01675 | 15750 | 30003 | 44430 | 59025 | 73786 | 88707 | 15 |
| 16 | 0360785 | 0374303 | 0388013 | 0401908 | 0415986 | 0430242 | 0444672 | 0459270 | 0474033 | 0488957 | 16 |
| 17 | 61008 | 74530 | 88243 | 02142 | 16223 | 30481 | 44914 | 59515 | 74281 | 89207 | 17 |
| 18 | 61232 | 74757 | 88473 | 02375 | 16459 | 30720 | 45156 | 59760 | 74528 | 89457 | 18 |
| 19 | 0361456 | 0374984 | 0388703 | 0402608 | 0416695 | 0430960 | 0445398 | 0460004 | 0474776 | 0489707 | 19 |
| 20 | 61680 | 75211 | 88933 | 02841 | 16931 | 31199 | 45640 | 60249 | 75023 | 89957 | 20 |
| 21 | 61904 | 75439 | 89164 | 03075 | 17168 | 31438 | 45882 | 60494 | 75271 | 90208 | 21 |
| 22 | 0362128 | 0375666 | 0389394 | 0403308 | 0417404 | 0431677 | 0446124 | 0460739 | 0475519 | 0490458 | 22 |
| 23 | 62352 | 75893 | 89624 | 03542 | 17640 | 31917 | 46366 | 60984 | 75766 | 90708 | 23 |
| 24 | 62576 | 76120 | 89855 | 03775 | 17877 | 32156 | 46608 | 61229 | 76014 | 90959 | 24 |
| 25 | 0362800 | 0376348 | 0390085 | 0404009 | 0418114 | 0432396 | 0446851 | 0461474 | 0476262 | 0491209 | 25 |
| 26 | 63024 | 76575 | 90316 | 04242 | 18350 | 32635 | 47093 | 61719 | 76510 | 91459 | 26 |
| 27 | 63249 | 76803 | 90546 | 04476 | 18587 | 32875 | 47335 | 61955 | 76758 | 91710 | 27 |
| 28 | 0363473 | 0377030 | 0390777 | 0404710 | 0418823 | 0433114 | 0447578 | 0462210 | 0477005 | 0491960 | 28 |
| 29 | 63697 | 77258 | 91008 | 04943 | 19060 | 33354 | 47820 | 62455 | 77253 | 92211 | 29 |
| 30 | 63922 | 77485 | 91239 | 05177 | 19297 | 33594 | 48063 | 62700 | 77501 | 92462 | 30 |
| 31 | 0364146 | 0377713 | 0391469 | 0405411 | 0419534 | 0433833 | 0448306 | 0462946 | 0477749 | 0492712 | 31 |
| 32 | 64371 | 77941 | 91700 | 05645 | 19771 | 34073 | 48548 | 63191 | 77998 | 92963 | 32 |
| 33 | 64595 | 78169 | 91931 | 05879 | 20008 | 34313 | 48791 | 63437 | 78246 | 93214 | 33 |
| 34 | 0364820 | 0378396 | 0392162 | 0406113 | 0420245 | 0434553 | 0449034 | 0463682 | 0478494 | 0493464 | 34 |
| 35 | 65045 | 78624 | 92393 | 06347 | 20482 | 34793 | 49276 | 63928 | 78742 | 93715 | 35 |
| 36 | 65269 | 78852 | 92624 | 06581 | 20719 | 35033 | 49519 | 64173 | 78990 | 93966 | 36 |
| 37 | 0365494 | 0379080 | 0392855 | 0406815 | 0420956 | 0435273 | 0449762 | 0464419 | 0479239 | 0494217 | 37 |
| 38 | 65719 | 79308 | 93086 | 07049 | 21193 | 35513 | 50005 | 64664 | 79487 | 94468 | 38 |
| 39 | 65944 | 79536 | 93318 | 07284 | 21430 | 35753 | 50248 | 64910 | 79735 | 94719 | 39 |
| 40 | 0366169 | 0379764 | 0393549 | 0407518 | 0421668 | 0435993 | 0450491 | 0465156 | 0479984 | 0494970 | 40 |
| 41 | 66394 | 79993 | 93780 | 07752 | 21905 | 36234 | 50734 | 65402 | 80232 | 95221 | 41 |
| 42 | 66619 | 80221 | 94012 | 07987 | 22142 | 36474 | 50977 | 65648 | 80481 | 95472 | 42 |
| 43 | 0366844 | 0380449 | 0394243 | 0408221 | 0422380 | 0436714 | 0451220 | 0465893 | 0480729 | 0495723 | 43 |
| 44 | 67069 | 80678 | 94474 | 08456 | 22617 | 36955 | 51463 | 66139 | 80978 | 95975 | 44 |
| 45 | 67295 | 80906 | 94706 | 08690 | 22855 | 37195 | 51707 | 66385 | 81227 | 96226 | 45 |
| 46 | 0367520 | 0381134 | 0394938 | 0408925 | 0423092 | 0437435 | 0451950 | 0466631 | 0481475 | 0496477 | 46 |
| 47 | 67745 | 81363 | 95169 | 09160 | 23330 | 37676 | 52193 | 66878 | 81724 | 96729 | 47 |
| 48 | 67971 | 81592 | 95401 | 09394 | 23568 | 37917 | 52437 | 67124 | 81973 | 96980 | 48 |
| 49 | 0368196 | 0381820 | 0395633 | 0409629 | 0423805 | 0438157 | 0452680 | 0467370 | 0482222 | 0497231 | 49 |
| 50 | 68422 | 82049 | 95864 | 09864 | 24043 | 38398 | 52924 | 67616 | 82471 | 97483 | 50 |
| 51 | 68647 | 82278 | 96096 | 10099 | 24281 | 38639 | 53167 | 67862 | 82720 | 97734 | 51 |
| 52 | 0368873 | 0382506 | 0396328 | 0410334 | 0424519 | 0438879 | 0453411 | 0468109 | 0482969 | 0497986 | 52 |
| 53 | 69098 | 82735 | 96560 | 10569 | 24757 | 39120 | 53654 | 68355 | 83218 | 98233 | 53 |
| 54 | 69324 | 82964 | 96792 | 10804 | 24995 | 39361 | 53898 | 68601 | 83467 | 98489 | 54 |
| 55 | 0369550 | 0383193 | 0397024 | 0411039 | 0425233 | 0439602 | 0454142 | 0468848 | 0483716 | 0498741 | 55 |
| 56 | 69776 | 83422 | 97256 | 11274 | 25471 | 39843 | 54385 | 69094 | 83965 | 98993 | 56 |
| 57 | 70002 | 83651 | 97488 | 11509 | 25709 | 40084 | 54629 | 69341 | 84214 | 99244 | 57 |
| 58 | 0370228 | 0383880 | 0397720 | 0411744 | 0425947 | 0440325 | 0454873 | 0469587 | 0484463 | 0499496 | 58 |
| 59 | 70454 | 84109 | 97953 | 11979 | 26185 | 40566 | 55117 | 69834 | 84713 | 99748 | 59 |
| 60 | 70680 | 84338 | 98185 | 12215 | 26424 | 40807 | 55361 | 70081 | 84962 | 500000 | 60 |

## Parts for Seconds. (v.)

| | 50° | | 51° | | 52° | | 53° | | 54° | | 55° | | 56° | | 57° | | 58° | | 59° | | 60° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30 | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 |
| 2 | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 2 |
| 3 | 11 | 11 | 11 | 11 | 11 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 13 | 13 | 3 |
| 4 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 | 17 | 4 |
| 5 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 21 | 21 | 21 | 21 | 21 | 5 |
| 6 | 22 | 22 | 23 | 23 | 23 | 23 | 23 | 23 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 25 | 25 | 25 | 25 | 25 | 25 | 6 |
| 7 | 26 | 26 | 26 | 27 | 27 | 27 | 27 | 27 | 27 | 28 | 28 | 28 | 28 | 28 | 28 | 29 | 29 | 29 | 29 | 29 | 29 | 7 |
| 8 | 30 | 30 | 30 | 30 | 31 | 31 | 31 | 31 | 31 | 32 | 32 | 32 | 32 | 32 | 32 | 33 | 33 | 33 | 33 | 33 | 34 | 8 |
| 9 | 33 | 34 | 34 | 34 | 34 | 35 | 35 | 35 | 35 | 36 | 36 | 36 | 36 | 36 | 37 | 37 | 37 | 37 | 37 | 38 | 38 | 9 |
| 10 | 37 | 37 | 38 | 38 | 38 | 38 | 39 | 39 | 39 | 39 | 40 | 40 | 40 | 40 | 41 | 41 | 41 | 41 | 42 | 42 | 42 | 10 |
| 11 | 41 | 41 | 41 | 42 | 42 | 42 | 43 | 43 | 43 | 43 | 44 | 44 | 44 | 44 | 45 | 45 | 45 | 45 | 46 | 46 | 46 | 11 |
| 12 | 45 | 45 | 45 | 46 | 46 | 46 | 46 | 47 | 47 | 47 | 48 | 48 | 48 | 49 | 49 | 49 | 49 | 50 | 50 | 50 | 50 | 12 |
| 13 | 48 | 49 | 49 | 49 | 50 | 50 | 50 | 51 | 51 | 51 | 52 | 52 | 52 | 53 | 53 | 53 | 53 | 54 | 54 | 54 | 55 | 13 |
| 14 | 52 | 52 | 52 | 53 | 53 | 54 | 54 | 55 | 55 | 55 | 56 | 56 | 56 | 57 | 57 | 57 | 58 | 58 | 58 | 58 | 59 | 14 |
| 15 | 56 | 56 | 57 | 57 | 57 | 58 | 58 | 58 | 59 | 59 | 60 | 60 | 60 | 61 | 61 | 61 | 62 | 62 | 62 | 63 | 63 | 15 |
| 16 | 59 | 60 | 60 | 61 | 61 | 62 | 62 | 62 | 63 | 63 | 64 | 64 | 64 | 65 | 65 | 65 | 66 | 66 | 66 | 67 | 67 | 16 |
| 17 | 63 | 64 | 64 | 64 | 65 | 65 | 66 | 66 | 67 | 67 | 68 | 68 | 68 | 69 | 69 | 70 | 70 | 70 | 71 | 71 | 71 | 17 |
| 18 | 67 | 67 | 68 | 68 | 69 | 69 | 70 | 70 | 71 | 71 | 71 | 72 | 72 | 73 | 73 | 74 | 74 | 74 | 75 | 75 | 76 | 18 |
| 19 | 71 | 71 | 72 | 72 | 73 | 73 | 74 | 74 | 75 | 75 | 75 | 76 | 76 | 77 | 77 | 78 | 78 | 79 | 79 | 79 | 80 | 19 |
| 20 | 74 | 75 | 75 | 76 | 76 | 77 | 77 | 78 | 78 | 79 | 79 | 80 | 80 | 81 | 81 | 82 | 82 | 83 | 83 | 84 | 84 | 20 |
| 21 | 78 | 79 | 79 | 80 | 80 | 81 | 81 | 82 | 82 | 83 | 83 | 84 | 84 | 85 | 85 | 86 | 86 | 87 | 87 | 88 | 88 | 21 |
| 22 | 82 | 82 | 83 | 83 | 84 | 85 | 85 | 86 | 86 | 87 | 87 | 88 | 88 | 89 | 89 | 90 | 90 | 91 | 91 | 92 | 92 | 22 |
| 23 | 85 | 86 | 87 | 87 | 88 | 88 | 89 | 90 | 90 | 91 | 91 | 92 | 92 | 93 | 94 | 94 | 95 | 95 | 96 | 96 | 97 | 23 |
| 24 | 89 | 90 | 90 | 91 | 92 | 92 | 93 | 94 | 94 | 95 | 95 | 96 | 96 | 97 | 98 | 98 | 99 | 99 | 100 | 100 | 101 | 24 |
| 25 | 93 | 94 | 94 | 95 | 96 | 96 | 97 | 97 | 98 | 99 | 99 | 100 | 100 | 101 | 102 | 102 | 103 | 103 | 104 | 104 | 105 | 25 |
| 26 | 97 | 97 | 98 | 99 | 99 | 100 | 101 | 101 | 102 | 103 | 103 | 104 | 104 | 105 | 106 | 106 | 107 | 107 | 108 | 109 | 109 | 26 |
| 27 | 100 | 101 | 102 | 102 | 103 | 104 | 105 | 105 | 106 | 107 | 107 | 108 | 109 | 109 | 110 | 110 | 111 | 112 | 112 | 113 | 113 | 27 |
| 28 | 104 | 105 | 105 | 106 | 107 | 108 | 108 | 109 | 110 | 111 | 111 | 112 | 113 | 113 | 114 | 114 | 115 | 116 | 116 | 117 | 118 | 28 |
| 29 | 108 | 108 | 109 | 110 | 111 | 112 | 112 | 113 | 114 | 114 | 115 | 116 | 117 | 117 | 118 | 119 | 119 | 120 | 121 | 121 | 122 | 29 |
| 30 | 111 | 112 | 113 | 114 | 115 | 115 | 116 | 117 | 118 | 118 | 119 | 120 | 121 | 121 | 122 | 123 | 123 | 124 | 125 | 125 | 126 | 30 |
| 31 | 115 | 116 | 117 | 118 | 118 | 119 | 120 | 121 | 122 | 122 | 123 | 124 | 125 | 125 | 126 | 127 | 127 | 128 | 129 | 130 | 130 | 31 |
| 32 | 119 | 120 | 120 | 121 | 122 | 123 | 124 | 125 | 126 | 126 | 127 | 128 | 129 | 129 | 130 | 131 | 132 | 132 | 133 | 134 | 134 | 32 |
| 33 | 123 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 129 | 130 | 131 | 132 | 133 | 133 | 134 | 135 | 136 | 136 | 137 | 138 | 139 | 33 |
| 34 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 133 | 134 | 135 | 136 | 137 | 137 | 138 | 139 | 140 | 141 | 141 | 142 | 143 | 34 |
| 35 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 136 | 137 | 138 | 139 | 140 | 141 | 141 | 142 | 143 | 144 | 145 | 145 | 146 | 147 | 35 |
| 36 | 134 | 135 | 136 | 137 | 138 | 138 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 146 | 147 | 148 | 149 | 150 | 150 | 151 | 36 |
| 37 | 137 | 139 | 139 | 140 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 150 | 151 | 152 | 153 | 154 | 155 | 155 | 37 |
| 38 | 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 38 |
| 39 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 159 | 160 | 161 | 162 | 163 | 164 | 39 |
| 40 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 164 | 165 | 166 | 167 | 168 | 40 |
| 41 | 152 | 153 | 154 | 156 | 157 | 158 | 159 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 169 | 170 | 171 | 172 | 41 |
| 42 | 156 | 157 | 158 | 159 | 160 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 175 | 176 | 42 |
| 43 | 160 | 161 | 162 | 163 | 164 | 165 | 166 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 43 |
| 44 | 163 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 44 |
| 45 | 167 | 168 | 170 | 171 | 172 | 173 | 174 | 175 | 177 | 178 | 179 | 180 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 45 |
| 46 | 171 | 172 | 173 | 175 | 176 | 177 | 178 | 179 | 180 | 182 | 183 | 184 | 185 | 186 | 187 | 188 | 189 | 191 | 191 | 192 | 193 | 46 |
| 47 | 175 | 176 | 177 | 178 | 180 | 181 | 182 | 183 | 184 | 185 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 47 |
| 48 | 178 | 180 | 181 | 182 | 183 | 185 | 186 | 187 | 188 | 190 | 191 | 192 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 201 | 202 | 48 |
| 49 | 182 | 183 | 185 | 186 | 187 | 188 | 190 | 191 | 192 | 193 | 195 | 196 | 197 | 198 | 199 | 200 | 201 | 203 | 204 | 205 | 206 | 49 |
| 50 | 186 | 187 | 188 | 190 | 191 | 192 | 194 | 195 | 196 | 197 | 199 | 200 | 201 | 202 | 203 | 204 | 206 | 207 | 208 | 209 | 210 | 50 |
| 51 | 189 | 191 | 192 | 194 | 195 | 196 | 197 | 199 | 200 | 201 | 203 | 204 | 205 | 206 | 207 | 209 | 210 | 211 | 212 | 213 | 214 | 51 |
| 52 | 193 | 195 | 196 | 197 | 199 | 200 | 201 | 203 | 204 | 205 | 207 | 208 | 209 | 210 | 211 | 213 | 214 | 215 | 216 | 217 | 218 | 52 |
| 53 | 197 | 198 | 200 | 201 | 203 | 204 | 205 | 207 | 208 | 209 | 210 | 212 | 213 | 214 | 215 | 217 | 218 | 219 | 220 | 221 | 223 | 53 |
| 54 | 201 | 202 | 203 | 205 | 206 | 208 | 209 | 210 | 212 | 213 | 214 | 216 | 217 | 218 | 220 | 221 | 222 | 223 | 224 | 226 | 227 | 54 |
| 55 | 204 | 206 | 207 | 209 | 210 | 212 | 213 | 214 | 216 | 217 | 218 | 220 | 221 | 222 | 224 | 225 | 226 | 227 | 229 | 230 | 231 | 55 |
| 56 | 208 | 209 | 211 | 212 | 214 | 215 | 217 | 218 | 220 | 221 | 222 | 224 | 225 | 226 | 228 | 229 | 230 | 232 | 233 | 234 | 235 | 56 |
| 57 | 212 | 213 | 215 | 216 | 218 | 219 | 221 | 222 | 224 | 225 | 226 | 228 | 229 | 230 | 232 | 233 | 234 | 236 | 237 | 238 | 239 | 57 |
| 58 | 215 | 217 | 219 | 220 | 222 | 223 | 225 | 226 | 228 | 229 | 230 | 232 | 233 | 234 | 236 | 237 | 238 | 240 | 241 | 242 | 244 | 58 |
| 59 | 219 | 221 | 222 | 224 | 225 | 227 | 228 | 230 | 231 | 233 | 234 | 236 | 237 | 239 | 240 | 241 | 243 | 244 | 245 | 246 | 248 | 59 |
| 60 | 223 | 224 | 226 | 228 | 229 | 231 | 232 | 234 | 235 | 237 | 238 | 240 | 241 | 243 | 244 | 245 | 247 | 248 | 249 | 251 | 252 | 60 |

(v.) Nat. Versines

| ′ | 60° | 61° | 62° | 63° | 64° | 65° | 66° | 67° | 68° | 69° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0500000 | 0515190 | 0530528 | 0546009 | 0561629 | 0577382 | 0593263 | 0609269 | 0625393 | 0641632 | 0 |
| 1 | 0500252 | 0515445 | 0530785 | 0546269 | 0561890 | 0577645 | 0593529 | 0609537 | 0625663 | 0641904 | 1 |
| 2 | 00504 | 15699 | 31042 | 46528 | 62152 | 77909 | 93795 | 09804 | 25933 | 42175 | 2 |
| 3 | 00756 | 15954 | 31299 | 46787 | 62413 | 78173 | 94061 | 10072 | 26203 | 42447 | 3 |
| 4 | 0501008 | 0516208 | 0531556 | 0547046 | 0562675 | 0578437 | 0594327 | 0610340 | 0626472 | 0642719 | 4 |
| 5 | 01260 | 16463 | 31813 | 47306 | 62937 | 78700 | 94592 | 10608 | 26742 | 42990 | 5 |
| 6 | 01512 | 16718 | 32070 | 47565 | 63198 | 78964 | 94858 | 10876 | 27012 | 43262 | 6 |
| 7 | 0501764 | 0516972 | 0532327 | 0547825 | 0563460 | 0579228 | 0595124 | 0611144 | 0627282 | 0643534 | 7 |
| 8 | 02017 | 17227 | 32584 | 48084 | 63722 | 79492 | 95390 | 11412 | 27552 | 43806 | 8 |
| 9 | 02269 | 17482 | 32842 | 48344 | 63983 | 79756 | 95656 | 11680 | 27822 | 44077 | 9 |
| 10 | 0502521 | 0517737 | 0533099 | 0548603 | 0564245 | 0580020 | 0595922 | 0611948 | 0628092 | 0644349 | 10 |
| 11 | 02774 | 17991 | 33356 | 48863 | 64507 | 80284 | 96189 | 12216 | 28362 | 44621 | 11 |
| 12 | 03026 | 18246 | 33613 | 49122 | 64769 | 80548 | 96455 | 12484 | 28632 | 44893 | 12 |
| 13 | 0503278 | 0518501 | 0533871 | 0549382 | 0565031 | 0580812 | 0596721 | 0612753 | 0628902 | 0645165 | 13 |
| 14 | 03531 | 18756 | 34128 | 49642 | 65293 | 81076 | 96987 | 13021 | 29172 | 45437 | 14 |
| 15 | 03783 | 19011 | 34385 | 49902 | 65555 | 81340 | 97253 | 13289 | 29443 | 45709 | 15 |
| 16 | 0504036 | 0519266 | 0534643 | 0550161 | 0565817 | 0581604 | 0597520 | 0613557 | 0629713 | 0645981 | 16 |
| 17 | 04289 | 19521 | 34900 | 50421 | 66079 | 81869 | 97786 | 13826 | 29983 | 46253 | 17 |
| 18 | 04541 | 19776 | 35158 | 50681 | 66341 | 82133 | 98052 | 14094 | 30253 | 46525 | 18 |
| 19 | 0504794 | 0520032 | 0535415 | 0550941 | 0566603 | 0582397 | 0598319 | 0614362 | 0630523 | 0646797 | 19 |
| 20 | 05047 | 20287 | 35673 | 51201 | 66865 | 82661 | 98585 | 14631 | 30794 | 47069 | 20 |
| 21 | 05299 | 20542 | 35931 | 51461 | 67127 | 82926 | 98851 | 14899 | 31064 | 47342 | 21 |
| 22 | 0505552 | 0520797 | 0536188 | 0551721 | 0567390 | 0583190 | 0599118 | 0615168 | 0631335 | 0647614 | 22 |
| 23 | 05805 | 21053 | 36446 | 51981 | 67652 | 83455 | 99384 | 15436 | 31605 | 47886 | 23 |
| 24 | 06058 | 21308 | 36704 | 52241 | 67914 | 83719 | 99651 | 15705 | 31875 | 48158 | 24 |
| 25 | 0506311 | 0521564 | 0536962 | 0552501 | 0568177 | 0583984 | 0599917 | 0615973 | 0632146 | 0648431 | 25 |
| 26 | 06564 | 21819 | 37220 | 52761 | 68439 | 84248 | 600184 | 16242 | 32416 | 48703 | 26 |
| 27 | 06817 | 22074 | 37477 | 53021 | 68701 | 84513 | 00451 | 16510 | 32687 | 48975 | 27 |
| 28 | 0507070 | 0522330 | 0537735 | 0553282 | 0568964 | 0584777 | 0600717 | 0616779 | 0632957 | 0649248 | 28 |
| 29 | 07323 | 22586 | 37993 | 53542 | 69226 | 85042 | 00984 | 17048 | 33228 | 49520 | 29 |
| 30 | 07576 | 22841 | 38251 | 53802 | 69489 | 85307 | 01251 | 17317 | 33499 | 49793 | 30 |
| 31 | 0507830 | 0523097 | 0538509 | 0554062 | 0569751 | 0585571 | 0601518 | 0617585 | 0633769 | 0650065 | 31 |
| 32 | 08083 | 23353 | 38767 | 54323 | 70014 | 85836 | 01784 | 17854 | 34040 | 50338 | 32 |
| 33 | 08336 | 23608 | 39026 | 54583 | 70277 | 86101 | 02051 | 18123 | 34311 | 50610 | 33 |
| 34 | 0508589 | 0523864 | 0539284 | 0554844 | 0570539 | 0586366 | 0602318 | 0618392 | 0634582 | 0650883 | 34 |
| 35 | 08843 | 24120 | 39542 | 55104 | 70802 | 86631 | 02585 | 18661 | 34852 | 51155 | 35 |
| 36 | 09096 | 24376 | 39800 | 55365 | 71065 | 86896 | 02852 | 18930 | 35123 | 51428 | 36 |
| 37 | 0509350 | 0524632 | 0540058 | 0555625 | 0571328 | 0587160 | 0603119 | 0619199 | 0635394 | 0651701 | 37 |
| 38 | 09603 | 24888 | 40317 | 55886 | 71590 | 87425 | 03386 | 19468 | 35665 | 51973 | 38 |
| 39 | 09857 | 25144 | 40575 | 56147 | 71853 | 87690 | 03653 | 19737 | 35936 | 52246 | 39 |
| 40 | 0510110 | 0525400 | 0540833 | 0556407 | 0572116 | 0587955 | 0603920 | 0620006 | 0636207 | 0652519 | 40 |
| 41 | 10364 | 25656 | 41092 | 56668 | 72379 | 88220 | 04187 | 20275 | 36478 | 52791 | 41 |
| 42 | 10617 | 25912 | 41350 | 56929 | 72642 | 88486 | 04454 | 20544 | 36749 | 53064 | 42 |
| 43 | 0510871 | 0526168 | 0541609 | 0557190 | 0572905 | 0588751 | 0604722 | 0620813 | 0637020 | 0653337 | 43 |
| 44 | 11125 | 26424 | 41867 | 57450 | 73168 | 89016 | 04989 | 21082 | 37291 | 53610 | 44 |
| 45 | 11379 | 26680 | 42126 | 57711 | 73431 | 89281 | 05256 | 21351 | 37562 | 53883 | 45 |
| 46 | 0511633 | 0526937 | 0542385 | 0557972 | 0573694 | 0589546 | 0605523 | 0621621 | 0637833 | 0654156 | 46 |
| 47 | 11886 | 27193 | 42643 | 58233 | 73957 | 89812 | 05791 | 21890 | 38104 | 54429 | 47 |
| 48 | 12140 | 27449 | 42902 | 58494 | 74221 | 90077 | 06058 | 22159 | 38375 | 54702 | 48 |
| 49 | 0512394 | 0527706 | 0543161 | 0558755 | 0574484 | 0590342 | 0606325 | 0622429 | 0638647 | 0654975 | 49 |
| 50 | 12648 | 27962 | 43420 | 59016 | 74747 | 90608 | 06593 | 22698 | 38918 | 55248 | 50 |
| 51 | 12902 | 28218 | 43678 | 59277 | 75010 | 90873 | 06860 | 22967 | 39189 | 55521 | 51 |
| 52 | 0513156 | 0528475 | 0543937 | 0559538 | 0575274 | 0591138 | 0607128 | 0623237 | 0639460 | 0655794 | 52 |
| 53 | 13410 | 28731 | 44196 | 59800 | 75537 | 91404 | 07395 | 23506 | 39732 | 56067 | 53 |
| 54 | 13665 | 28988 | 44455 | 60061 | 75801 | 91669 | 07663 | 23776 | 40003 | 56340 | 54 |
| 55 | 0513919 | 0529245 | 0544714 | 0560322 | 0576064 | 0591935 | 0607930 | 0624045 | 0640275 | 0656613 | 55 |
| 56 | 14173 | 29501 | 44973 | 60583 | 76327 | 92201 | 08198 | 24315 | 40546 | 56887 | 56 |
| 57 | 14427 | 29758 | 45232 | 60845 | 76591 | 92466 | 08466 | 24584 | 40817 | 57160 | 57 |
| 58 | 0514682 | 0530015 | 0545491 | 0561106 | 0576854 | 0592732 | 0608733 | 0624854 | 0641089 | 0657433 | 58 |
| 59 | 14936 | 30272 | 45750 | 61367 | 77118 | 92998 | 09001 | 25124 | 41360 | 57706 | 59 |
| 60 | 15190 | 30528 | 46009 | 61629 | 77382 | 93263 | 09269 | 25393 | 41632 | 57980 | 60 |

## Parts for Seconds. (v.)

| " | 60° | | 61° | | 62° | | 63° | | 64° | | 65° | | 66° | | 67° | | 68° | | 69° | | 70° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 1 |
| 2 | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 2 |
| 3 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 14 | 14 | 14 | 14 | 3 |
| 4 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 4 |
| 5 | 21 | 21 | 21 | 21 | 21 | 21 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 23 | 23 | 23 | 23 | 5 |
| 6 | 25 | 25 | 25 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 6 |
| 7 | 29 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 32 | 32 | 32 | 32 | 7 |
| 8 | 34 | 34 | 34 | 34 | 34 | 34 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 8 |
| 9 | 38 | 38 | 38 | 38 | 39 | 39 | 39 | 39 | 39 | 39 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 41 | 41 | 41 | 41 | 9 |
| 10 | 42 | 42 | 42 | 43 | 43 | 43 | 43 | 43 | 44 | 44 | 44 | 44 | 44 | 44 | 45 | 45 | 45 | 45 | 45 | 45 | 46 | 10 |
| 11 | 46 | 46 | 47 | 47 | 47 | 47 | 48 | 48 | 48 | 48 | 48 | 49 | 49 | 49 | 49 | 49 | 49 | 50 | 50 | 50 | 50 | 11 |
| 12 | 50 | 51 | 51 | 51 | 51 | 52 | 52 | 52 | 52 | 53 | 53 | 53 | 53 | 53 | 53 | 54 | 54 | 54 | 54 | 54 | 55 | 12 |
| 13 | 55 | 55 | 55 | 55 | 56 | 56 | 56 | 56 | 57 | 57 | 57 | 57 | 58 | 58 | 58 | 58 | 58 | 59 | 59 | 59 | 59 | 13 |
| 14 | 59 | 59 | 59 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 62 | 62 | 62 | 62 | 62 | 63 | 63 | 63 | 63 | 64 | 64 | 14 |
| 15 | 63 | 63 | 64 | 64 | 64 | 64 | 65 | 65 | 65 | 66 | 66 | 66 | 66 | 67 | 67 | 67 | 67 | 68 | 68 | 68 | 68 | 15 |
| 16 | 67 | 68 | 68 | 68 | 68 | 69 | 69 | 69 | 70 | 70 | 70 | 71 | 71 | 71 | 71 | 72 | 72 | 72 | 72 | 73 | 73 | 16 |
| 17 | 71 | 72 | 72 | 72 | 73 | 73 | 73 | 74 | 74 | 74 | 75 | 75 | 75 | 76 | 76 | 76 | 76 | 77 | 77 | 77 | 77 | 17 |
| 18 | 76 | 76 | 76 | 77 | 77 | 77 | 78 | 78 | 78 | 79 | 79 | 79 | 80 | 80 | 80 | 81 | 81 | 81 | 81 | 82 | 82 | 18 |
| 19 | 80 | 80 | 81 | 81 | 81 | 82 | 82 | 82 | 83 | 83 | 83 | 84 | 84 | 84 | 85 | 85 | 85 | 86 | 86 | 86 | 87 | 19 |
| 20 | 84 | 84 | 85 | 85 | 86 | 86 | 86 | 87 | 87 | 88 | 88 | 88 | 89 | 89 | 89 | 90 | 90 | 90 | 91 | 91 | 91 | 20 |
| 21 | 88 | 89 | 89 | 89 | 90 | 90 | 91 | 91 | 92 | 92 | 92 | 93 | 93 | 93 | 94 | 94 | 94 | 95 | 95 | 95 | 96 | 21 |
| 22 | 92 | 93 | 93 | 94 | 94 | 95 | 95 | 95 | 96 | 96 | 97 | 97 | 97 | 98 | 98 | 99 | 99 | 99 | 100 | 100 | 100 | 22 |
| 23 | 97 | 97 | 98 | 98 | 98 | 99 | 99 | 100 | 100 | 101 | 101 | 101 | 102 | 102 | 103 | 103 | 103 | 104 | 104 | 104 | 105 | 23 |
| 24 | 101 | 101 | 102 | 102 | 103 | 103 | 104 | 104 | 105 | 105 | 105 | 106 | 106 | 107 | 107 | 107 | 108 | 108 | 109 | 109 | 109 | 24 |
| 25 | 105 | 105 | 106 | 107 | 107 | 107 | 108 | 108 | 109 | 109 | 110 | 110 | 111 | 111 | 112 | 112 | 112 | 113 | 113 | 114 | 114 | 25 |
| 26 | 109 | 110 | 110 | 111 | 111 | 112 | 112 | 113 | 113 | 114 | 114 | 115 | 115 | 116 | 116 | 116 | 117 | 117 | 118 | 118 | 118 | 26 |
| 27 | 113 | 114 | 114 | 115 | 116 | 116 | 117 | 117 | 118 | 118 | 119 | 119 | 120 | 120 | 121 | 121 | 121 | 122 | 122 | 123 | 123 | 27 |
| 28 | 118 | 118 | 119 | 119 | 120 | 120 | 121 | 121 | 122 | 123 | 123 | 124 | 124 | 124 | 125 | 125 | 126 | 126 | 127 | 127 | 128 | 28 |
| 29 | 122 | 122 | 123 | 124 | 124 | 125 | 125 | 126 | 126 | 127 | 127 | 128 | 128 | 129 | 130 | 130 | 130 | 131 | 131 | 132 | 132 | 29 |
| 30 | 126 | 127 | 127 | 128 | 128 | 129 | 130 | 130 | 131 | 131 | 132 | 132 | 133 | 133 | 134 | 134 | 135 | 135 | 136 | 136 | 137 | 30 |
| 31 | 130 | 131 | 131 | 132 | 133 | 133 | 134 | 134 | 135 | 136 | 136 | 137 | 137 | 138 | 138 | 139 | 139 | 140 | 140 | 141 | 141 | 31 |
| 32 | 134 | 135 | 136 | 136 | 137 | 138 | 138 | 139 | 139 | 140 | 141 | 141 | 142 | 142 | 143 | 143 | 144 | 144 | 145 | 145 | 146 | 32 |
| 33 | 139 | 139 | 140 | 141 | 141 | 142 | 143 | 143 | 144 | 144 | 145 | 146 | 146 | 147 | 147 | 148 | 148 | 149 | 149 | 150 | 150 | 33 |
| 34 | 143 | 143 | 144 | 145 | 146 | 146 | 147 | 148 | 148 | 149 | 149 | 150 | 151 | 151 | 152 | 152 | 153 | 153 | 154 | 154 | 155 | 34 |
| 35 | 147 | 148 | 148 | 150 | 150 | 150 | 151 | 152 | 153 | 153 | 154 | 154 | 155 | 156 | 156 | 157 | 157 | 158 | 158 | 159 | 159 | 35 |
| 36 | 151 | 152 | 153 | 153 | 154 | 155 | 156 | 156 | 157 | 158 | 158 | 159 | 159 | 160 | 161 | 161 | 162 | 162 | 163 | 163 | 164 | 36 |
| 37 | 155 | 156 | 157 | 158 | 158 | 159 | 160 | 161 | 161 | 162 | 163 | 163 | 164 | 164 | 165 | 166 | 166 | 167 | 167 | 168 | 169 | 37 |
| 38 | 160 | 160 | 161 | 162 | 163 | 163 | 164 | 165 | 166 | 166 | 167 | 168 | 168 | 169 | 170 | 170 | 171 | 171 | 172 | 173 | 173 | 38 |
| 39 | 164 | 165 | 165 | 166 | 167 | 168 | 168 | 169 | 170 | 171 | 171 | 172 | 173 | 173 | 174 | 175 | 175 | 176 | 177 | 177 | 178 | 39 |
| 40 | 168 | 169 | 170 | 170 | 171 | 172 | 173 | 174 | 174 | 175 | 176 | 176 | 177 | 178 | 179 | 179 | 180 | 180 | 181 | 182 | 182 | 40 |
| 41 | 172 | 173 | 174 | 175 | 176 | 176 | 177 | 178 | 179 | 179 | 180 | 181 | 182 | 182 | 183 | 184 | 184 | 185 | 186 | 186 | 187 | 41 |
| 42 | 176 | 177 | 178 | 179 | 180 | 181 | 181 | 182 | 183 | 184 | 185 | 185 | 186 | 187 | 187 | 188 | 189 | 189 | 190 | 191 | 191 | 42 |
| 43 | 181 | 181 | 182 | 183 | 184 | 185 | 186 | 187 | 187 | 188 | 189 | 190 | 190 | 191 | 192 | 193 | 193 | 194 | 195 | 195 | 196 | 43 |
| 44 | 185 | 186 | 187 | 187 | 188 | 189 | 190 | 191 | 192 | 193 | 193 | 194 | 195 | 196 | 197 | 197 | 198 | 198 | 199 | 200 | 200 | 44 |
| 45 | 189 | 190 | 191 | 192 | 193 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 199 | 200 | 201 | 201 | 202 | 203 | 204 | 204 | 205 | 45 |
| 46 | 193 | 194 | 195 | 196 | 197 | 198 | 199 | 200 | 200 | 201 | 202 | 203 | 204 | 205 | 205 | 206 | 207 | 207 | 208 | 209 | 210 | 46 |
| 47 | 197 | 198 | 199 | 200 | 201 | 202 | 203 | 204 | 205 | 206 | 207 | 207 | 208 | 209 | 210 | 211 | 211 | 212 | 213 | 213 | 214 | 47 |
| 48 | 202 | 203 | 204 | 205 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 213 | 214 | 215 | 216 | 217 | 217 | 218 | 219 | 48 |
| 49 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 220 | 221 | 222 | 222 | 223 | 49 |
| 50 | 210 | 211 | 212 | 213 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 221 | 222 | 223 | 224 | 225 | 226 | 226 | 227 | 228 | 50 |
| 51 | 214 | 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 | 228 | 229 | 230 | 231 | 232 | 232 | 51 |
| 52 | 218 | 219 | 220 | 221 | 223 | 224 | 225 | 226 | 227 | 228 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 235 | 236 | 237 | 52 |
| 53 | 223 | 224 | 225 | 226 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 237 | 238 | 239 | 240 | 241 | 241 | 53 |
| 54 | 227 | 228 | 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 244 | 245 | 246 | 54 |
| 55 | 231 | 232 | 233 | 234 | 235 | 236 | 238 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 55 |
| 56 | 235 | 236 | 237 | 239 | 240 | 241 | 242 | 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 253 | 254 | 255 | 56 |
| 57 | 239 | 240 | 242 | 243 | 244 | 245 | 246 | 247 | 249 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 57 |
| 58 | 244 | 245 | 246 | 247 | 248 | 249 | 251 | 252 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 262 | 263 | 264 | 58 |
| 59 | 248 | 249 | 250 | 251 | 253 | 254 | 255 | 256 | 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 59 |
| 60 | 252 | 253 | 254 | 256 | 257 | 258 | 259 | 260 | 261 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 | 271 | 272 | 272 | 273 | 60 |

(v.) Nat. Versines.

| ′ | 70° | 71° | 72° | 73° | 74° | 75° | 76° | 77° | 78° | 79° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0657980 | 0674432 | 0690983 | 0707628 | 0724363 | 0741181 | 0758078 | 0775049 | 0792088 | 0809191 | 0 |
| 1 | 0658253 | 0674707 | 0691260 | 0707906 | 0724642 | 0741462 | 0758360 | 0775332 | 0792373 | 0809477 | 1 |
| 2 | 58527 | 74982 | 91536 | 08185 | 24922 | 41743 | 58643 | 75616 | 92657 | 09762 | 2 |
| 3 | 58800 | 75257 | 91813 | 08463 | 25202 | 42024 | 58925 | 75899 | 92942 | 10048 | 3 |
| 4 | 0659073 | 0675532 | 0692090 | 0708741 | 0725481 | 0742305 | 0759207 | 0776183 | 0793227 | 0810333 | 4 |
| 5 | 59347 | 75807 | 92367 | 09019 | 25761 | 42586 | 59490 | 76466 | 93511 | 10619 | 5 |
| 6 | 59620 | 76083 | 92643 | 09298 | 26041 | 42867 | 59772 | 76750 | 93796 | 10905 | 6 |
| 7 | 0659894 | 0676358 | 0692920 | 0709576 | 0726321 | 0743148 | 0760054 | 0777033 | 0794080 | 0811190 | 7 |
| 8 | 60167 | 76633 | 93197 | 09854 | 26600 | 43429 | 60337 | 77317 | 94365 | 11476 | 8 |
| 9 | 60441 | 76908 | 93474 | 10133 | 26880 | 43711 | 60619 | 77601 | 94650 | 11761 | 9 |
| 10 | 0660715 | 0677184 | 0693751 | 0710411 | 0727160 | 0743992 | 0760902 | 0777884 | 0794934 | 0812047 | 10 |
| 11 | 60988 | 77459 | 94028 | 10690 | 27440 | 44273 | 61184 | 78168 | 95219 | 12333 | 11 |
| 12 | 61262 | 77734 | 94305 | 10968 | 27720 | 44554 | 61466 | 78451 | 95504 | 12619 | 12 |
| 13 | 0661536 | 0678010 | 0694582 | 0711247 | 0728000 | 0744835 | 0761749 | 0778735 | 0795789 | 0812904 | 13 |
| 14 | 61809 | 78285 | 94859 | 11525 | 28280 | 45117 | 62032 | 79019 | 96073 | 13190 | 14 |
| 15 | 62083 | 78560 | 95136 | 11804 | 28560 | 45398 | 62314 | 79303 | 96358 | 13476 | 15 |
| 16 | 0662357 | 0678836 | 0695413 | 0712082 | 0728839 | 0745679 | 0762597 | 0779586 | 0796643 | 0813762 | 16 |
| 17 | 62631 | 79111 | 95690 | 12361 | 29119* | 45961 | 62879 | 79870 | 96928 | 14048 | 17 |
| 18 | 62905 | 79387 | 95967 | 12639 | 29400 | 46242 | 63162 | 90154 | 97213 | 14333 | 18 |
| 19 | 0663179 | 0679663 | 0696244 | 0712918 | 0729680 | 0746523 | 0763444 | 0780438 | 0797498 | 0814619 | 19 |
| 20 | 63452 | 79938 | 96521 | 13197 | 29960 | 46805 | 63727 | 80721 | 97782 | 14905 | 20 |
| 21 | 63726 | 80214 | 96798 | 13475 | 30240 | 47086 | 64010 | 81005 | 98067 | 15191 | 21 |
| 22 | 0664000 | 0680489 | 0697076 | 0713754 | 0730520 | 0747368 | 0764292 | 0781289 | 0798352 | 0815477 | 22 |
| 23 | 64274 | 80765 | 97353 | 14033 | 30800 | 47649 | 64575 | 81573 | 98637 | 15763 | 23 |
| 24 | 64548 | 81041 | 97630 | 14312 | 31080 | 47931 | 64858 | 81857 | 98922 | 16049 | 24 |
| 25 | 0664822 | 0681316 | 0697907 | 0714590 | 0731360 | 0748212 | 0765141 | 0782141 | 0799207 | 0816335 | 25 |
| 26 | 65097 | 81592 | 98185 | 14869 | 31641 | 48494 | 65423 | 82425 | 99492 | 16620 | 26 |
| 27 | 65371 | 81868 | 98462 | 15148 | 31921 | 48775 | 65706 | 82708 | 99777 | 16906 | 27 |
| 28 | 0665645 | 0682144 | 0698739 | 0715427 | 0732201 | 0749057 | 0765989 | 0782992 | 0800062 | 0817192 | 28 |
| 29 | 65919 | 82419 | 99017 | 15706 | 32481 | 49338 | 66272 | 83276 | 00347 | 17478 | 29 |
| 30 | 66193 | 82695 | 99294 | 15985 | 32762 | 49620 | 66555 | 83560 | 00632 | 17764 | 30 |
| 31 | 0666467 | 0682971 | 0699572 | 0716264 | 0733042 | 0749902 | 0766837 | 0783844 | 0800917 | 0818050 | 31 |
| 32 | 66742 | 83247 | 99849 | 16542 | 33322 | 50183 | 67120 | 84128 | 01202 | 18336 | 32 |
| 33 | 67016 | 83523 | 700127 | 16821 | 33603 | 50465 | 67403 | 84412 | 01487 | 18623 | 33 |
| 34 | 0667290 | 0683799 | 0700404 | 0717100 | 0733883 | 0750747 | 0767686 | 0784696 | 0801772 | 0818909 | 34 |
| 35 | 67564 | 84075 | 00682 | 17379 | 34163 | 51028 | 67969 | 84981 | 02057 | 19195 | 35 |
| 36 | 67839 | 84351 | 00959 | 17658 | 34444 | 51310 | 68252 | 85265 | 02343 | 19481 | 36 |
| 37 | 0668113 | 0684627 | 0701237 | 0717938 | 0734724 | 0751592 | 0768535 | 0785549 | 0802628 | 0819767 | 37 |
| 38 | 68388 | 84903 | 01514 | 18217 | 35005 | 51874 | 68818 | 85833 | 02913 | 20053 | 38 |
| 39 | 68662 | 85179 | 01792 | 18496 | 35285 | 52155 | 69101 | 86117 | 03198 | 20339 | 39 |
| 40 | 0668937 | 0685455 | 0702070 | 0718775 | 0735566 | 0752437 | 0769384 | 0786401 | 0803483 | 0820625 | 40 |
| 41 | 69211 | 85731 | 02347 | 19054 | 35846 | 52719 | 69667 | 86685 | 03769 | 20912 | 41 |
| 42 | 69486 | 86007 | 02625 | 19333 | 36127 | 53001 | 69950 | 86970 | 04054 | 21198 | 42 |
| 43 | 0669760 | 0686284 | 0702903 | 0719612 | 0736407 | 0753283 | 0770233 | 0787254 | 0804339 | 0821484 | 43 |
| 44 | .70035 | 86560 | 03181 | 19892 | 36688 | 53565 | 70516 | 87538 | 04624 | 21770 | 44 |
| 45 | 70309 | 86836 | 03458 | 20171 | 36969 | 53847 | 70800 | 87822 | 04910 | 22056 | 45 |
| 46 | 0670584 | 0687112 | 0703736 | 0720450 | 0737249 | 0754129 | 0771083 | 0788107 | 0805195 | 0822343 | 46 |
| 47 | 70859 | 87389 | 04014 | 20730 | 37530 | 54411 | 71366 | 88391 | 05480 | 22629 | 47 |
| 48 | 71133 | 87665 | 04292 | 21009 | 37811 | 54693 | 71649 | 88675 | 05766 | 22915 | 48 |
| 49 | 0671408 | 0687941 | 0704570 | 0721288 | 0738091 | 0754975 | 0771932 | 0788959 | 0806051 | 0823202 | 49 |
| 50 | 71683 | 88218 | 04848 | 21568 | 38372 | 55257 | 72216 | 89244 | 06336 | 23488 | 50 |
| 51 | 71958 | 88494 | 05126 | 21847 | 38653 | 55539 | 72499 | 89528 | 06622 | 23774 | 51 |
| 52 | 0672232 | 0688771 | 0705404 | 0722126 | 0738934 | 0755821 | 0772782 | 0789813 | 0806907 | 0824060 | 52 |
| 53 | 72507 | 89047 | 05682 | 22406 | 39215 | 56103 | 73065 | 90097 | 07193 | 24347 | 53 |
| 54 | 72782 | 89324 | 05960 | 22685 | 39495 | 56385 | 73349 | 90381 | 07478 | 24633 | 54 |
| 55 | 0673057 | 0689600 | 0706238 | 0722965 | 0739776 | 0756667 | 0773632 | 0790666 | 0807763 | 0824920 | 55 |
| 56 | 73332 | 89877 | 06516 | 23244 | 40057 | 56949 | 73915 | 90950 | 08049 | 25206 | 56 |
| 57 | 73607 | 90153 | 06794 | 23524 | 40338 | 57231 | 74199 | 91235 | 08334 | 25492 | 57 |
| 58 | 0673882 | 0690430 | 0707072 | 0723803 | 0740619 | 0757514 | 0774482 | 0791519 | 0808620 | 0825779 | 58 |
| 59 | 74157 | 90706 | 07350 | 24083 | 40900 | 57796 | 74765 | 91804 | 08905 | 26065 | 59 |
| 60 | 74432 | 90983 | 07628 | 24363 | 41181 | 58078 | 75049 | 92088 | 09191 | 26352 | 60 |

Parts for Seconds. (v.)

| | 70° | | 71° | | 72° | | 73° | | 74° | | 75° | | 76° | | 77° | | 78° | | 79° | | 80° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 |
| 2 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 2 |
| 3 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 3 |
| 4 | 18 | 18 | 18 | 18 | 18 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 4 |
| 5 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 5 |
| 6 | 27 | 27 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 29 | 29 | 29 | 29 | 6 |
| 7 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 7 |
| 8 | 36 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 8 |
| 9 | 41 | 41 | 41 | 41 | 41 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 9 |
| 10 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 48 | 48 | 48 | 48 | 10 |
| 11 | 50 | 50 | 50 | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 53 | 11 |
| 12 | 55 | 55 | 55 | 55 | 55 | 55 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 12 |
| 13 | 59 | 59 | 60 | 60 | 60 | 60 | 60 | 60 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 62 | 62 | 62 | 62 | 62 | 62 | 13 |
| 14 | 64 | 64 | 64 | 64 | 65 | 65 | 65 | 65 | 65 | 65 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 67 | 67 | 67 | 67 | 14 |
| 15 | 68 | 69 | 69 | 69 | 69 | 69 | 70 | 70 | 70 | 70 | 70 | 70 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 72 | 15 |
| 16 | 73 | 73 | 73 | 74 | 74 | 74 | 74 | 74 | 75 | 75 | 75 | 75 | 75 | 75 | 76 | 76 | 76 | 76 | 76 | 76 | 76 | 16 |
| 17 | 77 | 78 | 78 | 78 | 78 | 79 | 79 | 79 | 79 | 79 | 80 | 80 | 80 | 80 | 80 | 80 | 81 | 81 | 81 | 81 | 81 | 17 |
| 18 | 82 | 82 | 83 | 83 | 83 | 83 | 83 | 84 | 84 | 84 | 84 | 84 | 85 | 85 | 85 | 85 | 85 | 86 | 86 | 86 | 86 | 18 |
| 19 | 87 | 87 | 87 | 87 | 88 | 88 | 88 | 88 | 89 | 89 | 89 | 89 | 89 | 90 | 90 | 90 | 90 | 90 | 90 | 91 | 91 | 19 |
| 20 | 91 | 91 | 92 | 92 | 92 | 92 | 93 | 93 | 93 | 93 | 94 | 94 | 94 | 94 | 94 | 95 | 95 | 95 | 95 | 95 | 95 | 20 |
| 21 | 96 | 96 | 96 | 97 | 97 | 97 | 97 | 98 | 98 | 98 | 98 | 99 | 99 | 99 | 99 | 99 | 100 | 100 | 100 | 100 | 100 | 21 |
| 22 | 100 | 101 | 101 | 101 | 101 | 102 | 102 | 102 | 103 | 103 | 103 | 103 | 103 | 104 | 104 | 104 | 104 | 105 | 105 | 105 | 105 | 22 |
| 23 | 105 | 105 | 105 | 106 | 106 | 106 | 107 | 107 | 107 | 107 | 108 | 108 | 108 | 108 | 109 | 109 | 109 | 109 | 109 | 110 | 110 | 23 |
| 24 | 109 | 110 | 110 | 110 | 111 | 111 | 111 | 112 | 112 | 112 | 112 | 113 | 113 | 113 | 113 | 114 | 114 | 114 | 114 | 114 | 115 | 24 |
| 25 | 114 | 114 | 115 | 115 | 115 | 116 | 116 | 116 | 117 | 117 | 117 | 117 | 118 | 118 | 118 | 118 | 119 | 119 | 119 | 119 | 119 | 25 |
| 26 | 118 | 119 | 119 | 120 | 120 | 120 | 121 | 121 | 121 | 121 | 122 | 122 | 122 | 123 | 123 | 123 | 123 | 124 | 124 | 124 | 124 | 26 |
| 27 | 123 | 123 | 124 | 124 | 124 | 125 | 125 | 125 | 126 | 126 | 126 | 127 | 127 | 127 | 128 | 128 | 128 | 128 | 128 | 129 | 129 | 27 |
| 28 | 128 | 128 | 128 | 129 | 129 | 129 | 130 | 130 | 131 | 131 | 131 | 131 | 132 | 132 | 132 | 133 | 133 | 133 | 133 | 133 | 134 | 28 |
| 29 | 132 | 133 | 133 | 133 | 134 | 134 | 134 | 135 | 135 | 135 | 136 | 136 | 136 | 137 | 137 | 137 | 138 | 138 | 138 | 138 | 138 | 29 |
| 30 | 137 | 137 | 138 | 138 | 138 | 139 | 139 | 139 | 140 | 140 | 140 | 141 | 141 | 141 | 142 | 142 | 142 | 143 | 143 | 143 | 143 | 30 |
| 31 | 141 | 142 | 142 | 143 | 143 | 143 | 144 | 144 | 144 | 145 | 145 | 145 | 146 | 146 | 146 | 147 | 147 | 147 | 148 | 148 | 148 | 31 |
| 32 | 146 | 146 | 147 | 147 | 148 | 148 | 148 | 149 | 149 | 149 | 150 | 150 | 151 | 151 | 151 | 152 | 152 | 152 | 152 | 152 | 153 | 32 |
| 33 | 150 | 151 | 151 | 152 | 152 | 153 | 153 | 153 | 154 | 154 | 154 | 155 | 155 | 156 | 156 | 156 | 156 | 157 | 157 | 157 | 158 | 33 |
| 34 | 155 | 155 | 156 | 156 | 157 | 157 | 158 | 158 | 158 | 159 | 159 | 160 | 160 | 160 | 161 | 161 | 161 | 162 | 162 | 162 | 162 | 34 |
| 35 | 159 | 160 | 160 | 161 | 161 | 162 | 162 | 163 | 163 | 164 | 164 | 164 | 165 | 165 | 165 | 166 | 166 | 166 | 167 | 167 | 167 | 35 |
| 36 | 164 | 165 | 165 | 166 | 166 | 166 | 167 | 167 | 168 | 168 | 169 | 169 | 169 | 170 | 170 | 170 | 171 | 171 | 171 | 172 | 172 | 36 |
| 37 | 169 | 169 | 170 | 170 | 171 | 171 | 172 | 172 | 172 | 173 | 173 | 174 | 174 | 174 | 175 | 175 | 175 | 176 | 176 | 176 | 177 | 37 |
| 38 | 173 | 174 | 174 | 175 | 175 | 176 | 176 | 177 | 177 | 178 | 178 | 178 | 179 | 179 | 180 | 180 | 181 | 181 | 181 | 181 | 181 | 38 |
| 39 | 178 | 178 | 179 | 179 | 180 | 180 | 181 | 181 | 182 | 182 | 183 | 183 | 183 | 184 | 184 | 185 | 185 | 185 | 186 | 186 | 186 | 39 |
| 40 | 182 | 183 | 183 | 184 | 184 | 185 | 185 | 186 | 186 | 187 | 187 | 188 | 188 | 189 | 189 | 189 | 190 | 190 | 190 | 191 | 191 | 40 |
| 41 | 187 | 187 | 188 | 188 | 189 | 190 | 190 | 191 | 191 | 192 | 192 | 192 | 193 | 193 | 194 | 194 | 194 | 195 | 195 | 195 | 196 | 41 |
| 42 | 191 | 192 | 193 | 193 | 194 | 194 | 195 | 195 | 196 | 196 | 197 | 197 | 198 | 198 | 198 | 199 | 199 | 200 | 200 | 200 | 201 | 42 |
| 43 | 196 | 197 | 197 | 198 | 198 | 199 | 199 | 200 | 200 | 201 | 201 | 202 | 202 | 203 | 203 | 204 | 204 | 204 | 205 | 205 | 205 | 43 |
| 44 | 200 | 201 | 202 | 202 | 203 | 203 | 204 | 205 | 205 | 206 | 206 | 207 | 207 | 207 | 208 | 208 | 209 | 209 | 209 | 210 | 210 | 44 |
| 45 | 205 | 206 | 206 | 207 | 207 | 208 | 209 | 209 | 210 | 210 | 211 | 211 | 212 | 212 | 213 | 213 | 213 | 214 | 214 | 214 | 215 | 45 |
| 46 | 210 | 210 | 211 | 211 | 212 | 213 | 213 | 214 | 214 | 215 | 215 | 216 | 216 | 217 | 217 | 218 | 218 | 219 | 219 | 219 | 220 | 46 |
| 47 | 214 | 215 | 215 | 216 | 217 | 217 | 218 | 218 | 219 | 220 | 220 | 221 | 221 | 222 | 222 | 222 | 223 | 223 | 224 | 224 | 224 | 47 |
| 48 | 219 | 219 | 220 | 221 | 221 | 222 | 223 | 223 | 224 | 224 | 225 | 225 | 226 | 226 | 227 | 227 | 228 | 228 | 228 | 229 | 229 | 48 |
| 49 | 223 | 224 | 225 | 225 | 226 | 227 | 228 | 228 | 228 | 229 | 229 | 230 | 231 | 231 | 231 | 232 | 232 | 233 | 233 | 234 | 234 | 49 |
| 50 | 228 | 229 | 229 | 230 | 231 | 231 | 232 | 232 | 233 | 234 | 234 | 235 | 235 | 236 | 236 | 237 | 237 | 238 | 238 | 238 | 239 | 50 |
| 51 | 232 | 233 | 234 | 234 | 235 | 236 | 236 | 237 | 238 | 238 | 239 | 239 | 240 | 240 | 241 | 241 | 242 | 242 | 243 | 243 | 243 | 51 |
| 52 | 237 | 238 | 238 | 239 | 240 | 240 | 241 | 242 | 242 | 243 | 243 | 244 | 245 | 245 | 246 | 246 | 247 | 247 | 247 | 248 | 248 | 52 |
| 53 | 241 | 242 | 243 | 244 | 244 | 245 | 246 | 246 | 247 | 248 | 248 | 249 | 249 | 250 | 250 | 251 | 251 | 252 | 252 | 253 | 253 | 53 |
| 54 | 246 | 247 | 248 | 248 | 249 | 250 | 250 | 251 | 252 | 252 | 253 | 253 | 254 | 255 | 255 | 256 | 256 | 257 | 257 | 257 | 258 | 54 |
| 55 | 251 | 251 | 252 | 253 | 254 | 254 | 255 | 256 | 256 | 257 | 258 | 258 | 259 | 259 | 260 | 260 | 261 | 261 | 262 | 262 | 263 | 55 |
| 56 | 255 | 256 | 257 | 257 | 258 | 259 | 260 | 260 | 261 | 262 | 262 | 263 | 263 | 264 | 265 | 265 | 266 | 266 | 267 | 267 | 267 | 56 |
| 57 | 260 | 261 | 261 | 262 | 263 | 264 | 264 | 265 | 266 | 266 | 267 | 268 | 268 | 269 | 270 | 270 | 270 | 271 | 271 | 272 | 272 | 57 |
| 58 | 264 | 265 | 266 | 267 | 267 | 268 | 269 | 270 | 270 | 271 | 272 | 272 | 273 | 273 | 274 | 275 | 275 | 276 | 276 | 276 | 277 | 58 |
| 59 | 269 | 270 | 270 | 271 | 272 | 273 | 274 | 274 | 275 | 276 | 276 | 277 | 277 | 278 | 279 | 279 | 280 | 280 | 281 | 281 | 282 | 59 |
| 60 | 273 | 274 | 275 | 276 | 277 | 277 | 278 | 279 | 280 | 280 | 281 | 282 | 282 | 283 | 283 | 284 | 284 | 285 | 286 | 286 | 286 | 60 |

| (v.) | Nat. Versines. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 80° | 81° | 82° | 83° | 84° | 85° | 86° | 87° | 88° | 89° | |
| 0 | 0826352 | 0843565 | 0860827 | 0878131 | 0895471 | 0912844 | 0930243 | 0947664 | 0965100 | 0982548 | 0 |
| 1 | 0826638 | 0843853 | 0861115 | 0878419 | 0895761 | 0913134 | 0930534 | 0947954 | 0965391 | 0982838 | 1 |
| 2 | 26925 | 44140 | 61403 | 78708 | 96050 | 13424 | 30824 | 48245 | 65682 | 83129 | 2 |
| 3 | 27211 | 44427 | 61691 | 78997 | 96339 | 13714 | 31114 | 48535 | 65973 | 83420 | 3 |
| 4 | 0827498 | 0844715 | 0861979 | 0879286 | 0896629 | 0914003 | 0931404 | 0948826 | 0966263 | 0983711 | 4 |
| 5 | 27784 | 45002 | 62267 | 79574 | 96918 | 14293 | 31694 | 49116 | 66554 | 84002 | 5 |
| 6 | 28071 | 45290 | 62555 | 79863 | 97207 | 14583 | 31985 | 49407 | 66845 | 84293 | 6 |
| 7 | 0828357 | 0845577 | 0862844 | 0880152 | 0897497 | 0914873 | 0932275 | 0949698 | 0967136 | 0984583 | 7 |
| 8 | 28644 | 45864 | 63132 | 80441 | 97786 | 15163 | 32565 | 49988 | 67426 | 84874 | 8 |
| 9 | 28931 | 46152 | 63420 | 80730 | 98075 | 15453 | 32855 | 50279 | 67717 | 85165 | 9 |
| 10 | 0829217 | 0846439 | 0863708 | 0881018 | 0898365 | 0915742 | 0933146 | 0950569 | 0968008 | 0985456 | 10 |
| 11 | 29504 | 46727 | 63996 | 81307 | 98654 | 16032 | 33436 | 50860 | 68298 | 85747 | 11 |
| 12 | 29790 | 47014 | 64284 | 81596 | 98944 | 16322 | 33726 | 51150 | 68589 | 86038 | 12 |
| 13 | 0830077 | 0847302 | 0864573 | 0881885 | 0899233 | 0916612 | 0934016 | 0951441 | 0968880 | 0986329 | 13 |
| 14 | 30364 | 47589 | 64861 | 82174 | 99522 | 16902 | 34307 | 51731 | 69171 | 86619 | 14 |
| 15 | 30650 | 47877 | 65149 | 82463 | 99812 | 17192 | 34597 | 52022 | 69461 | 86910 | 15 |
| 16 | 0830937 | 0848164 | 0865437 | 0882751 | 0900101 | 0917482 | 0934887 | 0952312 | 0969752 | 0987201 | 16 |
| 17 | 31224 | 48452 | 65726 | 83040 | 00391 | 17772 | 35177 | 52603 | 70043 | 87492 | 17 |
| 18 | 31511 | 48739 | 66014 | 83329 | 00680 | 18061 | 35468 | 52893 | 70334 | 87783 | 18 |
| 19 | 0831797 | 0849027 | 0866302 | 0883618 | 0900970 | 0918351 | 0935758 | 0953184 | 0970624 | 0988074 | 19 |
| 20 | 32084 | 49314 | 66590 | 83907 | 01259 | 18641 | 36048 | 53475 | 70915 | 88365 | 20 |
| 21 | 32371 | 49602 | 66879 | 84196 | 01549 | 18931 | 36339 | 53765 | 71206 | 88656 | 21 |
| 22 | 0832658 | 0849889 | 0867167 | 0884485 | 0901838 | 0919221 | 0936629 | 0954056 | 0971497 | 0988946 | 22 |
| 23 | 32944 | 50177 | 67455 | 84774 | 02128 | 19511 | 36919 | 54346 | 71788 | 89237 | 23 |
| 24 | 33231 | 50465 | 67744 | 85063 | 02417 | 19801 | 37209 | 54637 | 72078 | 89528 | 24 |
| 25 | 0833518 | 0850752 | 0868032 | 0885352 | 0902707 | 0920091 | 0937500 | 0954928 | 0972369 | 0989819 | 25 |
| 26 | 33805 | 51040 | 68320 | 85641 | 02996 | 20381 | 37790 | 55218 | 72660 | 90110 | 26 |
| 27 | 34092 | 51328 | 68609 | 85930 | 03286 | 20671 | 38080 | 55509 | 72951 | 90401 | 27 |
| 28 | 0834379 | 0851615 | 0868897 | 0886219 | 0903575 | 0920961 | 0938371 | 0955799 | 0973241 | 0990692 | 28 |
| 29 | 34665 | 51903 | 69185 | 86508 | 03865 | 21251 | 38661 | 56090 | 73532 | 90983 | 29 |
| 30 | 34952 | 52191 | 69474 | 86797 | 04154 | 21541 | 38951 | 56381 | 73823 | 91273 | 30 |
| 31 | 0835239 | 0852478 | 0869762 | 0887086 | 0904444 | 0921831 | 0939242 | 0956671 | 0974114 | 0991564 | 31 |
| 32 | 35526 | 52766 | 70051 | 87375 | 04733 | 22121 | 39532 | 56962 | 74405 | 91855 | 32 |
| 33 | 35813 | 53054 | 70339 | 87664 | 05023 | 22411 | 39822 | 57252 | 74695 | 92146 | 33 |
| 34 | 0836100 | 0853341 | 0870627 | 0887953 | 0905312 | 0922701 | 0940113 | 0957543 | 0974986 | 0992437 | 34 |
| 35 | 36387 | 53629 | 70916 | 88242 | 05602 | 22991 | 40403 | 57834 | 75277 | 92728 | 35 |
| 36 | 36674 | 53917 | 71204 | 88531 | 05892 | 23281 | 40694 | 58124 | 75568 | 93019 | 36 |
| 37 | 0836961 | 0854205 | 0871493 | 0888820 | 0906181 | 0923571 | 0940984 | 0958415 | 0975859 | 0993310 | 37 |
| 38 | 37248 | 54492 | 71781 | 89109 | 06471 | 23861 | 41274 | 58706 | 76149 | 93600 | 38 |
| 39 | 37535 | 54780 | 72070 | 89398 | 06760 | 24151 | 41565 | 58996 | 76440 | 93891 | 39 |
| 40 | 0837822 | 0855068 | 0872358 | 0889687 | 0907050 | 0924441 | 0941855 | 0959287 | 0976731 | 0994182 | 40 |
| 41 | 38109 | 55356 | 72647 | 89977 | 07340 | 24731 | 42146 | 59578 | 77022 | 94473 | 41 |
| 42 | 38396 | 55644 | 72935 | 90266 | 07629 | 25021 | 42436 | 59868 | 77313 | 94764 | 42 |
| 43 | 0838683 | 0855932 | 0873224 | 0890555 | 0907919 | 0925311 | 0942726 | 0960159 | 0977603 | 0995055 | 43 |
| 44 | 38970 | 56219 | 73512 | 90844 | 08209 | 25601 | 43017 | 60449 | 77894 | 95346 | 44 |
| 45 | 39257 | 56507 | 73801 | 91133 | 08498 | 25891 | 43307 | 60740 | 78185 | 95637 | 45 |
| 46 | 0839544 | 0856795 | 0874090 | 0891422 | 0908788 | 0926182 | 0943598 | 0961031 | 0978476 | 0995928 | 46 |
| 47 | 39832 | 57083 | 74378 | 91711 | 09078 | 26472 | 43888 | 61321 | 78767 | 96218 | 47 |
| 48 | 40119 | 57371 | 74667 | 92001 | 09367 | 26762 | 44178 | 61612 | 79058 | 96509 | 48 |
| 49 | 0840406 | 0857659 | 0874955 | 0892290 | 0909657 | 0927052 | 0944469 | 0961903 | 0979348 | 0996800 | 49 |
| 50 | 40693 | 57947 | 75244 | 92579 | 09947 | 27342 | 44759 | 62193 | 79639 | 97091 | 50 |
| 51 | 40980 | 58235 | 75533 | 92868 | 10236 | 27632 | 45050 | 62484 | 79930 | 97382 | 51 |
| 52 | 0841267 | 0858523 | 0875821 | 0893157 | 0910526 | 0927922 | 0945340 | 0962775 | 0980221 | 0997673 | 52 |
| 53 | 41555 | 58811 | 76110 | 93447 | 10816 | 28212 | 45631 | 63066 | 80512 | 97964 | 53 |
| 54 | 41842 | 59099 | 76398 | 93736 | 11106 | 28503 | 45921 | 63356 | 80803 | 98255 | 54 |
| 55 | 0842129 | 0859387 | 0876687 | 0894025 | 0911395 | 0928793 | 0946212 | 0963647 | 0981093 | 0998546 | 55 |
| 56 | 42416 | 59675 | 76976 | 94314 | 11685 | 29083 | 46502 | 63938 | 81384 | 98836 | 56 |
| 57 | 42704 | 59963 | 77264 | 94604 | 11975 | 29373 | 46793 | 64228 | 81675 | 99127 | 57 |
| 58 | 0842991 | 0860251 | 0877553 | 0894893 | 0912265 | 0929663 | 0947083 | 0964519 | 0981966 | 0999418 | 58 |
| 59 | 43278 | 60539 | 77842 | 95182 | 12554 | 29953 | 47374 | 64810 | 82257 | 99709 | 59 |
| 60 | 43565 | 60827 | 78131 | 95471 | 12844 | 30243 | 47664 | 65100 | 82548 | 1000000 | 60 |

## Parts for Seconds. (v.)

| | 80° | | 81° | | 82° | | 83° | | 84° | | 85° | | 86° | | 87° | | 88° | | 89° | | 90° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | ″ |
| 1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 2 |
| 3 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 3 |
| 4 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 4 |
| 5 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 5 |
| 6 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 6 |
| 7 | 33 | 33 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 7 |
| 8 | 38 | 38 | 38 | 38 | 38 | 38 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 8 |
| 9 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 9 |
| 10 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 10 |
| 11 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 11 |
| 12 | 57 | 57 | 57 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 12 |
| 13 | 62 | 62 | 62 | 62 | 62 | 62 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 13 |
| 14 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 14 |
| 15 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 15 |
| 16 | 76 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 78 | 78 | 78 | 78 | 78 | 16 |
| 17 | 81 | 81 | 81 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 17 |
| 18 | 86 | 86 | 86 | 86 | 86 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 18 |
| 19 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 19 |
| 20 | 95 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 20 |
| 21 | 100 | 100 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 21 |
| 22 | 105 | 105 | 105 | 105 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 107 | 107 | 107 | 107 | 107 | 107 | 22 |
| 23 | 110 | 110 | 110 | 110 | 110 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 112 | 23 |
| 24 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 24 |
| 25 | 119 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 25 |
| 26 | 124 | 124 | 124 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 26 |
| 27 | 129 | 129 | 129 | 130 | 130 | 130 | 130 | 130 | 130 | 130 | 130 | 130 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 27 |
| 28 | 134 | 134 | 134 | 134 | 134 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 28 |
| 29 | 138 | 139 | 139 | 139 | 139 | 139 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 141 | 141 | 141 | 141 | 141 | 29 |
| 30 | 143 | 143 | 144 | 144 | 144 | 144 | 144 | 144 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 30 |
| 31 | 148 | 148 | 148 | 149 | 149 | 149 | 149 | 149 | 149 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 31 |
| 32 | 153 | 153 | 153 | 153 | 154 | 154 | 154 | 154 | 154 | 154 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 32 |
| 33 | 158 | 158 | 158 | 158 | 158 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 33 |
| 34 | 162 | 163 | 163 | 163 | 163 | 163 | 164 | 164 | 164 | 164 | 164 | 164 | 164 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 34 |
| 35 | 167 | 167 | 168 | 168 | 168 | 168 | 168 | 169 | 169 | 169 | 169 | 169 | 169 | 169 | 169 | 170 | 170 | 170 | 170 | 170 | 170 | 35 |
| 36 | 172 | 172 | 172 | 173 | 173 | 173 | 173 | 173 | 174 | 174 | 174 | 174 | 174 | 174 | 174 | 174 | 174 | 174 | 174 | 175 | 175 | 36 |
| 37 | 177 | 177 | 177 | 177 | 178 | 178 | 178 | 178 | 178 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 37 |
| 38 | 181 | 182 | 182 | 182 | 183 | 183 | 183 | 183 | 183 | 183 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 38 |
| 39 | 186 | 186 | 187 | 187 | 187 | 187 | 188 | 188 | 188 | 188 | 188 | 188 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 39 |
| 40 | 191 | 191 | 192 | 192 | 192 | 192 | 192 | 193 | 193 | 193 | 193 | 193 | 193 | 194 | 194 | 194 | 194 | 194 | 194 | 194 | 194 | 40 |
| 41 | 196 | 196 | 196 | 197 | 197 | 197 | 197 | 197 | 198 | 198 | 198 | 198 | 198 | 198 | 198 | 199 | 199 | 199 | 199 | 199 | 199 | 41 |
| 42 | 201 | 201 | 201 | 201 | 202 | 202 | 202 | 202 | 203 | 203 | 203 | 203 | 203 | 203 | 203 | 203 | 203 | 204 | 204 | 204 | 204 | 42 |
| 43 | 205 | 206 | 206 | 206 | 206 | 207 | 207 | 207 | 207 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 43 |
| 44 | 210 | 210 | 211 | 211 | 211 | 211 | 212 | 212 | 212 | 212 | 212 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 44 |
| 45 | 215 | 215 | 215 | 216 | 216 | 216 | 217 | 217 | 217 | 217 | 217 | 217 | 218 | 218 | 218 | 218 | 218 | 218 | 218 | 218 | 218 | 45 |
| 46 | 220 | 220 | 220 | 221 | 221 | 221 | 221 | 222 | 222 | 222 | 222 | 222 | 222 | 223 | 223 | 223 | 223 | 223 | 223 | 223 | 223 | 46 |
| 47 | 224 | 225 | 225 | 225 | 226 | 226 | 226 | 226 | 227 | 227 | 227 | 227 | 227 | 227 | 228 | 228 | 228 | 228 | 228 | 228 | 228 | 47 |
| 48 | 229 | 230 | 230 | 230 | 230 | 231 | 231 | 231 | 232 | 232 | 232 | 232 | 232 | 232 | 232 | 232 | 233 | 233 | 233 | 233 | 233 | 48 |
| 49 | 234 | 234 | 235 | 235 | 235 | 235 | 236 | 236 | 236 | 236 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 238 | 238 | 49 |
| 50 | 239 | 239 | 239 | 240 | 240 | 240 | 241 | 241 | 241 | 241 | 241 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 50 |
| 51 | 243 | 244 | 244 | 245 | 245 | 245 | 245 | 246 | 246 | 246 | 246 | 246 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 51 |
| 52 | 248 | 249 | 249 | 249 | 250 | 250 | 250 | 250 | 251 | 251 | 251 | 251 | 252 | 252 | 252 | 252 | 252 | 252 | 252 | 252 | 252 | 52 |
| 53 | 253 | 253 | 254 | 254 | 254 | 255 | 255 | 255 | 256 | 256 | 256 | 256 | 256 | 256 | 257 | 257 | 257 | 257 | 257 | 257 | 257 | 53 |
| 54 | 258 | 258 | 259 | 259 | 259 | 260 | 260 | 260 | 261 | 261 | 261 | 261 | 261 | 262 | 262 | 262 | 262 | 262 | 262 | 262 | 262 | 54 |
| 55 | 263 | 263 | 263 | 264 | 264 | 264 | 265 | 265 | 265 | 265 | 266 | 266 | 266 | 266 | 266 | 266 | 266 | 267 | 267 | 267 | 267 | 55 |
| 56 | 267 | 268 | 268 | 269 | 269 | 269 | 269 | 270 | 270 | 270 | 270 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 272 | 56 |
| 57 | 272 | 273 | 273 | 273 | 274 | 274 | 274 | 275 | 275 | 275 | 275 | 275 | 276 | 276 | 276 | 276 | 276 | 276 | 276 | 276 | 276 | 57 |
| 58 | 277 | 277 | 278 | 278 | 278 | 279 | 279 | 279 | 280 | 280 | 280 | 280 | 280 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 58 |
| 59 | 282 | 282 | 283 | 283 | 283 | 284 | 284 | 284 | 284 | 285 | 285 | 285 | 285 | 286 | 286 | 286 | 286 | 286 | 286 | 286 | 286 | 59 |
| 60 | 286 | 287 | 287 | 288 | 288 | 288 | 289 | 289 | 289 | 290 | 290 | 290 | 290 | 290 | 290 | 290 | 291 | 291 | 291 | 291 | 291 | 60 |

Nat. Versines. (v.)

| ′ | 90° | 91° | 92° | 93° | 94° | 95° | 96° | 97° | 98° | 99° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1000000 | 1017452 | 1034900 | 1052336 | 1069757 | 1087156 | 1104529 | 1121869 | 1139173 | 1156435 | 0 |
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| 2 | 00582 | 18034 | 35481 | 52917 | 70337 | 87735 | 05107 | 22447 | 39749 | 57009 | 2 |
| 3 | 00873 | 18325 | 35772 | 53207 | 70627 | 88025 | 05396 | 22736 | 40037 | 57296 | 3 |
| 4 | 1001164 | 1018616 | 1036062 | 1053498 | 1070917 | 1088315 | 1105686 | 1123024 | 1140325 | 1157584 | 4 |
| 5 | 01454 | 18907 | 36353 | 53788 | 71207 | 88605 | 05975 | 23313 | 40613 | 57871 | 5 |
| 6 | 01745 | 19197 | 36644 | 54079 | 71497 | 88894 | 06264 | 23602 | 40901 | 58158 | 6 |
| 7 | 1002036 | 1019488 | 1036934 | 1054369 | 1071788 | 1089184 | 1106553 | 1123890 | 1141189 | 1158445 | 7 |
| 8 | 02327 | 19779 | 37225 | 54660 | 72078 | 89474 | 06843 | 24179 | 41477 | 58733 | 8 |
| 9 | 02618 | 20070 | 37516 | 54950 | 72368 | 89764 | 07132 | 24467 | 41765 | 59020 | 9 |
| 10 | 1002909 | 1020361 | 1037807 | 1055241 | 1072658 | 1090053 | 1107421 | 1124756 | 1142053 | 1159307 | 10 |
| 11 | 03200 | 20652 | 38097 | 55531 | 72948 | 90343 | 07710 | 25045 | 42341 | 59594 | 11 |
| 12 | 03491 | 20942 | 38388 | 55822 | 73238 | 90633 | 07999 | 25333 | 42629 | 59881 | 12 |
| 13 | 1003781 | 1021233 | 1038679 | 1056112 | 1073528 | 1090922 | 1108289 | 1125622 | 1142917 | 1160168 | 13 |
| 14 | 04072 | 21524 | 38969 | 56402 | 73818 | 91212 | 08578 | 25910 | 43205 | 60456 | 14 |
| 15 | 04363 | 21815 | 39260 | 56693 | 74109 | 91502 | 08867 | 26199 | 43493 | 60743 | 15 |
| 16 | 1004654 | 1022106 | 1039551 | 1056983 | 1074399 | 1091791 | 1109156 | 1126488 | 1143781 | 1161030 | 16 |
| 17 | 04945 | 22397 | 39841 | 57274 | 74689 | 92081 | 09445 | 26776 | 44068 | 61317 | 17 |
| 18 | 05236 | 22687 | 40132 | 57564 | 74979 | 92371 | 09734 | 27065 | 44356 | 61604 | 18 |
| 19 | 1005527 | 1022978 | 1040422 | 1057854 | 1075269 | 1092660 | 1110023 | 1127353 | 1144644 | 1161891 | 19 |
| 20 | 05818 | 23269 | 40713 | 58145 | 75559 | 92950 | 10313 | 27642 | 44932 | 62178 | 20 |
| 21 | 06109 | 23560 | 41004 | 58435 | 75849 | 93240 | 10602 | 27930 | 45220 | 62465 | 21 |
| 22 | 1006400 | 1023851 | 1041294 | 1058726 | 1076139 | 1093529 | 1110891 | 1128219 | 1145508 | 1162752 | 22 |
| 23 | 06690 | 24141 | 41585 | 59016 | 76429 | 93819 | 11180 | 28507 | 45795 | 63039 | 23 |
| 24 | 06981 | 24432 | 41876 | 59306 | 76719 | 94108 | 11469 | 28796 | 46083 | 63326 | 24 |
| 25 | 1007272 | 1024723 | 1042166 | 1059597 | 1077009 | 1094398 | 1111758 | 1129084 | 1146371 | 1163613 | 25 |
| 26 | 07563 | 25014 | 42457 | 59887 | 77299 | 94688 | 12047 | 29373 | 46659 | 63900 | 26 |
| 27 | 07854 | 25305 | 42748 | 60178 | 77589 | 94977 | 12336 | 29661 | 46946 | 64187 | 27 |
| 28 | 1008145 | 1025595 | 1043038 | 1060468 | 1077879 | 1095267 | 1112625 | 1129949 | 1147234 | 1164474 | 28 |
| 29 | 08436 | 25886 | 43329 | 60758 | 78169 | 95556 | 12914 | 30238 | 47522 | 64761 | 29 |
| 30 | 08727 | 26177 | 43619 | 61049 | 78459 | 95846 | 13203 | 30526 | 47809 | 65048 | 30 |
| 31 | 1009017 | 1026468 | 1043910 | 1061339 | 1078749 | 1096135 | 1113492 | 1130815 | 1148097 | 1165335 | 31 |
| 32 | 09308 | 26759 | 44201 | 61629 | 79039 | 96425 | 13781 | 31103 | 48385 | 65621 | 32 |
| 33 | 09599 | 27049 | 44491 | 61920 | 79329 | 96714 | 14070 | 31391 | 48672 | 65908 | 33 |
| 34 | 1009890 | 1027340 | 1044782 | 1062210 | 1079619 | 1097004 | 1114359 | 1131680 | 1148960 | 1166193 | 34 |
| 35 | 10181 | 27631 | 45072 | 62500 | 79909 | 97293 | 14648 | 31968 | 49248 | 66482 | 35 |
| 36 | 10472 | 27922 | 45363 | 62791 | 80199 | 97583 | 14937 | 32256 | 49535 | 66769 | 36 |
| 37 | 1010763 | 1028212 | 1045654 | 1063081 | 1080489 | 1097872 | 1115226 | 1132545 | 1149823 | 1167056 | 37 |
| 38 | 11054 | 28503 | 45944 | 63371 | 80779 | 98162 | 15515 | 32833 | 50111 | 67342 | 38 |
| 39 | 11344 | 28794 | 46235 | 63661 | 81069 | 98451 | 15804 | 33121 | 50398 | 67629 | 39 |
| 40 | 1011635 | 1029085 | 1046525 | 1063952 | 1081359 | 1098741 | 1116093 | 1133410 | 1150686 | 1167916 | 40 |
| 41 | 11926 | 29376 | 46816 | 64242 | 81649 | 99030 | 16382 | 33698 | 50973 | 68203 | 41 |
| 42 | 12217 | 29666 | 47107 | 64532 | 81939 | 99320 | 16671 | 33986 | 51261 | 68489 | 42 |
| 43 | 1012508 | 1029957 | 1047397 | 1064823 | 1082228 | 1099609 | 1116960 | 1134274 | 1151548 | 1168776 | 43 |
| 44 | 12799 | 30248 | 47688 | 65113 | 82518 | 99899 | 17249 | 34563 | 51836 | 69063 | 44 |
| 45 | 13090 | 30539 | 47978 | 65403 | 82808 | 1100188 | 17537 | 34851 | 52123 | 69350 | 45 |
| 46 | 1013381 | 1030829 | 1048269 | 1065693 | 1083098 | 1100478 | 1117826 | 1135139 | 1152411 | 1169636 | 46 |
| 47 | 13671 | 31120 | 48559 | 65984 | 83388 | 00767 | 18115 | 35427 | 52698 | 69923 | 47 |
| 48 | 13962 | 31411 | 48850 | 66274 | 83678 | 01056 | 18404 | 35716 | 52986 | 70210 | 48 |
| 49 | 1014253 | 1031702 | 1049140 | 1066564 | 1083968 | 1101346 | 1118693 | 1136004 | 1153273 | 1170496 | 49 |
| 50 | 14544 | 31992 | 49431 | 66854 | 84258 | 01635 | 18982 | 36292 | 53561 | 70783 | 50 |
| 51 | 14835 | 32283 | 49721 | 67145 | 84547 | 01925 | 19270 | 36580 | 53848 | 71069 | 51 |
| 52 | 1015126 | 1032574 | 1050012 | 1067435 | 1084837 | 1102214 | 1119559 | 1136868 | 1154136 | 1171356 | 52 |
| 53 | 15417 | 32864 | 50302 | 67725 | 85127 | 02503 | 19848 | 37156 | 54423 | 71643 | 53 |
| 54 | 15707 | 33155 | 50593 | 68015 | 85417 | 02793 | 20137 | 37445 | 54710 | 71929 | 54 |
| 55 | 1015998 | 1033446 | 1050884 | 1068306 | 1085707 | 1103082 | 1120426 | 1137733 | 1154998 | 1172216 | 55 |
| 56 | 16289 | 33737 | 51174 | 68596 | 85997 | 03371 | 20714 | 38021 | 55285 | 72502 | 56 |
| 57 | 16580 | 34027 | 51465 | 68886 | 86286 | 03661 | 21003 | 38309 | 55573 | 72789 | 57 |
| 58 | 1016871 | 1034318 | 1051755 | 1069176 | 1086576 | 1103950 | 1121292 | 1138597 | 1155860 | 1173075 | 58 |
| 59 | 17162 | 34609 | 52046 | 69466 | 86866 | 04239 | 21581 | 38885 | 56147 | 73362 | 59 |
| 60 | 17452 | 34900 | 52336 | 69757 | 87156 | 04529 | 21869 | 39173 | 56435 | 73648 | 60 |

## Parts for Seconds. (v.)

| | 90° | | 91° | | 92° | | 93° | | 94° | | 95° | | 96° | | 97° | | 98° | | 99° | | 100° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 |
| 2 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 2 |
| 3 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 3 |
| 4 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 4 |
| 5 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 5 |
| 6 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 29 | 6 |
| 7 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 34 | 33 | 33 | 7 |
| 8 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 39 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 8 |
| 9 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 44 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 9 |
| 10 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 48 | 10 |
| 11 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 53 | 11 |
| 12 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 58 | 57 | 57 | 57 | 12 |
| 13 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 63 | 62 | 62 | 62 | 62 | 62 | 62 | 13 |
| 14 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 68 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 67 | 14 |
| 15 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 73 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 15 |
| 16 | 78 | 78 | 78 | 78 | 78 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 76 | 16 |
| 17 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 82 | 81 | 81 | 81 | 17 |
| 18 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 86 | 86 | 86 | 86 | 86 | 18 |
| 19 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 92 | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 19 |
| 20 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 96 | 95 | 20 |
| 21 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 102 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 101 | 100 | 100 | 21 |
| 22 | 107 | 107 | 107 | 107 | 107 | 107 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 106 | 105 | 105 | 105 | 105 | 22 |
| 23 | 112 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 111 | 110 | 110 | 110 | 110 | 110 | 23 |
| 24 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 116 | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 24 |
| 25 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 121 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 119 | 25 |
| 26 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 126 | 125 | 125 | 125 | 125 | 125 | 125 | 125 | 124 | 124 | 124 | 26 |
| 27 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 131 | 130 | 130 | 130 | 130 | 130 | 130 | 130 | 130 | 129 | 129 | 129 | 129 | 27 |
| 28 | 136 | 136 | 136 | 136 | 136 | 136 | 136 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 135 | 134 | 134 | 134 | 134 | 134 | 28 |
| 29 | 141 | 141 | 141 | 141 | 141 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 139 | 139 | 139 | 139 | 139 | 138 | 29 |
| 30 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 145 | 144 | 144 | 144 | 144 | 144 | 144 | 143 | 143 | 30 |
| 31 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 149 | 149 | 149 | 149 | 149 | 149 | 148 | 148 | 148 | 31 |
| 32 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 154 | 154 | 154 | 154 | 154 | 154 | 153 | 153 | 153 | 153 | 32 |
| 33 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 159 | 159 | 159 | 159 | 159 | 159 | 159 | 158 | 158 | 158 | 158 | 158 | 33 |
| 34 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 165 | 164 | 164 | 164 | 164 | 164 | 164 | 164 | 163 | 163 | 163 | 163 | 163 | 162 | 34 |
| 35 | 170 | 170 | 170 | 170 | 170 | 170 | 169 | 169 | 169 | 169 | 169 | 169 | 169 | 169 | 168 | 168 | 168 | 168 | 168 | 167 | 167 | 35 |
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| 37 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 179 | 178 | 178 | 178 | 178 | 178 | 177 | 177 | 177 | 177 | 37 |
| 38 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 184 | 183 | 183 | 183 | 183 | 183 | 183 | 182 | 182 | 182 | 181 | 38 |
| 39 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 189 | 188 | 188 | 188 | 188 | 188 | 188 | 187 | 187 | 187 | 187 | 186 | 186 | 39 |
| 40 | 194 | 194 | 194 | 194 | 194 | 194 | 194 | 194 | 193 | 193 | 193 | 193 | 193 | 193 | 192 | 192 | 192 | 192 | 192 | 191 | 191 | 40 |
| 41 | 199 | 199 | 199 | 199 | 199 | 199 | 198 | 198 | 198 | 198 | 198 | 198 | 198 | 197 | 197 | 197 | 197 | 197 | 196 | 196 | 196 | 41 |
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| 43 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 208 | 207 | 207 | 207 | 207 | 206 | 206 | 206 | 206 | 205 | 43 |
| 44 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 212 | 212 | 212 | 212 | 212 | 211 | 211 | 211 | 211 | 210 | 210 | 44 |
| 45 | 218 | 218 | 218 | 218 | 218 | 218 | 218 | 218 | 218 | 217 | 217 | 217 | 217 | 217 | 217 | 216 | 216 | 216 | 215 | 215 | 215 | 45 |
| 46 | 223 | 223 | 223 | 223 | 223 | 223 | 223 | 223 | 222 | 222 | 222 | 222 | 222 | 222 | 221 | 221 | 221 | 221 | 220 | 220 | 220 | 46 |
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| 48 | 233 | 233 | 233 | 233 | 233 | 232 | 232 | 232 | 232 | 232 | 232 | 232 | 231 | 231 | 231 | 231 | 230 | 230 | 230 | 230 | 229 | 48 |
| 49 | 238 | 238 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 237 | 236 | 236 | 236 | 236 | 235 | 235 | 235 | 235 | 234 | 234 | 49 |
| 50 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 242 | 241 | 241 | 241 | 241 | 241 | 240 | 240 | 240 | 239 | 239 | 239 | 50 |
| 51 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 247 | 246 | 246 | 246 | 246 | 246 | 245 | 245 | 245 | 245 | 244 | 244 | 243 | 51 |
| 52 | 252 | 252 | 252 | 252 | 252 | 252 | 252 | 252 | 252 | 251 | 251 | 251 | 251 | 250 | 250 | 250 | 250 | 249 | 249 | 249 | 248 | 52 |
| 53 | 257 | 257 | 257 | 257 | 257 | 257 | 257 | 256 | 256 | 256 | 256 | 256 | 256 | 255 | 255 | 255 | 254 | 254 | 254 | 253 | 253 | 53 |
| 54 | 262 | 262 | 262 | 262 | 262 | 262 | 261 | 261 | 261 | 261 | 261 | 261 | 260 | 260 | 260 | 260 | 259 | 259 | 259 | 258 | 258 | 54 |
| 55 | 267 | 267 | 267 | 267 | 266 | 266 | 266 | 266 | 266 | 266 | 266 | 265 | 265 | 265 | 265 | 264 | 264 | 264 | 263 | 263 | 263 | 55 |
| 56 | 272 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 270 | 270 | 270 | 270 | 269 | 269 | 269 | 269 | 268 | 268 | 267 | 56 |
| 57 | 276 | 276 | 276 | 276 | 276 | 276 | 276 | 276 | 276 | 275 | 275 | 275 | 275 | 275 | 274 | 274 | 274 | 273 | 273 | 273 | 272 | 57 |
| 58 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 281 | 280 | 280 | 280 | 280 | 280 | 279 | 279 | 279 | 278 | 278 | 278 | 277 | 277 | 58 |
| 59 | 286 | 286 | 286 | 286 | 286 | 286 | 286 | 286 | 285 | 285 | 285 | 285 | 284 | 284 | 284 | 284 | 283 | 283 | 283 | 282 | 282 | 59 |
| 60 | 291 | 291 | 291 | 291 | 291 | 290 | 290 | 290 | 290 | 290 | 290 | 290 | 289 | 289 | 289 | 288 | 288 | 288 | 287 | 287 | 286 | 60 |

(v.) Nat. Versines.

| ′ | 100° | 101° | 102° | 103° | 104° | 105° | 106° | 107° | 108° | 109° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1173648 | 1190809 | 1207912 | 1224951 | 1241922 | 1258819 | 1275637 | 1292372 | 1309017 | 1325568 | 0 |
| 1 | 1173935 | 1191095 | 1208196 | 1225235 | 1242204 | 1259100 | 1275917 | 1292650 | 1309294 | 1325843 | 1 |
| 2 | 74221 | 91380 | 08481 | 25518 | 42486 | 59381 | 76197 | 92928 | 09570 | 26118 | 2 |
| 3 | 74508 | 91666 | 08765 | 25801 | 42769 | 59662 | 76476 | 93206 | 09847 | 26393 | 3 |
| 4 | 1174794 | 1191951 | 1209050 | 1226085 | 1243051 | 1259943 | 1276756 | 1293484 | 1310123 | 1326668 | 4 |
| 5 | 75080 | 92237 | 09334 | 26368 | 43333 | 60224 | 77035 | 93762 | 10400 | 26943 | 5 |
| 6 | 75367 | 92522 | 09619 | 26651 | 43615 | 60505 | 77315 | 94040 | 10676 | 27218 | 6 |
| 7 | 1175653 | 1192807 | 1209903 | 1226935 | 1243897 | 1260785 | 1277594 | 1294318 | 1310953 | 1327493 | 7 |
| 8 | 75940 | 93093 | 10187 | 27218 | 44179 | 61066 | 77874 | 94596 | 11229 | 27768 | 8 |
| 9 | 76226 | 93378 | 10472 | 27501 | 44461 | 61347 | 78153 | 94874 | 11506 | 28042 | 9 |
| 10 | 1176512 | 1193664 | 1210756 | 1227784 | 1244743 | 1261628 | 1278432 | 1295152 | 1311782 | 1328317 | 10 |
| 11 | 76798 | 93949 | 11041 | 28068 | 45025 | 61909 | 78712 | 95430 | 12059 | 28592 | 11 |
| 12 | 77085 | 94234 | 11325 | 28351 | 45307 | 62189 | 78991 | 95708 | 12335 | 28867 | 12 |
| 13 | 1177371 | 1194520 | 1211609 | 1228634 | 1245589 | 1262470 | 1279270 | 1295986 | 1312611 | 1329141 | 13 |
| 14 | 77657 | 94805 | 11893 | 28917 | 45871 | 62751 | 79550 | 96264 | 12888 | 29416 | 14 |
| 15 | 77944 | 95090 | 12178 | 29200 | 46153 | 63031 | 79829 | 96542 | 13164 | 29691 | 15 |
| 16 | 1178230 | 1195376 | 1212462 | 1229484 | 1246435 | 1263312 | 1280108 | 1296819 | 1313440 | 1329965 | 16 |
| 17 | 78516 | 95661 | 12746 | 29767 | 46717 | 63593 | 80388 | 97097 | 13716 | 30240 | 17 |
| 18 | 78802 | 95946 | 13030 | 30050 | 46999 | 63873 | 80667 | 97375 | 13993 | 30514 | 18 |
| 19 | 1179088 | 1196231 | 1213315 | 1230333 | 1247281 | 1264154 | 1280946 | 1297653 | 1314269 | 1330789 | 19 |
| 20 | 79375 | 96517 | 13599 | 30616 | 47563 | 64434 | 81225 | 97930 | 14545 | 31063 | 20 |
| 21 | 79661 | 96802 | 13883 | 30899 | 47845 | 64715 | 81504 | 98208 | 14821 | 31338 | 21 |
| 22 | 1179947 | 1197087 | 1214167 | 1231182 | 1248126 | 1264995 | 1281783 | 1298486 | 1315097 | 1331612 | 22 |
| 23 | 80233 | 97372 | 14451 | 31465 | 48408 | 65276 | 82062 | 98763 | 15373 | 31887 | 23 |
| 24 | 80519 | 97657 | 14735 | 31748 | 48690 | 65556 | 82342 | 99041 | 15649 | 32161 | 24 |
| 25 | 1180805 | 1197943 | 1215019 | 1232031 | 1248972 | 1265837 | 1282621 | 1299318 | 1315925 | 1332436 | 25 |
| 26 | 81091 | 98228 | 15304 | 32314 | 49253 | 66117 | 82900 | 99596 | 16201 | 32710 | 26 |
| 27 | 81377 | 98513 | 15588 | 32597 | 49535 | 66397 | 83179 | 99873 | 16477 | 32984 | 27 |
| 28 | 1181664 | 1198798 | 1215872 | 1232880 | 1249817 | 1266678 | 1283458 | 1300151 | 1316753 | 1333258 | 28 |
| 29 | 81950 | 99083 | 16156 | 33163 | 50098 | 66958 | 83736 | 00428 | 17029 | 33533 | 29 |
| 30 | 82236 | 99368 | 16440 | 33445 | 50380 | 67238 | 84015 | 00706 | 17305 | 33807 | 30 |
| 31 | 1182522 | 1199653 | 1216724 | 1233728 | 1250662 | 1267519 | 1284294 | 1300983 | 1317581 | 1334081 | 31 |
| 32 | 82808 | 99938 | 17008 | 34011 | 50943 | 67799 | 84573 | 01261 | 17856 | 34355 | 32 |
| 33 | 83094 | 1200223 | 17292 | 34294 | 51225 | 68079 | 84852 | 01538 | 18132 | 34629 | 33 |
| 34 | 1183380 | 1200508 | 1217575 | 1234577 | 1251506 | 1268359 | 1285131 | 1301815 | 1318408 | 1334903 | 34 |
| 35 | 83665 | 00793 | 17859 | 34859 | 51788 | 68640 | 85410 | 02093 | 18684 | 35178 | 35 |
| 36 | 83951 | 01078 | 18143 | 35142 | 52069 | 68920 | 85688 | 02370 | 18959 | 35452 | 36 |
| 37 | 1184237 | 1201363 | 1218427 | 1235425 | 1252351 | 1269200 | 1285967 | 1302647 | 1319235 | 1335726 | 37 |
| 38 | 84523 | 01648 | 18711 | 35708 | 52632 | 69480 | 86246 | 02924 | 19511 | 36000 | 38 |
| 39 | 84809 | 01933 | 18995 | 35990 | 52914 | 69760 | 86525 | 03202 | 19786 | 36274 | 39 |
| 40 | 1185095 | 1202218 | 1219279 | 1236273 | 1253195 | 1270040 | 1286803 | 1303479 | 1320062 | 1336548 | 40 |
| 41 | 85381 | 02502 | 19562 | 36556 | 53477 | 70320 | 87082 | 03756 | 20337 | 36821 | 41 |
| 42 | 85667 | 02787 | 19846 | 36838 | 53758 | 70600 | 87361 | 04033 | 20613 | 37095 | 42 |
| 43 | 1185952 | 1203072 | 1220130 | 1237121 | 1254039 | 1270881 | 1287639 | 1304310 | 1320889 | 1337369 | 43 |
| 44 | 86238 | 03357 | 20414 | 37403 | 54321 | 71161 | 87918 | 04587 | 21164 | 37643 | 44 |
| 45 | 86524 | 03642 | 20697 | 37686 | 54602 | 71440 | 88196 | 04864 | 21440 | 37917 | 45 |
| 46 | 1186810 | 1203927 | 1220981 | 1237968 | 1254883 | 1271720 | 1288475 | 1305141 | 1321715 | 1338191 | 46 |
| 47 | 87096 | 04211 | 21265 | 38251 | 55165 | 72000 | 88753 | 05418 | 21990 | 38464 | 47 |
| 48 | 87381 | 04496 | 21549 | 38534 | 55446 | 72280 | 89032 | 05695 | 22266 | 38738 | 48 |
| 49 | 1187667 | 1204781 | 1221832 | 1238816 | 1255727 | 1272560 | 1289310 | 1305972 | 1322541 | 1339012 | 49 |
| 50 | 87953 | 05066 | 22116 | 39098 | 56008 | 72840 | 89589 | 06249 | 22816 | 39285 | 50 |
| 51 | 88239 | 05350 | 22399 | 39381 | 56289 | 73120 | 89867 | 06526 | 23092 | 39559 | 51 |
| 52 | 1188524 | 1205635 | 1222683 | 1239663 | 1256571 | 1273400 | 1290146 | 1306803 | 1323367 | 1339833 | 52 |
| 53 | 88810 | 05920 | 22967 | 39946 | 56852 | 73679 | 90424 | 07080 | 23642 | 40106 | 53 |
| 54 | 89095 | 06204 | 23250 | 40228 | 57133 | 73959 | 90702 | 07357 | 23917 | 40380 | 54 |
| 55 | 1189381 | 1206489 | 1223534 | 1240510 | 1257414 | 1274239 | 1290981 | 1307633 | 1324193 | 1340653 | 55 |
| 56 | 89667 | 06773 | 23817 | 40793 | 57695 | 74519 | 91259 | 07910 | 24468 | 40927 | 56 |
| 57 | 89952 | 07058 | 24101 | 41075 | 57976 | 74798 | 91537 | 08187 | 24743 | 41200 | 57 |
| 58 | 1190238 | 1207343 | 1224384 | 1241357 | 1258257 | 1275078 | 1291815 | 1308464 | 1325018 | 1341473 | 58 |
| 59 | 90523 | 07627 | 24668 | 41640 | 58538 | 75358 | 92094 | 08740 | 25293 | 41747 | 59 |
| 60 | 90809 | 07912 | 24951 | 41922 | 58819 | 75637 | 92372 | 09017 | 25568 | 42020 | 60 |

Parts for Seconds. (v.)

| | 100° | | 101° | | 102° | | 103° | | 104° | | 105° | | 106° | | 107° | | 108° | | 109° | | 110° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 |
| 2 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 2 |
| 3 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 3 |
| 4 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 4 |
| 5 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 23 | 5 |
| 6 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 6 |
| 7 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 7 |
| 8 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 38 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 36 | 8 |
| 9 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 42 | 41 | 41 | 41 | 41 | 41 | 9 |
| 10 | 48 | 48 | 48 | 48 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 47 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 10 |
| 11 | 53 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 52 | 51 | 51 | 51 | 51 | 51 | 51 | 51 | 50 | 50 | 50 | 11 |
| 12 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 57 | 56 | 56 | 56 | 56 | 56 | 56 | 56 | 55 | 55 | 55 | 55 | 55 | 55 | 12 |
| 13 | 62 | 62 | 62 | 62 | 62 | 62 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 60 | 60 | 60 | 60 | 60 | 60 | 59 | 59 | 13 |
| 14 | 67 | 67 | 67 | 67 | 66 | 66 | 66 | 66 | 66 | 66 | 66 | 65 | 65 | 65 | 65 | 65 | 65 | 64 | 64 | 64 | 64 | 14 |
| 15 | 72 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 71 | 70 | 70 | 70 | 70 | 70 | 70 | 69 | 69 | 69 | 69 | 69 | 68 | 15 |
| 16 | 76 | 76 | 76 | 76 | 76 | 76 | 76 | 75 | 75 | 75 | 75 | 75 | 75 | 74 | 74 | 74 | 74 | 74 | 73 | 73 | 73 | 16 |
| 17 | 81 | 81 | 81 | 81 | 81 | 80 | 80 | 80 | 80 | 80 | 80 | 79 | 79 | 79 | 79 | 79 | 78 | 78 | 78 | 78 | 77 | 17 |
| 18 | 86 | 86 | 86 | 86 | 85 | 85 | 85 | 85 | 85 | 84 | 84 | 84 | 84 | 84 | 83 | 83 | 83 | 83 | 83 | 82 | 82 | 18 |
| 19 | 91 | 91 | 90 | 90 | 90 | 90 | 90 | 90 | 89 | 89 | 89 | 89 | 89 | 88 | 88 | 88 | 88 | 87 | 87 | 87 | 87 | 19 |
| 20 | 95 | 95 | 95 | 95 | 95 | 95 | 94 | 94 | 94 | 94 | 94 | 93 | 93 | 93 | 93 | 92 | 92 | 92 | 92 | 91 | 91 | 20 |
| 21 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 99 | 99 | 99 | 98 | 98 | 98 | 98 | 97 | 97 | 97 | 97 | 96 | 96 | 96 | 21 |
| 22 | 105 | 105 | 105 | 105 | 104 | 104 | 104 | 104 | 103 | 103 | 103 | 103 | 103 | 102 | 102 | 102 | 101 | 101 | 101 | 101 | 100 | 22 |
| 23 | 110 | 110 | 109 | 109 | 109 | 109 | 109 | 108 | 108 | 108 | 108 | 107 | 107 | 107 | 107 | 106 | 106 | 106 | 105 | 105 | 105 | 23 |
| 24 | 115 | 114 | 114 | 114 | 114 | 114 | 113 | 113 | 113 | 113 | 112 | 112 | 112 | 112 | 111 | 111 | 111 | 110 | 110 | 110 | 109 | 24 |
| 25 | 119 | 119 | 119 | 119 | 119 | 118 | 118 | 118 | 118 | 117 | 117 | 117 | 117 | 116 | 116 | 116 | 115 | 115 | 115 | 114 | 114 | 25 |
| 26 | 124 | 124 | 124 | 124 | 123 | 123 | 123 | 123 | 122 | 122 | 122 | 121 | 121 | 121 | 121 | 120 | 120 | 120 | 119 | 119 | 118 | 26 |
| 27 | 129 | 129 | 128 | 128 | 128 | 128 | 128 | 127 | 127 | 127 | 126 | 126 | 126 | 125 | 125 | 125 | 124 | 124 | 124 | 123 | 123 | 27 |
| 28 | 134 | 133 | 133 | 133 | 133 | 133 | 132 | 132 | 132 | 131 | 131 | 131 | 131 | 130 | 130 | 129 | 129 | 129 | 128 | 128 | 128 | 28 |
| 29 | 138 | 138 | 138 | 138 | 138 | 137 | 137 | 137 | 136 | 136 | 136 | 135 | 135 | 135 | 134 | 134 | 134 | 133 | 133 | 133 | 132 | 29 |
| 30 | 143 | 143 | 143 | 143 | 142 | 142 | 142 | 141 | 141 | 141 | 140 | 140 | 140 | 139 | 139 | 139 | 138 | 138 | 138 | 137 | 137 | 30 |
| 31 | 148 | 148 | 148 | 147 | 147 | 147 | 146 | 146 | 146 | 145 | 145 | 145 | 144 | 144 | 144 | 143 | 143 | 143 | 142 | 142 | 141 | 31 |
| 32 | 153 | 152 | 152 | 152 | 152 | 152 | 151 | 151 | 151 | 150 | 150 | 150 | 150 | 149 | 148 | 148 | 148 | 147 | 147 | 146 | 146 | 32 |
| 33 | 158 | 157 | 157 | 157 | 156 | 156 | 156 | 156 | 155 | 155 | 154 | 154 | 154 | 153 | 153 | 153 | 152 | 152 | 151 | 151 | 150 | 33 |
| 34 | 162 | 162 | 162 | 162 | 161 | 161 | 161 | 160 | 160 | 160 | 159 | 159 | 158 | 158 | 158 | 157 | 157 | 156 | 156 | 155 | 155 | 34 |
| 35 | 167 | 167 | 167 | 166 | 166 | 166 | 165 | 165 | 165 | 164 | 164 | 164 | 163 | 163 | 162 | 162 | 161 | 161 | 160 | 160 | 159 | 35 |
| 36 | 172 | 172 | 171 | 171 | 171 | 170 | 170 | 170 | 169 | 169 | 169 | 168 | 168 | 167 | 167 | 166 | 166 | 166 | 165 | 165 | 164 | 36 |
| 37 | 177 | 176 | 176 | 176 | 175 | 175 | 175 | 174 | 174 | 174 | 173 | 173 | 172 | 172 | 172 | 171 | 171 | 170 | 170 | 169 | 169 | 37 |
| 38 | 181 | 181 | 181 | 181 | 181 | 180 | 180 | 179 | 179 | 178 | 178 | 178 | 177 | 177 | 176 | 176 | 175 | 175 | 174 | 174 | 173 | 38 |
| 39 | 186 | 186 | 186 | 185 | 185 | 185 | 184 | 184 | 183 | 183 | 183 | 182 | 182 | 181 | 181 | 180 | 180 | 179 | 179 | 178 | 178 | 39 |
| 40 | 191 | 191 | 190 | 190 | 190 | 189 | 189 | 189 | 188 | 188 | 187 | 187 | 186 | 186 | 185 | 185 | 184 | 184 | 183 | 183 | 182 | 40 |
| 41 | 196 | 195 | 195 | 195 | 194 | 194 | 194 | 193 | 193 | 192 | 192 | 192 | 191 | 191 | 190 | 190 | 189 | 188 | 188 | 187 | 187 | 41 |
| 42 | 201 | 200 | 200 | 200 | 199 | 199 | 198 | 198 | 198 | 197 | 197 | 196 | 196 | 195 | 195 | 194 | 194 | 193 | 193 | 192 | 191 | 42 |
| 43 | 205 | 205 | 205 | 204 | 204 | 204 | 203 | 203 | 202 | 202 | 201 | 201 | 200 | 200 | 199 | 199 | 198 | 198 | 197 | 197 | 196 | 43 |
| 44 | 210 | 210 | 209 | 209 | 209 | 208 | 208 | 207 | 207 | 207 | 206 | 206 | 205 | 205 | 204 | 203 | 203 | 202 | 202 | 201 | 200 | 44 |
| 45 | 215 | 214 | 214 | 214 | 213 | 213 | 213 | 212 | 212 | 211 | 211 | 210 | 210 | 209 | 209 | 208 | 207 | 207 | 206 | 206 | 205 | 45 |
| 46 | 220 | 219 | 219 | 219 | 218 | 218 | 217 | 217 | 216 | 216 | 215 | 215 | 214 | 214 | 213 | 213 | 212 | 211 | 211 | 210 | 210 | 46 |
| 47 | 224 | 224 | 224 | 223 | 223 | 222 | 222 | 222 | 221 | 221 | 220 | 220 | 219 | 218 | 218 | 217 | 217 | 216 | 215 | 215 | 214 | 47 |
| 48 | 229 | 229 | 228 | 228 | 228 | 227 | 227 | 226 | 226 | 225 | 225 | 224 | 224 | 223 | 223 | 222 | 221 | 221 | 220 | 219 | 219 | 48 |
| 49 | 234 | 234 | 233 | 233 | 232 | 232 | 231 | 231 | 231 | 230 | 229 | 229 | 228 | 228 | 228 | 227 | 226 | 225 | 225 | 224 | 223 | 49 |
| 50 | 239 | 238 | 238 | 238 | 237 | 237 | 236 | 236 | 235 | 235 | 234 | 234 | 233 | 232 | 232 | 231 | 231 | 230 | 229 | 229 | 228 | 50 |
| 51 | 243 | 243 | 243 | 242 | 242 | 241 | 241 | 240 | 240 | 239 | 239 | 238 | 238 | 237 | 236 | 236 | 235 | 234 | 234 | 233 | 232 | 51 |
| 52 | 248 | 248 | 247 | 247 | 247 | 246 | 246 | 245 | 245 | 244 | 243 | 243 | 242 | 242 | 241 | 240 | 240 | 239 | 238 | 238 | 237 | 52 |
| 53 | 253 | 253 | 252 | 252 | 251 | 251 | 250 | 250 | 249 | 249 | 248 | 248 | 247 | 246 | 246 | 245 | 244 | 244 | 243 | 242 | 241 | 53 |
| 54 | 258 | 257 | 257 | 257 | 256 | 256 | 255 | 255 | 254 | 253 | 253 | 252 | 252 | 251 | 250 | 250 | 249 | 248 | 248 | 247 | 246 | 54 |
| 55 | 263 | 262 | 262 | 261 | 261 | 260 | 260 | 259 | 259 | 258 | 258 | 257 | 256 | 256 | 255 | 254 | 254 | 253 | 252 | 251 | 251 | 55 |
| 56 | 267 | 267 | 267 | 266 | 266 | 265 | 265 | 264 | 263 | 263 | 262 | 262 | 261 | 260 | 260 | 259 | 258 | 257 | 257 | 256 | 255 | 56 |
| 57 | 272 | 272 | 271 | 271 | 270 | 270 | 270 | 269 | 268 | 268 | 267 | 266 | 266 | 265 | 264 | 264 | 263 | 262 | 261 | 261 | 260 | 57 |
| 58 | 277 | 276 | 276 | 276 | 275 | 275 | 274 | 273 | 273 | 272 | 272 | 271 | 270 | 270 | 269 | 268 | 267 | 267 | 266 | 265 | 264 | 58 |
| 59 | 282 | 281 | 281 | 280 | 280 | 279 | 279 | 278 | 277 | 277 | 276 | 276 | 275 | 274 | 274 | 273 | 272 | 271 | 270 | 270 | 269 | 59 |
| 60 | 286 | 286 | 286 | 285 | 284 | 284 | 283 | 283 | 282 | 282 | 281 | 280 | 280 | 279 | 278 | 277 | 277 | 276 | 275 | 274 | 273 | 60 |

(v.) Nat. Versines.

| ′ | 110° | 111° | 112° | 113° | 114° | 115° | 116° | 117° | 118° | 119° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1342020 | 1358368 | 1374607 | 1390731 | 1406737 | 1422618 | 1438371 | 1453991 | 1469472 | 1484810 | 0 |
| 1 | 1342294 | 1358640 | 1374876 | 1390999 | 1407002 | 1422882 | 1438633 | 1454250 | 1469728 | 1485064 | 1 |
| 2 | 42567 | 58911 | 75146 | 91267 | 07268 | 23146 | 38894 | 54509 | 69985 | 85318 | 2 |
| 3 | 42840 | 59183 | 75416 | 91534 | 07534 | 23409 | 39155 | 54768 | 70242 | 85573 | 3 |
| 4 | 1343113 | 1359454 | 1375685 | 1391802 | 1407799 | 1423673 | 1439417 | 1455027 | 1470499 | 1485827 | 4 |
| 5 | 43387 | 59725 | 75955 | 92070 | 08065 | 23936 | 39678 | 55286 | 70755 | 86081 | 5 |
| 6 | 43660 | 59997 | 76224 | 92337 | 08331 | 24199 | 39939 | 55545 | 71012 | 86335 | 6 |
| 7 | 1343933 | 1360268 | 1376494 | 1392605 | 1408596 | 1424463 | 1440200 | 1455804 | 1471269 | 1486590 | 7 |
| 8 | 44206 | 60540 | 76763 | 92872 | 08862 | 24726 | 40462 | 56063 | 71525 | 86844 | 8 |
| 9 | 44479 | 60811 | 77033 | 93140 | 09127 | 24990 | 40723 | 56322 | 71782 | 87098 | 9 |
| 10 | 1344752 | 1361082 | 1377302 | 1393407 | 1409392 | 1425253 | 1440984 | 1456580 | 1472038 | 1487352 | 10 |
| 11 | 45025 | 61353 | 77571 | 93675 | 09658 | 25516 | 41245 | 56839 | 72294 | 87606 | 11 |
| 12 | 45298 | 61625 | 77841 | 93942 | 09923 | 25779 | 41506 | 57098 | 72551 | 87860 | 12 |
| 13 | 1345571 | 1361896 | 1378110 | 1394209 | 1410188 | 1426043 | 1441767 | 1457357 | 1472807 | 1488114 | 13 |
| 14 | 45844 | 62167 | 78379 | 94477 | 10454 | 26306 | 42028 | 57615 | 73063 | 88367 | 14 |
| 15 | 46117 | 62438 | 78649 | 94744 | 10719 | 26569 | 42289 | 57874 | 73320 | 88621 | 15 |
| 16 | 1346390 | 1362709 | 1378918 | 1395011 | 1410984 | 1426832 | 1442550 | 1458133 | 1473576 | 1488875 | 16 |
| 17 | 46663 | 62980 | 79187 | 95278 | 11249 | 27095 | 42810 | 58391 | 73832 | 89129 | 17 |
| 18 | 46936 | 63251 | 79456 | 95546 | 11514 | 27358 | 43071 | 58650 | 74088 | 89383 | 18 |
| 19 | 1347209 | 1363522 | 1379725 | 1395813 | 1411780 | 1427621 | 1443332 | 1458908 | 1474344 | 1489636 | 19 |
| 20 | 47481 | 63793 | 79994 | 96080 | 12045 | 27884 | 43593 | 59167 | 74600 | 89890 | 20 |
| 21 | 47754 | 64064 | 80263 | 96347 | 12310 | 28147 | 43853 | 59425 | 74856 | 90143 | 21 |
| 22 | 1348027 | 1364335 | 1380532 | 1396614 | 1412575 | 1428410 | 1444114 | 1459683 | 1475112 | 1490397 | 22 |
| 23 | 48299 | 64606 | 80801 | 96881 | 12840 | 28672 | 44375 | 59942 | 75368 | 90650 | 23 |
| 24 | 48572 | 64877 | 81070 | 97148 | 13104 | 28935 | 44635 | 60200 | 75624 | 90904 | 24 |
| 25 | 1348845 | 1365148 | 1381339 | 1397415 | 1413369 | 1429198 | 1444896 | 1460458 | 1475880 | 1491157 | 25 |
| 26 | 49117 | 65418 | 81608 | 97682 | 13634 | 29461 | 45156 | 60716 | 76136 | 91411 | 26 |
| 27 | 49390 | 65689 | 81877 | 97949 | 13899 | 29723 | 45417 | 60974 | 76392 | 91664 | 27 |
| 28 | 1349662 | 1365960 | 1382146 | 1398216 | 1414164 | 1429986 | 1445677 | 1461233 | 1476647 | 1491917 | 28 |
| 29 | 49935 | 66231 | 82415 | 98482 | 14429 | 30249 | 45938 | 61491 | 76903 | 92170 | 29 |
| 30 | 50207 | 66501 | 82683 | 98749 | 14693 | 30511 | 46198 | 61749 | 77159 | 92424 | 30 |
| 31 | 1350480 | 1366772 | 1382952 | 1399016 | 1414958 | 1430774 | 1446458 | 1462007 | 1477414 | 1492677 | 31 |
| 32 | 50752 | 67043 | 83221 | 99283 | 15223 | 31036 | 46718 | 62265 | 77670 | 92930 | 32 |
| 33 | 51025 | 67313 | 83490 | 99549 | 15487 | 31299 | 46979 | 62523 | 77926 | 93183 | 33 |
| 34 | 1351297 | 1367584 | 1383758 | 1399816 | 1415752 | 1431561 | 1447239 | 1462780 | 1478181 | 1493436 | 34 |
| 35 | 51569 | 67854 | 84027 | 1400083 | 16016 | 31823 | 47499 | 63038 | 78436 | 93689 | 35 |
| 36 | 51842 | 68125 | 84295 | 00349 | 16281 | 32086 | 47759 | 63296 | 78692 | 93942 | 36 |
| 37 | 1352114 | 1368395 | 1384564 | 1400616 | 1416545 | 1432348 | 1448019 | 1463554 | 1478947 | 1494195 | 37 |
| 38 | 52386 | 68665 | 84832 | 00882 | 16810 | 32610 | 48279 | 63812 | 79203 | 94448 | 38 |
| 39 | 52658 | 68936 | 85101 | 01149 | 17074 | 32873 | 48539 | 64069 | 79458 | 94701 | 39 |
| 40 | 1352931 | 1369206 | 1385369 | 1401415 | 1417339 | 1433135 | 1448799 | 1464327 | 1479713 | 1494953 | 40 |
| 41 | 53203 | 69477 | 85638 | 01681 | 17603 | 33397 | 49059 | 64585 | 79968 | 95206 | 41 |
| 42 | 53475 | 69747 | 85906 | 01948 | 17867 | 33659 | 49319 | 64842 | 80224 | 95459 | 42 |
| 43 | 1353747 | 1370017 | 1386174 | 1402214 | 1418131 | 1433921 | 1449579 | 1465100 | 1480479 | 1495711 | 43 |
| 44 | 54019 | 70287 | 86443 | 02480 | 18396 | 34183 | 49839 | 65357 | 80734 | 95964 | 44 |
| 45 | 54291 | 70557 | 86711 | 02747 | 18660 | 34445 | 50098 | 65615 | 80989 | 96217 | 45 |
| 46 | 1354563 | 1370828 | 1386979 | 1403013 | 1418924 | 1434707 | 1450358 | 1465872 | 1481244 | 1496469 | 46 |
| 47 | 54835 | 71098 | 87247 | 03279 | 19188 | 34969 | 50618 | 66129 | 81499 | 96722 | 47 |
| 48 | 55107 | 71368 | 87516 | 03545 | 19452 | 35231 | 50878 | 66387 | 81754 | 96974 | 48 |
| 49 | 1355379 | 1371638 | 1387784 | 1403811 | 1419716 | 1435493 | 1451137 | 1466644 | 1482009 | 1497226 | 49 |
| 50 | 55651 | 71908 | 88052 | 04078 | 19980 | 35755 | 51397 | 66901 | 82263 | 97479 | 50 |
| 51 | 55923 | 72178 | 88320 | 04344 | 20244 | 36017 | 51656 | 67158 | 82518 | 97731 | 51 |
| 52 | 1356194 | 1372448 | 1388588 | 1404610 | 1420508 | 1436278 | 1451916 | 1467416 | 1482773 | 1497983 | 52 |
| 53 | 56466 | 72718 | 88856 | 04876 | 20772 | 36540 | 52175 | 67673 | 83028 | 98236 | 53 |
| 54 | 56738 | 72988 | 89124 | 05142 | 21036 | 36802 | 52435 | 67930 | 83282 | 98488 | 54 |
| 55 | 1357010 | 1373258 | 1389392 | 1405408 | 1421300 | 1437063 | 1452694 | 1468187 | 1483537 | 1498740 | 55 |
| 56 | 57281 | 73528 | 89660 | 05673 | 21563 | 37325 | 52954 | 68444 | 83792 | 98992 | 56 |
| 57 | 57553 | 73797 | 89928 | 05939 | 21827 | 37587 | 53213 | 68701 | 84046 | 99244 | 57 |
| 58 | 1357825 | 1374067 | 1390196 | 1406205 | 1422091 | 1437848 | 1453472 | 1468958 | 1484301 | 1499496 | 58 |
| 59 | 58096 | 74337 | 90463 | 06471 | 22355 | 38110 | 53731 | 69215 | 84555 | 99748 | 59 |
| 60 | 58368 | 74607 | 90731 | 06737 | 22618 | 38371 | 53991 | 69472 | 84810 | 1500000 | 60 |

Parts for Seconds. (v.)

| " | 110° | | 111° | | 112° | | 113° | | 114° | | 115° | | 116° | | 117° | | 118° | | 119° | | 120° | " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | |
| 1 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 |
| 2 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 2 |
| 3 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 3 |
| 4 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 4 |
| 5 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 5 |
| 6 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 6 |
| 7 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 29 | 7 |
| 8 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 34 | 34 | 8 |
| 9 | 41 | 41 | 41 | 41 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 39 | 39 | 39 | 39 | 39 | 39 | 38 | 38 | 38 | 38 | 9 |
| 10 | 46 | 45 | 45 | 45 | 45 | 45 | 45 | 44 | 44 | 44 | 44 | 44 | 44 | 43 | 43 | 43 | 43 | 43 | 42 | 42 | 42 | 10 |
| 11 | 50 | 50 | 50 | 50 | 49 | 49 | 49 | 49 | 49 | 49 | 48 | 48 | 48 | 48 | 48 | 47 | 47 | 47 | 47 | 46 | 46 | 11 |
| 12 | 55 | 54 | 54 | 54 | 54 | 54 | 53 | 53 | 53 | 53 | 53 | 53 | 52 | 52 | 52 | 52 | 51 | 51 | 51 | 51 | 50 | 12 |
| 13 | 59 | 59 | 59 | 59 | 58 | 58 | 58 | 58 | 58 | 57 | 57 | 57 | 57 | 56 | 56 | 56 | 56 | 55 | 55 | 55 | 55 | 13 |
| 14 | 64 | 64 | 63 | 63 | 63 | 63 | 62 | 62 | 62 | 62 | 62 | 61 | 61 | 61 | 60 | 60 | 60 | 60 | 59 | 59 | 59 | 14 |
| 15 | 68 | 68 | 68 | 68 | 67 | 67 | 67 | 67 | 66 | 66 | 66 | 66 | 65 | 65 | 65 | 64 | 64 | 64 | 64 | 63 | 63 | 15 |
| 16 | 73 | 73 | 72 | 72 | 72 | 72 | 71 | 71 | 71 | 71 | 70 | 70 | 70 | 69 | 69 | 69 | 68 | 68 | 68 | 68 | 67 | 16 |
| 17 | 77 | 77 | 77 | 77 | 76 | 76 | 76 | 76 | 75 | 75 | 75 | 74 | 74 | 74 | 73 | 73 | 73 | 72 | 72 | 72 | 71 | 17 |
| 18 | 82 | 82 | 81 | 81 | 81 | 81 | 80 | 80 | 80 | 79 | 79 | 79 | 78 | 78 | 78 | 77 | 77 | 77 | 76 | 76 | 76 | 18 |
| 19 | 87 | 86 | 86 | 86 | 85 | 85 | 85 | 84 | 84 | 84 | 83 | 83 | 83 | 82 | 82 | 82 | 81 | 81 | 81 | 80 | 80 | 19 |
| 20 | 91 | 91 | 91 | 90 | 90 | 90 | 89 | 89 | 89 | 88 | 88 | 88 | 87 | 87 | 86 | 86 | 86 | 85 | 85 | 84 | 84 | 20 |
| 21 | 96 | 95 | 95 | 95 | 94 | 94 | 94 | 93 | 93 | 93 | 92 | 92 | 92 | 91 | 91 | 90 | 90 | 89 | 89 | 89 | 88 | 21 |
| 22 | 100 | 100 | 100 | 99 | 99 | 99 | 98 | 98 | 97 | 97 | 97 | 96 | 96 | 95 | 95 | 95 | 94 | 94 | 93 | 93 | 92 | 22 |
| 23 | 105 | 104 | 104 | 104 | 103 | 103 | 103 | 102 | 102 | 101 | 101 | 101 | 100 | 100 | 99 | 99 | 98 | 98 | 98 | 97 | 97 | 23 |
| 24 | 109 | 109 | 109 | 108 | 108 | 107 | 107 | 107 | 106 | 106 | 105 | 105 | 105 | 104 | 104 | 103 | 103 | 102 | 102 | 101 | 101 | 24 |
| 25 | 114 | 114 | 113 | 113 | 112 | 112 | 112 | 111 | 111 | 110 | 110 | 109 | 109 | 108 | 108 | 107 | 107 | 107 | 106 | 105 | 105 | 25 |
| 26 | 118 | 118 | 118 | 117 | 117 | 116 | 116 | 116 | 115 | 115 | 114 | 114 | 113 | 113 | 112 | 112 | 111 | 111 | 110 | 110 | 109 | 26 |
| 27 | 123 | 123 | 122 | 122 | 121 | 121 | 121 | 120 | 120 | 119 | 119 | 118 | 118 | 117 | 117 | 116 | 116 | 115 | 114 | 114 | 113 | 27 |
| 28 | 128 | 127 | 127 | 126 | 126 | 125 | 125 | 124 | 124 | 124 | 123 | 123 | 122 | 121 | 121 | 120 | 120 | 119 | 119 | 118 | 118 | 28 |
| 29 | 132 | 132 | 131 | 131 | 130 | 130 | 130 | 129 | 128 | 128 | 127 | 127 | 126 | 126 | 125 | 125 | 124 | 124 | 123 | 122 | 122 | 29 |
| 30 | 137 | 136 | 136 | 135 | 135 | 134 | 134 | 133 | 133 | 132 | 132 | 131 | 131 | 130 | 130 | 129 | 128 | 128 | 127 | 127 | 126 | 30 |
| 31 | 141 | 141 | 140 | 140 | 139 | 139 | 138 | 138 | 137 | 137 | 136 | 136 | 135 | 134 | 134 | 133 | 133 | 132 | 131 | 131 | 130 | 31 |
| 32 | 146 | 145 | 145 | 144 | 144 | 143 | 143 | 142 | 142 | 141 | 141 | 140 | 139 | 139 | 138 | 138 | 137 | 136 | 136 | 135 | 134 | 32 |
| 33 | 150 | 150 | 149 | 149 | 148 | 148 | 147 | 147 | 146 | 146 | 145 | 144 | 144 | 143 | 143 | 142 | 141 | 141 | 140 | 139 | 139 | 33 |
| 34 | 155 | 154 | 154 | 153 | 153 | 152 | 152 | 151 | 151 | 150 | 149 | 149 | 148 | 148 | 147 | 146 | 146 | 145 | 144 | 143 | 143 | 34 |
| 35 | 159 | 159 | 158 | 158 | 157 | 157 | 156 | 156 | 155 | 154 | 154 | 153 | 153 | 152 | 151 | 150 | 150 | 150 | 148 | 148 | 147 | 35 |
| 36 | 164 | 163 | 163 | 162 | 162 | 161 | 161 | 160 | 159 | 159 | 158 | 158 | 157 | 156 | 156 | 155 | 154 | 153 | 153 | 152 | 151 | 36 |
| 37 | 169 | 168 | 167 | 167 | 166 | 166 | 165 | 164 | 164 | 163 | 163 | 162 | 161 | 161 | 160 | 159 | 158 | 158 | 157 | 156 | 155 | 37 |
| 38 | 173 | 173 | 172 | 171 | 171 | 170 | 170 | 169 | 168 | 168 | 167 | 166 | 166 | 165 | 164 | 163 | 163 | 162 | 161 | 160 | 160 | 38 |
| 39 | 178 | 177 | 177 | 176 | 175 | 175 | 174 | 173 | 173 | 172 | 171 | 171 | 170 | 169 | 168 | 168 | 167 | 166 | 165 | 165 | 164 | 39 |
| 40 | 182 | 182 | 181 | 180 | 180 | 179 | 179 | 178 | 177 | 176 | 176 | 175 | 174 | 174 | 173 | 172 | 171 | 170 | 170 | 169 | 168 | 40 |
| 41 | 187 | 186 | 186 | 185 | 184 | 184 | 183 | 182 | 182 | 181 | 180 | 179 | 179 | 178 | 177 | 176 | 176 | 175 | 174 | 173 | 172 | 41 |
| 42 | 191 | 191 | 190 | 189 | 189 | 188 | 187 | 186 | 186 | 185 | 185 | 184 | 183 | 182 | 181 | 181 | 180 | 179 | 178 | 177 | 176 | 42 |
| 43 | 196 | 195 | 195 | 194 | 193 | 193 | 192 | 191 | 190 | 190 | 189 | 188 | 187 | 187 | 186 | 185 | 184 | 183 | 182 | 181 | 181 | 43 |
| 44 | 200 | 200 | 199 | 198 | 198 | 197 | 197 | 196 | 195 | 194 | 193 | 193 | 192 | 191 | 190 | 189 | 188 | 187 | 187 | 186 | 185 | 44 |
| 45 | 205 | 204 | 204 | 203 | 202 | 201 | 201 | 200 | 199 | 199 | 198 | 197 | 196 | 195 | 194 | 193 | 193 | 192 | 191 | 190 | 189 | 45 |
| 46 | 210 | 209 | 208 | 207 | 207 | 206 | 205 | 205 | 204 | 203 | 202 | 201 | 200 | 200 | 199 | 198 | 197 | 196 | 195 | 194 | 193 | 46 |
| 47 | 214 | 213 | 213 | 212 | 211 | 211 | 210 | 209 | 208 | 207 | 207 | 206 | 205 | 204 | 203 | 202 | 201 | 200 | 199 | 198 | 197 | 47 |
| 48 | 219 | 218 | 217 | 217 | 216 | 215 | 214 | 213 | 213 | 212 | 211 | 210 | 209 | 208 | 207 | 206 | 205 | 205 | 204 | 203 | 202 | 48 |
| 49 | 223 | 222 | 222 | 221 | 220 | 220 | 219 | 218 | 217 | 216 | 215 | 214 | 214 | 213 | 212 | 211 | 210 | 209 | 208 | 207 | 206 | 49 |
| 50 | 228 | 227 | 226 | 226 | 225 | 224 | 223 | 222 | 221 | 221 | 220 | 219 | 218 | 217 | 216 | 215 | 214 | 213 | 212 | 211 | 210 | 50 |
| 51 | 232 | 232 | 231 | 230 | 229 | 228 | 228 | 227 | 226 | 225 | 224 | 223 | 222 | 221 | 220 | 219 | 218 | 217 | 216 | 215 | 214 | 51 |
| 52 | 237 | 236 | 235 | 235 | 234 | 233 | 232 | 231 | 230 | 229 | 228 | 228 | 227 | 226 | 225 | 224 | 223 | 221 | 220 | 219 | 218 | 52 |
| 53 | 241 | 241 | 240 | 239 | 238 | 237 | 237 | 236 | 235 | 234 | 233 | 232 | 231 | 230 | 229 | 228 | 227 | 226 | 225 | 224 | 223 | 53 |
| 54 | 246 | 245 | 244 | 244 | 243 | 242 | 241 | 240 | 239 | 238 | 237 | 236 | 235 | 234 | 233 | 232 | 231 | 230 | 229 | 228 | 227 | 54 |
| 55 | 251 | 250 | 249 | 248 | 247 | 246 | 245 | 245 | 244 | 243 | 242 | 241 | 240 | 239 | 238 | 236 | 235 | 234 | 233 | 232 | 231 | 55 |
| 56 | 255 | 254 | 253 | 253 | 252 | 251 | 250 | 249 | 248 | 247 | 246 | 245 | 244 | 243 | 242 | 241 | 240 | 239 | 237 | 236 | 235 | 56 |
| 57 | 260 | 259 | 258 | 257 | 256 | 255 | 254 | 253 | 252 | 251 | 250 | 249 | 249 | 247 | 246 | 245 | 244 | 243 | 242 | 240 | 239 | 57 |
| 58 | 264 | 263 | 262 | 262 | 261 | 260 | 259 | 258 | 257 | 256 | 255 | 254 | 253 | 252 | 251 | 249 | 248 | 247 | 246 | 245 | 244 | 58 |
| 59 | 269 | 268 | 267 | 266 | 265 | 264 | 263 | 262 | 261 | 260 | 259 | 258 | 257 | 256 | 255 | 254 | 253 | 251 | 250 | 249 | 248 | 59 |
| 60 | 273 | 273 | 272 | 271 | 270 | 269 | 268 | 267 | 266 | 265 | 264 | 263 | 261 | 260 | 259 | 258 | 257 | 256 | 254 | 253 | 252 | 60 |

| (v.) | Nat. Versines. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ′ | 120° | 121° | 122° | 123° | 124° | 125° | 126° | 127° | 128° | 129° | ′ |
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| 1 | 1500252 | 1515287 | 1530166 | 1544883 | 1559434 | 1573815 | 1588021 | 1602047 | 1615891 | 1629546 | 1 |
| 2 | 00504 | 15537 | 30413 | 45127 | 59675 | 74053 | 88256 | 02280 | 16120 | 29772 | 2 |
| 3 | 00756 | 15786 | 30659 | 45371 | 59916 | 74291 | 88491 | 02512 | 16349 | 29998 | 3 |
| 4 | 1501007 | 1516035 | 1530906 | 1545615 | 1560157 | 1574529 | 1588726 | 1602744 | 1616578 | 1630224 | 4 |
| 5 | 01259 | 16284 | 31152 | 45858 | 60398 | 74767 | 88961 | 02976 | 16807 | 30450 | 5 |
| 6 | 01511 | 16533 | 31399 | 46102 | 60639 | 75005 | 89196 | 03208 | 17036 | 30676 | 6 |
| 7 | 1501762 | 1516782 | 1531645 | 1546346 | 1560880 | 1575243 | 1589431 | 1603440 | 1617265 | 1630902 | 7 |
| 8 | 02014 | 17031 | 31891 | 46589 | 61121 | 75481 | 89666 | 03672 | 17494 | 31127 | 8 |
| 9 | 02266 | 17280 | 32138 | 46833 | 61361 | 75719 | 89901 | 03904 | 17722 | 31353 | 9 |
| 10 | 1502517 | 1517529 | 1532384 | 1547076 | 1561602 | 1575957 | 1590136 | 1604136 | 1617951 | 1631578 | 10 |
| 11 | 02769 | 17778 | 32630 | 47320 | 61843 | 76195 | 90371 | 04367 | 18180 | 31804 | 11 |
| 12 | 03020 | 18027 | 32876 | 47563 | 62083 | 76432 | 90606 | 04599 | 18408 | 32029 | 12 |
| 13 | 1503271 | 1518276 | 1533122 | 1547807 | 1562324 | 1576670 | 1590840 | 1604831 | 1618637 | 1632255 | 13 |
| 14 | 03523 | 18525 | 33369 | 48050 | 62565 | 76908 | 91075 | 05062 | 18865 | 32480 | 14 |
| 15 | 03774 | 18773 | 33615 | 48293 | 62805 | 77145 | 91310 | 05294 | 19094 | 32705 | 15 |
| 16 | 1504025 | 1519022 | 1533861 | 1548537 | 1563045 | 1577383 | 1591544 | 1605526 | 1619322 | 1632931 | 16 |
| 17 | 04277 | 19271 | 34107 | 48780 | 63286 | 77620 | 91779 | 05757 | 19551 | 33156 | 17 |
| 18 | 04528 | 19519 | 34352 | 49023 | 63526 | 77858 | 92013 | 05988 | 19779 | 33381 | 18 |
| 19 | 1504779 | 1519768 | 1534598 | 1549266 | 1563766 | 1578095 | 1592248 | 1606220 | 1620007 | 1633606 | 19 |
| 20 | 05030 | 20016 | 34844 | 49509 | 64007 | 78332 | 92482 | 06451 | 20236 | 33831 | 20 |
| 21 | 05281 | 20265 | 35090 | 49752 | 64247 | 78570 | 92716 | 06682 | 20464 | 34056 | 21 |
| 22 | 1505532 | 1520513 | 1535336 | 1549995 | 1564487 | 1578807 | 1592951 | 1606914 | 1620692 | 1634281 | 22 |
| 23 | 05783 | 20761 | 35581 | 50238 | 64727 | 79044 | 93185 | 07145 | 20920 | 34506 | 23 |
| 24 | 06034 | 21010 | 35827 | 50481 | 64967 | 79281 | 93419 | 07376 | 21148 | 34731 | 24 |
| 25 | 1506285 | 1521258 | 1536072 | 1550724 | 1565207 | 1579518 | 1593653 | 1607607 | 1621376 | 1634955 | 25 |
| 26 | 06536 | 21506 | 36318 | 50966 | 65447 | 79755 | 93887 | 07838 | 21604 | 35180 | 26 |
| 27 | 06786 | 21754 | 36563 | 51209 | 65687 | 79992 | 94121 | 08069 | 21831 | 35405 | 27 |
| 28 | 1507037 | 1522002 | 1536809 | 1551452 | 1565927 | 1580229 | 1594355 | 1608300 | 1622059 | 1635629 | 28 |
| 29 | 07288 | 22251 | 37054 | 51694 | 66167 | 80466 | 94589 | 08531 | 22287 | 35854 | 29 |
| 30 | 07538 | 22499 | 37300 | 51937 | 66406 | 80703 | 94823 | 08761 | 22515 | 36078 | 30 |
| 31 | 1507789 | 1522747 | 1537545 | 1552180 | 1566646 | 1580940 | 1595057 | 1608992 | 1622742 | 1636303 | 31 |
| 32 | 08040 | 22995 | 37790 | 52422 | 66886 | 81177 | 95290 | 09223 | 22970 | 36527 | 32 |
| 33 | 08290 | 23242 | 38035 | 52665 | 67125 | 81413 | 95524 | 09454 | 23197 | 36751 | 33 |
| 34 | 1508541 | 1523490 | 1538281 | 1552907 | 1567365 | 1581650 | 1595758 | 1609684 | 1623425 | 1636976 | 34 |
| 35 | 08791 | 23738 | 38526 | 53149 | 67604 | 81886 | 95991 | 09915 | 23652 | 37200 | 35 |
| 36 | 09041 | 23986 | 38771 | 53392 | 67844 | 82123 | 96225 | 10145 | 23880 | 37424 | 36 |
| 37 | 1509292 | 1524234 | 1539016 | 1553634 | 1568083 | 1582360 | 1596458 | 1610376 | 1624107 | 1637648 | 37 |
| 38 | 09542 | 24481 | 39261 | 53876 | 68323 | 82596 | 96692 | 10606 | 24334 | 37872 | 38 |
| 39 | 09792 | 24729 | 39506 | 54118 | 68562 | 82832 | 96925 | 10836 | 24561 | 38096 | 39 |
| 40 | 1510043 | 1524977 | 1539751 | 1554360 | 1568801 | 1583069 | 1597159 | 1611067 | 1624789 | 1638320 | 40 |
| 41 | 10293 | 25224 | 39996 | 54602 | 69040 | 83305 | 97392 | 11297 | 25016 | 38544 | 41 |
| 42 | 10543 | 25472 | 40240 | 54844 | 69280 | 83541 | 97625 | 11527 | 25243 | 38768 | 42 |
| 43 | 1510793 | 1525719 | 1540485 | 1555086 | 1569519 | 1583777 | 1597858 | 1611757 | 1625470 | 1638992 | 43 |
| 44 | 11043 | 25967 | 40730 | 55328 | 69758 | 84014 | 98092 | 11987 | 25697 | 39215 | 44 |
| 45 | 11293 | 26214 | 40975 | 55570 | 69997 | 84250 | 98325 | 12217 | 25924 | 39439 | 45 |
| 46 | 1511543 | 1526461 | 1541219 | 1555812 | 1570236 | 1584486 | 1598558 | 1612447 | 1626150 | 1639663 | 46 |
| 47 | 11793 | 26709 | 41464 | 56054 | 70475 | 84722 | 98791 | 12677 | 26377 | 39886 | 47 |
| 48 | 12043 | 26956 | 41708 | 56296 | 70714 | 84958 | 99024 | 12907 | 26604 | 40110 | 48 |
| 49 | 1512293 | 1527203 | 1541953 | 1556537 | 1570952 | 1585194 | 1599257 | 1613137 | 1626831 | 1640333 | 49 |
| 50 | 12543 | 27450 | 42197 | 56779 | 71191 | 85429 | 99489 | 13367 | 27057 | 40557 | 50 |
| 51 | 12792 | 27697 | 42442 | 57021 | 71430 | 85665 | 99722 | 13596 | 27284 | 40780 | 51 |
| 52 | 1513042 | 1527944 | 1542686 | 1557262 | 1571669 | 1585901 | 1599955 | 1613826 | 1627510 | 1641003 | 52 |
| 53 | 13292 | 28191 | 42930 | 57504 | 71907 | 86137 | 1600188 | 14056 | 27737 | 41226 | 53 |
| 54 | 13541 | 28438 | 43174 | 57745 | 72146 | 86372 | 00420 | 14285 | 27963 | 41450 | 54 |
| 55 | 1513791 | 1528685 | 1543419 | 1557987 | 1572384 | 1586608 | 1600653 | 1614515 | 1628189 | 1641673 | 55 |
| 56 | 14040 | 28932 | 43663 | 58228 | 72623 | 86844 | 00885 | 14744 | 28416 | 41896 | 56 |
| 57 | 14290 | 29179 | 43907 | 58469 | 72861 | 87079 | 01118 | 14974 | 28642 | 42119 | 57 |
| 58 | 1514539 | 1529426 | 1544151 | 1558711 | 1573100 | 1587315 | 1601350 | 1615203 | 1628868 | 1642342 | 58 |
| 59 | 14789 | 29673 | 44395 | 58952 | 73338 | 87550 | 01583 | 15432 | 29094 | 42565 | 59 |
| 60 | 15038 | 29919 | 44639 | 59193 | 73576 | 87785 | 01815 | 15662 | 29320 | 42788 | 60 |

Parts for Seconds. (v.)

| | 120° | | 121° | | 122° | | 123° | | 124° | | 125° | | 126° | | 127° | | 128° | | 129° | | 130° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ″ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | ″ |
| 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 |
| 2 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 2 |
| 3 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 3 |
| 4 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 4 |
| 5 | 21 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 5 |
| 6 | 25 | 25 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 23 | 23 | 22 | 22 | 6 |
| 7 | 29 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 7 |
| 8 | 34 | 33 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 30 | 8 |
| 9 | 38 | 38 | 37 | 37 | 37 | 37 | 37 | 36 | 36 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 34 | 33 | 9 |
| 10 | 42 | 42 | 42 | 41 | 41 | 41 | 41 | 40 | 40 | 40 | 40 | 39 | 39 | 39 | 39 | 38 | 38 | 38 | 38 | 37 | 37 | 10 |
| 11 | 46 | 46 | 46 | 45 | 45 | 45 | 45 | 44 | 44 | 44 | 44 | 43 | 43 | 43 | 43 | 42 | 42 | 42 | 41 | 41 | 41 | 11 |
| 12 | 50 | 50 | 50 | 50 | 49 | 49 | 49 | 49 | 48 | 48 | 48 | 47 | 47 | 47 | 46 | 46 | 46 | 46 | 45 | 45 | 45 | 12 |
| 13 | 55 | 54 | 54 | 54 | 53 | 53 | 53 | 53 | 52 | 52 | 52 | 51 | 51 | 51 | 50 | 50 | 50 | 49 | 49 | 49 | 48 | 13 |
| 14 | 59 | 58 | 58 | 58 | 58 | 57 | 57 | 57 | 56 | 56 | 56 | 55 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 52 | 52 | 14 |
| 15 | 63 | 63 | 62 | 62 | 62 | 61 | 61 | 61 | 60 | 60 | 60 | 59 | 59 | 58 | 58 | 58 | 57 | 57 | 57 | 56 | 56 | 15 |
| 16 | 67 | 67 | 66 | 66 | 66 | 65 | 65 | 65 | 64 | 64 | 64 | 63 | 63 | 62 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 16 |
| 17 | 71 | 71 | 71 | 70 | 70 | 70 | 69 | 69 | 68 | 68 | 68 | 67 | 67 | 66 | 66 | 65 | 65 | 64 | 64 | 64 | 63 | 17 |
| 18 | 76 | 75 | 75 | 74 | 74 | 74 | 73 | 73 | 72 | 72 | 71 | 71 | 71 | 70 | 70 | 69 | 69 | 68 | 68 | 67 | 67 | 18 |
| 19 | 80 | 79 | 79 | 79 | 78 | 78 | 77 | 77 | 76 | 76 | 75 | 75 | 75 | 74 | 74 | 73 | 73 | 72 | 72 | 71 | 71 | 19 |
| 20 | 84 | 84 | 83 | 83 | 82 | 82 | 81 | 81 | 80 | 80 | 79 | 79 | 78 | 78 | 77 | 77 | 76 | 76 | 75 | 75 | 74 | 20 |
| 21 | 88 | 88 | 87 | 87 | 86 | 86 | 85 | 85 | 84 | 84 | 83 | 83 | 82 | 82 | 81 | 81 | 80 | 80 | 79 | 79 | 78 | 21 |
| 22 | 92 | 92 | 91 | 91 | 90 | 90 | 89 | 89 | 88 | 88 | 87 | 87 | 86 | 86 | 85 | 85 | 84 | 83 | 83 | 82 | 82 | 22 |
| 23 | 97 | 96 | 96 | 95 | 95 | 94 | 94 | 93 | 92 | 92 | 91 | 91 | 90 | 90 | 89 | 88 | 88 | 87 | 87 | 86 | 85 | 23 |
| 24 | 101 | 100 | 100 | 99 | 99 | 98 | 98 | 97 | 96 | 96 | 95 | 95 | 94 | 94 | 93 | 92 | 92 | 91 | 90 | 90 | 89 | 24 |
| 25 | 105 | 104 | 104 | 103 | 103 | 102 | 102 | 101 | 100 | 100 | 99 | 99 | 98 | 97 | 97 | 96 | 96 | 95 | 94 | 94 | 93 | 25 |
| 26 | 109 | 109 | 108 | 107 | 107 | 106 | 106 | 105 | 104 | 104 | 103 | 103 | 102 | 101 | 101 | 100 | 99 | 99 | 98 | 97 | 97 | 26 |
| 27 | 113 | 113 | 112 | 112 | 111 | 110 | 110 | 109 | 109 | 108 | 107 | 107 | 106 | 105 | 105 | 104 | 103 | 102 | 102 | 101 | 100 | 27 |
| 28 | 118 | 117 | 116 | 116 | 115 | 114 | 114 | 113 | 113 | 112 | 111 | 111 | 110 | 109 | 108 | 108 | 107 | 106 | 105 | 105 | 104 | 28 |
| 29 | 122 | 121 | 121 | 120 | 119 | 119 | 118 | 117 | 117 | 116 | 115 | 114 | 114 | 113 | 112 | 112 | 111 | 110 | 109 | 108 | 108 | 29 |
| 30 | 126 | 125 | 125 | 124 | 123 | 123 | 122 | 121 | 121 | 120 | 119 | 118 | 118 | 117 | 116 | 115 | 115 | 114 | 113 | 112 | 111 | 30 |
| 31 | 130 | 130 | 129 | 128 | 127 | 127 | 126 | 125 | 125 | 124 | 123 | 122 | 122 | 121 | 120 | 119 | 118 | 118 | 117 | 116 | 115 | 31 |
| 32 | 134 | 134 | 133 | 132 | 132 | 131 | 130 | 129 | 129 | 128 | 127 | 126 | 126 | 125 | 124 | 123 | 122 | 121 | 120 | 120 | 119 | 32 |
| 33 | 139 | 138 | 137 | 136 | 136 | 135 | 134 | 133 | 133 | 132 | 131 | 130 | 129 | 129 | 128 | 127 | 126 | 125 | 124 | 123 | 123 | 33 |
| 34 | 143 | 142 | 141 | 141 | 140 | 139 | 138 | 137 | 137 | 136 | 135 | 134 | 133 | 133 | 132 | 131 | 130 | 129 | 128 | 127 | 126 | 34 |
| 35 | 147 | 146 | 145 | 145 | 144 | 143 | 142 | 141 | 141 | 140 | 139 | 138 | 137 | 136 | 136 | 135 | 134 | 133 | 132 | 131 | 130 | 35 |
| 36 | 151 | 150 | 150 | 149 | 148 | 147 | 146 | 146 | 145 | 144 | 143 | 142 | 141 | 140 | 139 | 138 | 138 | 137 | 136 | 135 | 134 | 36 |
| 37 | 155 | 155 | 154 | 153 | 152 | 151 | 150 | 150 | 149 | 148 | 147 | 146 | 145 | 144 | 143 | 142 | 141 | 140 | 139 | 139 | 137 | 37 |
| 38 | 160 | 159 | 158 | 157 | 156 | 155 | 154 | 154 | 153 | 152 | 151 | 150 | 149 | 148 | 147 | 146 | 145 | 144 | 143 | 142 | 141 | 38 |
| 39 | 164 | 163 | 162 | 161 | 160 | 159 | 159 | 158 | 157 | 156 | 155 | 154 | 153 | 152 | 151 | 150 | 149 | 148 | 147 | 146 | 145 | 39 |
| 40 | 168 | 167 | 166 | 165 | 164 | 164 | 163 | 162 | 161 | 160 | 159 | 158 | 157 | 156 | 155 | 154 | 153 | 152 | 151 | 150 | 149 | 40 |
| 41 | 172 | 171 | 170 | 169 | 169 | 168 | 167 | 166 | 165 | 164 | 163 | 162 | 161 | 160 | 159 | 158 | 157 | 156 | 154 | 153 | 152 | 41 |
| 42 | 176 | 175 | 175 | 174 | 173 | 172 | 171 | 170 | 169 | 168 | 167 | 166 | 165 | 164 | 163 | 162 | 160 | 159 | 158 | 157 | 156 | 42 |
| 43 | 181 | 180 | 179 | 178 | 177 | 176 | 175 | 174 | 173 | 172 | 171 | 170 | 169 | 168 | 166 | 165 | 164 | 163 | 162 | 161 | 160 | 43 |
| 44 | 185 | 184 | 183 | 182 | 181 | 180 | 179 | 178 | 177 | 176 | 175 | 174 | 173 | 171 | 170 | 169 | 168 | 167 | 166 | 165 | 163 | 44 |
| 45 | 189 | 188 | 187 | 186 | 185 | 184 | 183 | 182 | 181 | 180 | 179 | 178 | 177 | 175 | 174 | 173 | 172 | 171 | 170 | 168 | 167 | 45 |
| 46 | 193 | 192 | 191 | 191 | 189 | 188 | 187 | 186 | 185 | 184 | 183 | 182 | 180 | 179 | 178 | 177 | 176 | 175 | 173 | 172 | 171 | 46 |
| 47 | 197 | 196 | 195 | 194 | 193 | 192 | 191 | 190 | 189 | 188 | 187 | 185 | 184 | 183 | 182 | 181 | 180 | 178 | 177 | 176 | 175 | 47 |
| 48 | 202 | 201 | 199 | 198 | 197 | 196 | 195 | 194 | 193 | 192 | 191 | 190 | 188 | 187 | 186 | 185 | 183 | 182 | 181 | 180 | 178 | 48 |
| 49 | 206 | 205 | 204 | 203 | 201 | 200 | 199 | 198 | 197 | 196 | 195 | 193 | 192 | 191 | 190 | 188 | 187 | 186 | 185 | 183 | 182 | 49 |
| 50 | 210 | 209 | 208 | 207 | 206 | 204 | 203 | 202 | 201 | 200 | 199 | 197 | 196 | 195 | 194 | 192 | 191 | 190 | 188 | 187 | 186 | 50 |
| 51 | 214 | 213 | 212 | 211 | 210 | 209 | 207 | 206 | 205 | 204 | 203 | 201 | 200 | 199 | 197 | 196 | 195 | 194 | 192 | 191 | 189 | 51 |
| 52 | 218 | 217 | 216 | 215 | 214 | 213 | 211 | 210 | 209 | 208 | 207 | 205 | 204 | 203 | 201 | 200 | 199 | 197 | 196 | 195 | 193 | 52 |
| 53 | 223 | 221 | 220 | 219 | 218 | 217 | 215 | 214 | 213 | 212 | 210 | 209 | 208 | 207 | 205 | 204 | 203 | 201 | 200 | 198 | 197 | 53 |
| 54 | 227 | 226 | 224 | 223 | 222 | 221 | 220 | 218 | 217 | 216 | 214 | 213 | 212 | 210 | 209 | 208 | 206 | 205 | 203 | 202 | 201 | 54 |
| 55 | 231 | 230 | 229 | 227 | 226 | 225 | 224 | 222 | 221 | 220 | 218 | 217 | 216 | 214 | 213 | 212 | 210 | 209 | 207 | 206 | 204 | 55 |
| 56 | 235 | 234 | 233 | 232 | 230 | 229 | 228 | 226 | 225 | 224 | 222 | 221 | 220 | 218 | 217 | 215 | 214 | 212 | 211 | 209 | 208 | 56 |
| 57 | 239 | 238 | 237 | 236 | 234 | 233 | 232 | 230 | 229 | 228 | 226 | 225 | 224 | 222 | 221 | 219 | 218 | 216 | 215 | 213 | 212 | 57 |
| 58 | 244 | 242 | 241 | 240 | 238 | 237 | 236 | 234 | 233 | 232 | 230 | 229 | 228 | 226 | 225 | 223 | 222 | 220 | 219 | 217 | 215 | 58 |
| 59 | 248 | 246 | 246 | 244 | 243 | 241 | 240 | 239 | 237 | 236 | 234 | 233 | 231 | 230 | 228 | 227 | 225 | 224 | 222 | 221 | 219 | 59 |
| 60 | 252 | 251 | 249 | 248 | 247 | 245 | 244 | 243 | 241 | 240 | 238 | 237 | 235 | 234 | 232 | 231 | 229 | 228 | 226 | 224 | 223 | 60 |

(v.) Nat. Versines

| ′ | 130° | 131° | 132° | 133° | 134° | 135° | 136° | 137° | 138° | 139° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1642788 | 1656059 | 1669131 | 1681998 | 1694658 | 1707107 | 1719340 | 1731354 | 1743145 | 1754710 | 0 |
| 1 | 1643010 | 1656279 | 1669347 | 1682211 | 1694868 | 1707312 | 1719542 | 1731552 | 1743339 | 1754900 | 1 |
| 2 | 43233 | 56498 | 69563 | 82424 | 95077 | 07518 | 19744 | 31750 | 43534 | 55091 | 2 |
| 3 | 43456 | 56717 | 69779 | 82636 | 95286 | 07724 | 19946 | 31949 | 43729 | 55282 | 3 |
| 4 | 1643679 | 1656937 | 1669995 | 1682849 | 1695495 | 1707929 | 1720148 | 1732147 | 1743923 | 1755472 | 4 |
| 5 | 43901 | 57156 | 70211 | 83061 | 95704 | 08135 | 20349 | 32345 | 44117 | 55663 | 5 |
| 6 | 44124 | 57375 | 70427 | 83274 | 95913 | 08340 | 20551 | 32543 | 44312 | 55854 | 6 |
| 7 | 1644346 | 1657594 | 1670642 | 1683486 | 1696122 | 1708545 | 1720753 | 1732741 | 1744506 | 1756044 | 7 |
| 8 | 44569 | 57814 | 70858 | 83698 | 96331 | 08750 | 20954 | 32939 | 44700 | 56234 | 8 |
| 9 | 44791 | 58033 | 71074 | 83911 | 96539 | 08956 | 21156 | 33137 | 44894 | 56425 | 9 |
| 10 | 1645013 | 1658252 | 1671290 | 1684123 | 1696748 | 1709161 | 1721357 | 1733335 | 1745088 | 1756615 | 10 |
| 11 | 45236 | 58471 | 71505 | 84335 | 96957 | 09366 | 21559 | 33532 | 45282 | 56805 | 11 |
| 12 | 45458 | 58690 | 71721 | 84547 | 97165 | 09571 | 21760 | 33730 | 45476 | 56995 | 12 |
| 13 | 1645680 | 1658908 | 1671936 | 1684759 | 1697374 | 1709776 | 1721962 | 1733928 | 1745670 | 1757185 | 13 |
| 14 | 45902 | 59127 | 72152 | 84971 | 97582 | 09981 | 22163 | 34125 | 45864 | 57375 | 14 |
| 15 | 46124 | 59346 | 72367 | 85183 | 97791 | 10185 | 22364 | 34323 | 46057 | 57565 | 15 |
| 16 | 1646346 | 1659565 | 1672582 | 1685395 | 1697999 | 1710390 | 1722565 | 1734520 | 1746251 | 1757755 | 16 |
| 17 | 46568 | 59783 | 72797 | 85607 | 98207 | 10595 | 22766 | 34717 | 46445 | 57945 | 17 |
| 18 | 46790 | 60002 | 73013 | 85818 | 98415 | 10800 | 22967 | 34915 | 46638 | 58134 | 18 |
| 19 | 1647012 | 1660220 | 1673228 | 1686030 | 1698623 | 1711004 | 1723168 | 1735112 | 1746832 | 1758324 | 19 |
| 20 | 47233 | 60439 | 73443 | 86242 | 98832 | 11209 | 23369 | 35309 | 47025 | 58514 | 20 |
| 21 | 47455 | 60657 | 73658 | 86453 | 99040 | 11413 | 23570 | 35506 | 47218 | 58703 | 21 |
| 22 | 1647677 | 1660875 | 1673873 | 1686665 | 1699248 | 1711617 | 1723771 | 1735703 | 1747412 | 1758893 | 22 |
| 23 | 47898 | 61094 | 74088 | 86876 | 99456 | 11822 | 23971 | 35900 | 47605 | 59082 | 23 |
| 24 | 48120 | 61312 | 74302 | 87088 | 99663 | 12026 | 24172 | 36097 | 47798 | 59271 | 24 |
| 25 | 1648341 | 1661530 | 1674517 | 1687299 | 1699871 | 1712230 | 1724372 | 1736294 | 1747991 | 1759461 | 25 |
| 26 | 48563 | 61748 | 74732 | 87510 | 1700079 | 12434 | 24573 | 36491 | 48184 | 59650 | 26 |
| 27 | 48784 | 61966 | 74947 | 87721 | 00287 | 12639 | 24773 | 36683 | 48377 | 59839 | 27 |
| 28 | 1649006 | 1662184 | 1675161 | 1687933 | 1700494 | 1712843 | 1724974 | 1736884 | 1748570 | 1760028 | 28 |
| 29 | 49227 | 62402 | 75376 | 88144 | 00702 | 13047 | 25174 | 37081 | 48763 | 60217 | 29 |
| 30 | 49448 | 62620 | 75590 | 88355 | 00909 | 13250 | 25374 | 37277 | 48956 | 60406 | 30 |
| 31 | 1649669 | 1662838 | 1675805 | 1688566 | 1701117 | 1713454 | 1725575 | 1737474 | 1749148 | 1760595 | 31 |
| 32 | 49890 | 63056 | 76019 | 88777 | 01324 | 13658 | 25775 | 37670 | 49341 | 60784 | 32 |
| 33 | 50111 | 63273 | 76233 | 88987 | 01531 | 13862 | 25975 | 37867 | 49534 | 60972 | 33 |
| 34 | 1650332 | 1663491 | 1676448 | 1689198 | 1701739 | 1714066 | 1726175 | 1738063 | 1749726 | 1761161 | 34 |
| 35 | 50553 | 63709 | 76662 | 89409 | 01946 | 14269 | 26375 | 38259 | 49919 | 61350 | 35 |
| 36 | 50774 | 63926 | 76876 | 89620 | 02153 | 14473 | 26575 | 38455 | 50111 | 61538 | 36 |
| 37 | 1650995 | 1664144 | 1677090 | 1689830 | 1702360 | 1714676 | 1726775 | 1738652 | 1750303 | 1761727 | 37 |
| 38 | 51216 | 64361 | 77304 | 90041 | 02567 | 14880 | 26974 | 38848 | 50496 | 61915 | 38 |
| 39 | 51437 | 64579 | 77518 | 90251 | 02774 | 15083 | 27174 | 39044 | 50688 | 62104 | 39 |
| 40 | 1651657 | 1664796 | 1677732 | 1690462 | 1702981 | 1715286 | 1727374 | 1739239 | 1750880 | 1762292 | 40 |
| 41 | 51878 | 65013 | 77946 | 90672 | 03188 | 15490 | 27573 | 39435 | 51072 | 62480 | 41 |
| 42 | 52098 | 65230 | 78160 | 90882 | 03395 | 15693 | 27773 | 39631 | 51264 | 62668 | 42 |
| 43 | 1652319 | 1665448 | 1678373 | 1691093 | 1703601 | 1715896 | 1727972 | 1739827 | 1751456 | 1762856 | 43 |
| 44 | 52539 | 65665 | 78587 | 91303 | 03808 | 16099 | 28172 | 40023 | 51648 | 63045 | 44 |
| 45 | 52760 | 65882 | 78801 | 91513 | 04015 | 16302 | 28371 | 40218 | 51840 | 63233 | 45 |
| 46 | 1652980 | 1666099 | 1679014 | 1691723 | 1704221 | 1716505 | 1728570 | 1740414 | 1752032 | 1763420 | 46 |
| 47 | 53200 | 66316 | 79228 | 91933 | 04428 | 16708 | 28770 | 40609 | 52223 | 63608 | 47 |
| 48 | 53421 | 66533 | 79441 | 92143 | 04634 | 16911 | 28969 | 40805 | 52415 | 63796 | 48 |
| 49 | 1653641 | 1666749 | 1679655 | 1692353 | 1704841 | 1717113 | 1729168 | 1741000 | 1752607 | 1763984 | 49 |
| 50 | 53861 | 66966 | 79868 | 92563 | 05047 | 17316 | 29367 | 41195 | 52798 | 64171 | 50 |
| 51 | 54081 | 67183 | 80081 | 92773 | 05253 | 17519 | 29566 | 41391 | 52989 | 64359 | 51 |
| 52 | 1654301 | 1667399 | 1680295 | 1692983 | 1705459 | 1717721 | 1729765 | 1741586 | 1753181 | 1764547 | 52 |
| 53 | 54521 | 67616 | 80508 | 93192 | 05665 | 17924 | 29963 | 41781 | 53372 | 64734 | 53 |
| 54 | 54741 | 67833 | 80721 | 93402 | 05872 | 18126 | 30162 | 41976 | 53563 | 64921 | 54 |
| 55 | 1654961 | 1668049 | 1680934 | 1693611 | 1706078 | 1718329 | 1730361 | 1742171 | 1753755 | 1765109 | 55 |
| 56 | 55180 | 68266 | 81147 | 93821 | 06284 | 18531 | 30560 | 42366 | 53946 | 65296 | 56 |
| 57 | 55400 | 68482 | 81360 | 94030 | 06489 | 18733 | 30758 | 42561 | 54137 | 65483 | 57 |
| 58 | 1655620 | 1668698 | 1681573 | 1694240 | 1706695 | 1718936 | 1730957 | 1742755 | 1754328 | 1765670 | 58 |
| 59 | 55840 | 68914 | 81786 | 94449 | 06901 | 19138 | 31155 | 42950 | 54519 | 65857 | 59 |
| 60 | 56059 | 69131 | 81998 | 94658 | 07107 | 19340 | 31354 | 43145 | 54710 | 66044 | 60 |

## Parts for Seconds. (v.)

| | 130° | | 131° | | 132° | | 133° | | 134° | | 135° | | 136° | | 137° | | 138° | | 139° | | 140° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 |
| 2 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 2 |
| 3 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 3 |
| 4 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 13 | 12 | 4 |
| 5 | 19 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 5 |
| 6 | 22 | 22 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 19 | 6 |
| 7 | 26 | 26 | 26 | 25 | 25 | 25 | 25 | 25 | 24 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 22 | 7 |
| 8 | 30 | 29 | 29 | 29 | 29 | 29 | 28 | 28 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 26 | 25 | 25 | 25 | 8 |
| 9 | 33 | 33 | 33 | 33 | 32 | 32 | 32 | 32 | 31 | 31 | 31 | 31 | 30 | 30 | 30 | 29 | 29 | 29 | 29 | 28 | 28 | 9 |
| 10 | 37 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 35 | 34 | 34 | 34 | 33 | 33 | 33 | 32 | 32 | 32 | 31 | 31 | 10 |
| 11 | 41 | 41 | 40 | 40 | 40 | 39 | 39 | 39 | 38 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 36 | 35 | 35 | 35 | 34 | 11 |
| 12 | 45 | 44 | 44 | 44 | 43 | 43 | 43 | 42 | 42 | 41 | 41 | 41 | 40 | 40 | 40 | 39 | 39 | 39 | 38 | 38 | 37 | 12 |
| 13 | 48 | 48 | 48 | 47 | 47 | 46 | 46 | 46 | 45 | 45 | 45 | 44 | 44 | 43 | 43 | 43 | 42 | 42 | 41 | 41 | 41 | 13 |
| 14 | 52 | 52 | 51 | 51 | 50 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 47 | 46 | 46 | 45 | 45 | 45 | 44 | 44 | 14 |
| 15 | 56 | 55 | 55 | 54 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 51 | 50 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 15 |
| 16 | 59 | 59 | 59 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 16 |
| 17 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 59 | 58 | 58 | 57 | 57 | 56 | 56 | 55 | 55 | 54 | 54 | 53 | 17 |
| 18 | 67 | 66 | 66 | 65 | 65 | 64 | 64 | 63 | 63 | 62 | 62 | 61 | 61 | 60 | 60 | 59 | 58 | 58 | 57 | 57 | 56 | 18 |
| 19 | 71 | 70 | 70 | 69 | 68 | 68 | 67 | 67 | 66 | 66 | 65 | 65 | 64 | 63 | 63 | 62 | 62 | 61 | 60 | 60 | 59 | 19 |
| 20 | 74 | 74 | 73 | 73 | 72 | 71 | 71 | 70 | 70 | 69 | 69 | 68 | 67 | 67 | 66 | 65 | 65 | 64 | 64 | 63 | 62 | 20 |
| 21 | 78 | 77 | 77 | 76 | 76 | 75 | 74 | 74 | 73 | 73 | 72 | 71 | 70 | 70 | 69 | 69 | 68 | 67 | 67 | 66 | 65 | 21 |
| 22 | 82 | 81 | 80 | 80 | 79 | 79 | 78 | 77 | 77 | 76 | 75 | 75 | 74 | 73 | 73 | 72 | 71 | 71 | 70 | 69 | 69 | 22 |
| 23 | 85 | 85 | 84 | 84 | 83 | 82 | 82 | 81 | 80 | 80 | 79 | 78 | 77 | 77 | 76 | 75 | 75 | 74 | 73 | 72 | 72 | 23 |
| 24 | 89 | 88 | 88 | 87 | 86 | 86 | 85 | 84 | 84 | 83 | 82 | 82 | 81 | 80 | 79 | 79 | 78 | 77 | 76 | 76 | 75 | 24 |
| 25 | 93 | 92 | 91 | 91 | 90 | 89 | 89 | 88 | 87 | 86 | 86 | 85 | 84 | 83 | 83 | 82 | 81 | 80 | 80 | 79 | 78 | 25 |
| 26 | 97 | 96 | 95 | 94 | 94 | 93 | 92 | 91 | 91 | 90 | 89 | 88 | 87 | 87 | 86 | 85 | 84 | 84 | 83 | 82 | 81 | 26 |
| 27 | 100 | 100 | 99 | 98 | 97 | 97 | 96 | 95 | 94 | 93 | 92 | 92 | 91 | 90 | 89 | 88 | 88 | 87 | 86 | 85 | 84 | 27 |
| 28 | 104 | 103 | 102 | 102 | 101 | 100 | 99 | 98 | 98 | 97 | 96 | 96 | 94 | 93 | 93 | 92 | 91 | 90 | 89 | 88 | 87 | 28 |
| 29 | 108 | 107 | 106 | 105 | 104 | 104 | 103 | 102 | 101 | 100 | 99 | 99 | 98 | 97 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 29 |
| 30 | 111 | 111 | 110 | 109 | 108 | 107 | 106 | 105 | 105 | 104 | 103 | 102 | 101 | 100 | 99 | 98 | 97 | 96 | 95 | 94 | 93 | 30 |
| 31 | 115 | 114 | 113 | 113 | 112 | 111 | 110 | 109 | 108 | 107 | 106 | 105 | 104 | 103 | 103 | 102 | 101 | 100 | 99 | 98 | 97 | 31 |
| 32 | 119 | 118 | 117 | 116 | 115 | 114 | 113 | 113 | 112 | 111 | 110 | 109 | 108 | 107 | 106 | 105 | 104 | 103 | 102 | 101 | 100 | 32 |
| 33 | 123 | 122 | 121 | 120 | 119 | 118 | 117 | 116 | 115 | 114 | 113 | 112 | 111 | 110 | 109 | 108 | 107 | 106 | 105 | 104 | 103 | 33 |
| 34 | 126 | 125 | 124 | 123 | 123 | 121 | 121 | 120 | 119 | 118 | 117 | 116 | 114 | 113 | 112 | 111 | 110 | 109 | 108 | 107 | 106 | 34 |
| 35 | 130 | 129 | 128 | 127 | 126 | 125 | 124 | 123 | 122 | 121 | 120 | 119 | 118 | 117 | 116 | 115 | 114 | 112 | 111 | 110 | 109 | 35 |
| 36 | 134 | 133 | 132 | 131 | 130 | 129 | 128 | 127 | 126 | 124 | 123 | 122 | 121 | 120 | 119 | 118 | 117 | 116 | 115 | 113 | 112 | 36 |
| 37 | 137 | 136 | 135 | 134 | 133 | 132 | 131 | 130 | 129 | 128 | 127 | 126 | 125 | 123 | 122 | 121 | 120 | 119 | 118 | 117 | 115 | 37 |
| 38 | 141 | 140 | 139 | 138 | 137 | 136 | 135 | 134 | 133 | 131 | 130 | 129 | 128 | 127 | 126 | 124 | 123 | 122 | 121 | 120 | 118 | 38 |
| 39 | 145 | 144 | 143 | 142 | 141 | 139 | 138 | 137 | 136 | 135 | 134 | 132 | 131 | 130 | 129 | 128 | 126 | 125 | 124 | 123 | 122 | 39 |
| 40 | 149 | 147 | 146 | 145 | 144 | 143 | 142 | 141 | 139 | 138 | 137 | 136 | 135 | 133 | 132 | 131 | 130 | 128 | 127 | 126 | 125 | 40 |
| 41 | 152 | 151 | 150 | 149 | 148 | 147 | 145 | 144 | 143 | 142 | 141 | 139 | 138 | 137 | 136 | 134 | 133 | 132 | 130 | 129 | 128 | 41 |
| 42 | 156 | 155 | 154 | 152 | 151 | 150 | 149 | 148 | 146 | 145 | 144 | 143 | 141 | 140 | 139 | 138 | 136 | 135 | 134 | 132 | 131 | 42 |
| 43 | 160 | 159 | 157 | 156 | 155 | 154 | 152 | 151 | 150 | 149 | 147 | 146 | 145 | 144 | 142 | 141 | 139 | 138 | 137 | 135 | 134 | 43 |
| 44 | 163 | 162 | 161 | 160 | 159 | 157 | 156 | 155 | 153 | 152 | 151 | 150 | 148 | 147 | 145 | 144 | 143 | 141 | 140 | 139 | 137 | 44 |
| 45 | 167 | 166 | 165 | 163 | 162 | 161 | 160 | 158 | 157 | 156 | 154 | 153 | 152 | 150 | 149 | 147 | 146 | 145 | 143 | 142 | 140 | 45 |
| 46 | 171 | 170 | 168 | 167 | 166 | 164 | 163 | 162 | 160 | 159 | 158 | 156 | 155 | 154 | 152 | 151 | 149 | 148 | 146 | 145 | 143 | 46 |
| 47 | 175 | 173 | 172 | 171 | 169 | 168 | 167 | 165 | 164 | 163 | 161 | 160 | 158 | 157 | 155 | 154 | 152 | 151 | 150 | 148 | 146 | 47 |
| 48 | 178 | 177 | 176 | 174 | 173 | 172 | 170 | 169 | 167 | 166 | 165 | 163 | 162 | 160 | 159 | 157 | 156 | 154 | 153 | 151 | 150 | 48 |
| 49 | 182 | 181 | 179 | 178 | 177 | 175 | 174 | 172 | 171 | 169 | 168 | 167 | 165 | 164 | 162 | 160 | 159 | 157 | 156 | 154 | 153 | 49 |
| 50 | 186 | 184 | 183 | 182 | 180 | 179 | 177 | 176 | 174 | 173 | 171 | 170 | 168 | 167 | 165 | 164 | 162 | 161 | 160 | 157 | 156 | 50 |
| 51 | 189 | 188 | 187 | 185 | 184 | 182 | 181 | 179 | 178 | 176 | 175 | 173 | 172 | 170 | 169 | 167 | 165 | 164 | 162 | 161 | 159 | 51 |
| 52 | 193 | 192 | 190 | 189 | 187 | 186 | 184 | 183 | 181 | 180 | 178 | 177 | 175 | 174 | 172 | 170 | 169 | 167 | 165 | 164 | 162 | 52 |
| 53 | 197 | 195 | 194 | 192 | 191 | 189 | 188 | 186 | 185 | 183 | 182 | 180 | 178 | 177 | 175 | 174 | 172 | 170 | 169 | 167 | 165 | 53 |
| 54 | 201 | 199 | 198 | 196 | 195 | 193 | 191 | 190 | 188 | 187 | 185 | 184 | 182 | 180 | 179 | 177 | 175 | 173 | 172 | 170 | 168 | 54 |
| 55 | 204 | 203 | 201 | 200 | 198 | 197 | 195 | 193 | 192 | 190 | 189 | 187 | 185 | 184 | 182 | 180 | 178 | 177 | 175 | 173 | 171 | 55 |
| 56 | 208 | 206 | 205 | 203 | 202 | 200 | 199 | 197 | 195 | 194 | 192 | 190 | 189 | 187 | 185 | 183 | 182 | 180 | 178 | 176 | 174 | 56 |
| 57 | 212 | 210 | 209 | 207 | 205 | 204 | 202 | 200 | 199 | 197 | 195 | 194 | 192 | 190 | 188 | 187 | 185 | 183 | 181 | 180 | 178 | 57 |
| 58 | 215 | 214 | 212 | 211 | 209 | 207 | 206 | 204 | 202 | 200 | 199 | 197 | 195 | 194 | 192 | 190 | 188 | 186 | 184 | 183 | 181 | 58 |
| 59 | 219 | 218 | 216 | 214 | 213 | 211 | 209 | 207 | 206 | 204 | 202 | 201 | 199 | 197 | 195 | 193 | 191 | 190 | 188 | 186 | 184 | 59 |
| 60 | 223 | 221 | 219 | 219 | 216 | 214 | 213 | 211 | 209 | 207 | 206 | 204 | 202 | 200 | 198 | 196 | 195 | 193 | 190 | .89 | 187 | 60 |

(v.) Nat. Versines.

| ′ | 140° | 141° | 142° | 143° | 144° | 145° | 146° | 147° | 148° | 149° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1766044 | 1777146 | 1788011 | 1798636 | 1809017 | 1819152 | 1829038 | 1838671 | 1848048 | 1857167 | 0 |
| 1 | 1766231 | 1777329 | 1788190 | 1798811 | 1809188 | 1819319 | 1829200 | 1838829 | 1848202 | 1857317 | 1 |
| 2 | 66418 | 77512 | 88369 | 98985 | 09359 | 19486 | 29363 | 38987 | 48356 | 57467 | 2 |
| 3 | 66605 | 77695 | 88548 | 99160 | 09530 | 19652 | 29525 | 39146 | 48510 | 57616 | 3 |
| 4 | 1766792 | 1777878 | 1788727 | 1799335 | 1809700 | 1819819 | 1829688 | 1839304 | 1848664 | 1857766 | 4 |
| 5 | 66979 | 78060 | 88905 | 99510 | 09871 | 19985 | 29850 | 39462 | 48818 | 57916 | 5 |
| 6 | 67165 | 78243 | 89084 | 99685 | 10042 | 20159 | 30012 | 39620 | 48972 | 58065 | 6 |
| 7 | 1767352 | 1778426 | 1789263 | 1799859 | 1810212 | 1820318 | 1830175 | 1839778 | 1849125 | 1858214 | 7 |
| 8 | 67538 | 78608 | 89441 | 1800034 | 10383 | 20485 | 30337 | 39936 | 49279 | 58364 | 8 |
| 9 | 67725 | 78791 | 89620 | 00208 | 10553 | 20651 | 30499 | 40094 | 49433 | 58513 | 9 |
| 10 | 1767911 | 1778973 | 1789798 | 1800383 | 1810723 | 1820817 | 1830661 | 1840251 | 1849586 | 1858662 | 10 |
| 11 | 68097 | 79156 | 89977 | 00557 | 10894 | 20983 | 30823 | 40409 | 49739 | 58811 | 11 |
| 12 | 68284 | 79338 | 90155 | 00731 | 11064 | 21149 | 30985 | 40567 | 49893 | 58960 | 12 |
| 13 | 1768470 | 1779520 | 1790333 | 1800906 | 1811234 | 1821315 | 1831146 | 1840724 | 1850046 | 1859109 | 13 |
| 14 | 68656 | 79702 | 90512 | 01080 | 11404 | 21481 | 31308 | 40882 | 50199 | 59258 | 14 |
| 15 | 68842 | 79885 | 90690 | 01254 | 11574 | 21647 | 31470 | 41039 | 50352 | 59406 | 15 |
| 16 | 1769028 | 1780067 | 1790868 | 1801428 | 1811744 | 1821813 | 1831631 | 1841196 | 1850505 | 1859555 | 16 |
| 17 | 69214 | 80249 | 91046 | 01602 | 11914 | 21978 | 31793 | 41354 | 50658 | 59704 | 17 |
| 18 | 69400 | 80430 | 91224 | 01776 | 12084 | 22144 | 31954 | 41511 | 50811 | 59852 | 18 |
| 19 | 1769585 | 1780612 | 1791401 | 1801950 | 1812253 | 1822310 | 1832116 | 1841668 | 1850964 | 1860001 | 19 |
| 20 | 69771 | 80794 | 91579 | 02123 | 12423 | 22475 | 32277 | 41825 | 51117 | 60149 | 20 |
| 21 | 69957 | 80976 | 91757 | 02297 | 12593 | 22641 | 32438 | 41982 | 51269 | 60298 | 21 |
| 22 | 1770142 | 1781157 | 1791935 | 1802471 | 1812762 | 1822806 | 1832599 | 1842139 | 1851422 | 1860446 | 22 |
| 23 | 70328 | 81339 | 92112 | 02644 | 12931 | 22971 | 32760 | 42296 | 51575 | 60594 | 23 |
| 24 | 70513 | 81521 | 92290 | 02818 | 13101 | 23136 | 32921 | 42452 | 51727 | 60742 | 24 |
| 25 | 1770699 | 1781702 | 1792467 | 1802991 | 1813270 | 1823302 | 1833082 | 1842609 | 1851879 | 1860890 | 25 |
| 26 | 70884 | 81883 | 92645 | 03164 | 13439 | 23467 | 33243 | 42766 | 52032 | 61038 | 26 |
| 27 | 71069 | 82065 | 92822 | 03338 | 13608 | 23632 | 33404 | 42922 | 52184 | 61186 | 27 |
| 28 | 1771254 | 1782246 | 1792999 | 1803511 | 1813778 | 1823797 | 1833565 | 1843079 | 1852336 | 1861334 | 28 |
| 29 | 71440 | 82427 | 93176 | 03684 | 13947 | 23961 | 33725 | 43235 | 52488 | 61482 | 29 |
| 30 | 71625 | 82608 | 93353 | 03857 | 14116 | 24126 | 33886 | 43391 | 52640 | 61629 | 30 |
| 31 | 1771810 | 1782789 | 1793530 | 1804030 | 1814284 | 1824291 | 1834046 | 1843548 | 1852792 | 1861777 | 31 |
| 32 | 71995 | 82970 | 93707 | 04203 | 14453 | 24456 | 34207 | 43704 | 52944 | 61924 | 32 |
| 33 | 72179 | 83151 | 93884 | 04376 | 14622 | 24620 | 34367 | 43860 | 53096 | 62072 | 33 |
| 34 | 1772364 | 1783332 | 1794061 | 1804548 | 1814791 | 1824785 | 1834528 | 1844016 | 1853248 | 1862219 | 34 |
| 35 | 72549 | 83513 | 94238 | 04721 | 14959 | 24949 | 34688 | 44172 | 53399 | 62366 | 35 |
| 36 | 72734 | 83694 | 94415 | 04894 | 15128 | 25114 | 34848 | 44328 | 53551 | 62514 | 36 |
| 37 | 1772918 | 1783874 | 1794591 | 1805066 | 1815296 | 1825278 | 1835008 | 1844484 | 1853702 | 1862661 | 37 |
| 38 | 73103 | 84055 | 94768 | 05239 | 15465 | 25442 | 35168 | 44640 | 53854 | 62808 | 38 |
| 39 | 73287 | 84235 | 94944 | 05411 | 15633 | 25606 | 35328 | 44795 | 54005 | 62955 | 39 |
| 40 | 1773472 | 1784416 | 1795121 | 1805584 | 1815801 | 1825770 | 1835488 | 1844951 | 1854156 | 1863102 | 40 |
| 41 | 73656 | 84596 | 95297 | 05756 | 15970 | 25934 | 35648 | 45106 | 54308 | 63249 | 41 |
| 42 | 73840 | 84776 | 95474 | 05928 | 16138 | 26098 | 35807 | 45262 | 54459 | 63396 | 42 |
| 43 | 1774024 | 1784957 | 1795650 | 1806101 | 1816306 | 1826262 | 1835967 | 1845417 | 1854610 | 1863542 | 43 |
| 44 | 74209 | 85137 | 95826 | 06273 | 16474 | 26426 | 36127 | 45573 | 54761 | 63689 | 44 |
| 45 | 74393 | 85317 | 96002 | 06445 | 16642 | 26590 | 36286 | 45728 | 54912 | 63836 | 45 |
| 46 | 1774577 | 1785497 | 1796178 | 1806617 | 1816809 | 1826753 | 1836446 | 1845883 | 1855063 | 1863982 | 46 |
| 47 | 74761 | 85677 | 96354 | 06789 | 16977 | 26917 | 36605 | 46038 | 55214 | 64128 | 47 |
| 48 | 74945 | 85857 | 96530 | 06960 | 17145 | 27081 | 36764 | 46193 | 55364 | 64275 | 48 |
| 49 | 1775128 | 1786037 | 1796706 | 1807132 | 1817313 | 1827244 | 1836924 | 1846348 | 1855515 | 1864421 | 49 |
| 50 | 75312 | 86217 | 96882 | 07304 | 17480 | 27407 | 37083 | 46503 | 55666 | 64567 | 50 |
| 51 | 75496 | 86396 | 97057 | 07475 | 17648 | 27571 | 37242 | 46658 | 55816 | 64713 | 51 |
| 52 | 1775679 | 1786576 | 1797233 | 1807647 | 1817815 | 1827734 | 1837401 | 1846813 | 1855966 | 1864860 | 52 |
| 53 | 75863 | 86756 | 97408 | 07819 | 17982 | 27897 | 37560 | 46967 | 56117 | 65006 | 53 |
| 54 | 76046 | 86935 | 97584 | 07990 | 18150 | 28060 | 37719 | 47122 | 56267 | 65151 | 54 |
| 55 | 1776230 | 1787115 | 1797759 | 1808161 | 1818317 | 1828223 | 1837878 | 1847277 | 1856417 | 1865297 | 55 |
| 56 | 76413 | 87294 | 97935 | 08333 | 18484 | 28386 | 38036 | 47431 | 56567 | 65443 | 56 |
| 57 | 76597 | 87473 | 98110 | 08504 | 18651 | 28549 | 38195 | 47585 | 56718 | 65589 | 57 |
| 58 | 1776780 | 1787652 | 1798285 | 1808675 | 1818818 | 1828712 | 1838354 | 1847740 | 1856868 | 1865734 | 58 |
| 59 | 76963 | 87832 | 98460 | 08846 | 18985 | 28875 | 38512 | 47894 | 57017 | 65880 | 59 |
| 60 | 77146 | 88011 | 98636 | 09017 | 19152 | 29038 | 38671 | 48048 | 57167 | 66025 | 60 |

## Parts for Seconds (v.)

| " | 140° | | 141° | | 142° | | 143° | | 144° | | 145° | | 146° | | 147° | | 148° | | 149° | | 150° | " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | |
| 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 |
| 2 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 2 |
| 3 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 3 |
| 4 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 10 | 4 |
| 5 | 16 | 15 | 15 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 5 |
| 6 | 19 | 19 | 18 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 17 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 15 | 6 |
| 7 | 22 | 22 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 20 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 18 | 17 | 17 | 17 | 7 |
| 8 | 25 | 25 | 24 | 24 | 24 | 24 | 23 | 23 | 23 | 23 | 22 | 22 | 22 | 21 | 21 | 21 | 21 | 20 | 20 | 20 | 19 | 8 |
| 9 | 28 | 28 | 27 | 27 | 27 | 27 | 26 | 26 | 26 | 25 | 25 | 25 | 24 | 24 | 24 | 23 | 23 | 23 | 22 | 22 | 22 | 9 |
| 10 | 31 | 31 | 31 | 30 | 30 | 30 | 29 | 29 | 28 | 28 | 28 | 27 | 27 | 27 | 26 | 26 | 26 | 25 | 25 | 25 | 24 | 10 |
| 11 | 34 | 34 | 34 | 33 | 33 | 32 | 32 | 32 | 31 | 31 | 31 | 30 | 30 | 29 | 29 | 29 | 28 | 28 | 27 | 27 | 27 | 11 |
| 12 | 37 | 37 | 37 | 36 | 36 | 35 | 35 | 35 | 34 | 34 | 33 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 30 | 29 | 12 |
| 13 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 33 | 32 | 32 | 32 | 13 |
| 14 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 38 | 37 | 37 | 36 | 36 | 35 | 35 | 34 | 34 | 14 |
| 15 | 47 | 46 | 46 | 45 | 45 | 44 | 44 | 43 | 43 | 42 | 42 | 41 | 41 | 40 | 40 | 39 | 39 | 38 | 37 | 37 | 36 | 15 |
| 16 | 50 | 49 | 49 | 48 | 48 | 47 | 47 | 46 | 46 | 45 | 44 | 44 | 44 | 43 | 42 | 42 | 41 | 41 | 40 | 39 | 39 | 16 |
| 17 | 53 | 52 | 52 | 51 | 51 | 50 | 50 | 49 | 48 | 48 | 47 | 47 | 46 | 45 | 45 | 44 | 44 | 43 | 42 | 42 | 41 | 17 |
| 18 | 56 | 56 | 55 | 54 | 54 | 53 | 53 | 52 | 51 | 51 | 50 | 49 | 49 | 48 | 48 | 47 | 46 | 46 | 45 | 44 | 44 | 18 |
| 19 | 59 | 59 | 58 | 57 | 57 | 56 | 55 | 55 | 54 | 53 | 53 | 52 | 52 | 51 | 50 | 49 | 49 | 48 | 47 | 47 | 46 | 19 |
| 20 | 62 | 62 | 61 | 60 | 60 | 59 | 58 | 58 | 57 | 56 | 56 | 55 | 54 | 54 | 53 | 52 | 51 | 51 | 50 | 49 | 48 | 20 |
| 21 | 65 | 65 | 64 | 63 | 63 | 62 | 61 | 60 | 60 | 59 | 58 | 58 | 57 | 56 | 55 | 55 | 54 | 53 | 52 | 52 | 51 | 21 |
| 22 | 69 | 68 | 67 | 66 | 66 | 65 | 64 | 63 | 63 | 62 | 61 | 60 | 60 | 59 | 58 | 57 | 57 | 56 | 55 | 54 | 53 | 22 |
| 23 | 72 | 71 | 70 | 69 | 69 | 68 | 67 | 66 | 66 | 65 | 64 | 63 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 57 | 56 | 23 |
| 24 | 75 | 74 | 73 | 72 | 72 | 71 | 70 | 69 | 68 | 68 | 67 | 66 | 65 | 64 | 63 | 63 | 62 | 61 | 60 | 59 | 58 | 24 |
| 25 | 78 | 77 | 76 | 75 | 75 | 74 | 73 | 72 | 71 | 70 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | 63 | 62 | 62 | 61 | 25 |
| 26 | 81 | 80 | 79 | 78 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | 63 | 26 |
| 27 | 84 | 83 | 82 | 81 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 67 | 66 | 65 | 27 |
| 28 | 87 | 86 | 85 | 84 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 72 | 71 | 70 | 69 | 68 | 28 |
| 29 | 90 | 89 | 88 | 87 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 80 | 79 | 78 | 77 | 76 | 75 | 73 | 72 | 71 | 70 | 29 |
| 30 | 93 | 93 | 92 | 91 | 90 | 89 | 88 | 87 | 85 | 84 | 83 | 82 | 82 | 80 | 79 | 78 | 77 | 76 | 75 | 74 | 73 | 30 |
| 31 | 97 | 96 | 95 | 94 | 93 | 91 | 90 | 89 | 88 | 87 | 86 | 85 | 84 | 83 | 82 | 81 | 80 | 79 | 77 | 76 | 75 | 31 |
| 32 | 100 | 99 | 98 | 97 | 96 | 94 | 93 | 92 | 91 | 90 | 89 | 88 | 87 | 86 | 85 | 83 | 82 | 81 | 80 | 79 | 78 | 32 |
| 33 | 103 | 102 | 101 | 100 | 98 | 97 | 96 | 95 | 94 | 93 | 92 | 91 | 90 | 88 | 87 | 86 | 85 | 84 | 82 | 81 | 80 | 33 |
| 34 | 106 | 105 | 104 | 103 | 101 | 100 | 99 | 98 | 97 | 96 | 95 | 93 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | 84 | 82 | 34 |
| 35 | 109 | 108 | 107 | 106 | 104 | 103 | 102 | 101 | 100 | 99 | 97 | 96 | 95 | 94 | 92 | 91 | 90 | 89 | 87 | 86 | 85 | 35 |
| 36 | 112 | 111 | 110 | 109 | 107 | 106 | 105 | 104 | 103 | 101 | 100 | 99 | 98 | 96 | 95 | 94 | 92 | 91 | 90 | 89 | 87 | 36 |
| 37 | 115 | 114 | 113 | 112 | 110 | 109 | 108 | 107 | 105 | 104 | 103 | 102 | 101 | 99 | 98 | 96 | 95 | 94 | 92 | 91 | 90 | 37 |
| 38 | 118 | 117 | 116 | 115 | 113 | 112 | 111 | 110 | 108 | 107 | 106 | 104 | 103 | 102 | 100 | 99 | 98 | 96 | 95 | 94 | 92 | 38 |
| 39 | 122 | 120 | 119 | 118 | 116 | 115 | 114 | 112 | 111 | 110 | 108 | 107 | 106 | 104 | 103 | 102 | 100 | 99 | 97 | 96 | 95 | 39 |
| 40 | 125 | 123 | 122 | 121 | 119 | 118 | 117 | 115 | 114 | 113 | 111 | 110 | 109 | 107 | 106 | 104 | 103 | 101 | 100 | 98 | 97 | 40 |
| 41 | 128 | 126 | 125 | 124 | 122 | 121 | 120 | 118 | 117 | 115 | 114 | 113 | 111 | 110 | 108 | 107 | 105 | 104 | 102 | 101 | 99 | 41 |
| 42 | 131 | 130 | 128 | 127 | 125 | 124 | 123 | 121 | 120 | 118 | 117 | 115 | 114 | 112 | 111 | 109 | 108 | 106 | 105 | 103 | 102 | 42 |
| 43 | 134 | 133 | 131 | 130 | 128 | 127 | 125 | 124 | 123 | 121 | 120 | 118 | 117 | 115 | 114 | 112 | 110 | 109 | 107 | 106 | 104 | 43 |
| 44 | 137 | 136 | 134 | 133 | 131 | 130 | 128 | 127 | 125 | 124 | 122 | 121 | 120 | 118 | 116 | 115 | 113 | 111 | 110 | 108 | 107 | 44 |
| 45 | 140 | 139 | 137 | 136 | 134 | 133 | 131 | 130 | 128 | 127 | 125 | 124 | 122 | 120 | 119 | 117 | 116 | 114 | 112 | 111 | 109 | 45 |
| 46 | 143 | 142 | 140 | 139 | 137 | 136 | 134 | 133 | 131 | 130 | 128 | 126 | 125 | 123 | 121 | 120 | 118 | 117 | 115 | 113 | 112 | 46 |
| 47 | 146 | 145 | 143 | 142 | 140 | 139 | 137 | 136 | 134 | 132 | 131 | 129 | 128 | 126 | 124 | 122 | 121 | 119 | 117 | 116 | 114 | 47 |
| 48 | 150 | 148 | 146 | 145 | 143 | 142 | 140 | 138 | 137 | 135 | 133 | 132 | 131 | 128 | 127 | 125 | 123 | 122 | 120 | 118 | 116 | 48 |
| 49 | 153 | 151 | 149 | 148 | 146 | 145 | 143 | 141 | 140 | 138 | 136 | 135 | 133 | 131 | 129 | 128 | 126 | 124 | 122 | 121 | 119 | 49 |
| 50 | 156 | 154 | 152 | 151 | 149 | 148 | 146 | 144 | 142 | 141 | 139 | 137 | 136 | 134 | 132 | 130 | 128 | 127 | 125 | 123 | 121 | 50 |
| 51 | 159 | 157 | 156 | 154 | 152 | 150 | 149 | 147 | 145 | 144 | 142 | 140 | 139 | 136 | 135 | 133 | 131 | 129 | 127 | 126 | 124 | 51 |
| 52 | 162 | 160 | 159 | 157 | 155 | 153 | 152 | 150 | 148 | 146 | 145 | 143 | 141 | 139 | 137 | 135 | 134 | 132 | 130 | 128 | 126 | 52 |
| 53 | 165 | 163 | 162 | 160 | 158 | 156 | 155 | 153 | 151 | 149 | 147 | 146 | 144 | 142 | 140 | 138 | 136 | 134 | 132 | 130 | 128 | 53 |
| 54 | 168 | 167 | 165 | 163 | 161 | 159 | 158 | 156 | 154 | 152 | 150 | 148 | 147 | 144 | 143 | 141 | 139 | 137 | 135 | 133 | 131 | 54 |
| 55 | 171 | 170 | 168 | 166 | 164 | 162 | 160 | 159 | 157 | 155 | 153 | 151 | 150 | 147 | 145 | 143 | 141 | 139 | 137 | 135 | 133 | 55 |
| 56 | 174 | 173 | 171 | 169 | 167 | 165 | 163 | 162 | 160 | 158 | 156 | 154 | 152 | 150 | 148 | 146 | 144 | 142 | 140 | 138 | 136 | 56 |
| 57 | 178 | 176 | 174 | 172 | 170 | 168 | 166 | 164 | 162 | 160 | 159 | 157 | 155 | 153 | 151 | 148 | 146 | 144 | 142 | 140 | 138 | 57 |
| 58 | 181 | 179 | 177 | 175 | 173 | 171 | 169 | 167 | 165 | 163 | 161 | 159 | 158 | 155 | 153 | 151 | 149 | 147 | 145 | 143 | 141 | 58 |
| 59 | 184 | 182 | 180 | 178 | 176 | 174 | 172 | 170 | 168 | 166 | 164 | 162 | 160 | 158 | 156 | 154 | 152 | 150 | 147 | 145 | 143 | 59 |
| 60 | 187 | 185 | 183 | 181 | 179 | 177 | 175 | 173 | 171 | 169 | 167 | 165 | 163 | 161 | 158 | 156 | 154 | 152 | 150 | 148 | 145 | 60 |

(v.) Nat. Versines.

| ′ | 150° | 151° | 152° | 153° | 154° | 155° | 156° | 157° | 158° | 159° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1866025 | 1874620 | 1882948 | 1891007 | 1898794 | 1906308 | 1913546 | 1920505 | 1927184 | 1933580 | 0 |
| 1 | 1866171 | 1874761 | 1883084 | 1891139 | 1898922 | 1906431 | 1913664 | 1920619 | 1927293 | 1933685 | 1 |
| 2 | 66316 | 74902 | 83221 | 91271 | 99049 | 06554 | 13782 | 20732 | 27402 | 33789 | 2 |
| 3 | 66461 | 75043 | 83357 | 91402 | 99176 | 06676 | 13900 | 20846 | 27510 | 33893 | 3 |
| 4 | 1866607 | 1875183 | 1883493 | 1891534 | 1899304 | 1906799 | 1914018 | 1920959 | 1927619 | 1933997 | 4 |
| 5 | 66752 | 75324 | 83630 | 91666 | 99431 | 06922 | 14136 | 21072 | 27728 | 34101 | 5 |
| 6 | 66897 | 75465 | 83766 | 91798 | 99558 | 07044 | 14254 | 21185 | 27836 | 34205 | 6 |
| 7 | 1867042 | 1875605 | 1883902 | 1891929 | 1899685 | 1907167 | 1914372 | 1921299 | 1927945 | 1934308 | 7 |
| 8 | 67187 | 75746 | 84038 | 92061 | 99812 | 07289 | 14490 | 21412 | 28053 | 34412 | 8 |
| 9 | 67331 | 75886 | 84174 | 92192 | 99939 | 07411 | 14607 | 21525 | 28161 | 34515 | 9 |
| 10 | 1867476 | 1876026 | 1884310 | 1892323 | 1900065 | 1907533 | 1914725 | 1921638 | 1928270 | 1934619 | 10 |
| 11 | 67621 | 76167 | 84445 | 92455 | 00192 | 07655 | 14842 | 21750 | 28378 | 34722 | 11 |
| 12 | 67766 | 76307 | 84581 | 92586 | 00319 | 07778 | 14960 | 21863 | 28486 | 34826 | 12 |
| 13 | 1867910 | 1876447 | 1884717 | 1892717 | 1900445 | 1907900 | 1915077 | 1921976 | 1928594 | 1934929 | 13 |
| 14 | 68054 | 76587 | 84852 | 92848 | 00572 | 08021 | 15194 | 22088 | 28702 | 35032 | 14 |
| 15 | 68199 | 76727 | 84988 | 92979 | 00698 | 08143 | 15312 | 22201 | 28810 | 35135 | 15 |
| 16 | 1868343 | 1876867 | 1885123 | 1893110 | 1900825 | 1908265 | 1915429 | 1922313 | 1928917 | 1935238 | 16 |
| 17 | 68487 | 77006 | 85258 | 93241 | 00951 | 08387 | 15546 | 22426 | 29025 | 35341 | 17 |
| 18 | 68632 | 77146 | 85394 | 93371 | 01077 | 08508 | 15663 | 22538 | 29133 | 35444 | 18 |
| 19 | 1868776 | 1877286 | 1885529 | 1893502 | 1901203 | 1908630 | 1915780 | 1922650 | 1929240 | 1935547 | 19 |
| 20 | 68920 | 77425 | 85664 | 93633 | 01329 | 08751 | 15896 | 22762 | 29348 | 35650 | 20 |
| 21 | 69064 | 77565 | 85799 | 93763 | 01455 | 08873 | 16013 | 22875 | 29455 | 35752 | 21 |
| 22 | 1869207 | 1877704 | 1885934 | 1893894 | 1901581 | 1908994 | 1916130 | 1922987 | 1929562 | 1935855 | 22 |
| 23 | 69351 | 77844 | 86069 | 94024 | 01707 | 09115 | 16246 | 23098 | 29669 | 35957 | 23 |
| 24 | 69495 | 77983 | 86204 | 94154 | 01833 | 09236 | 16363 | 23210 | 29777 | 36060 | 24 |
| 25 | 1869639 | 1878122 | 1886338 | 1894284 | 1901958 | 1909357 | 1916479 | 1923322 | 1929884 | 1936162 | 25 |
| 26 | 69782 | 78261 | 86473 | 94415 | 02084 | 09478 | 16596 | 23434 | 29991 | 36264 | 26 |
| 27 | 69926 | 78400 | 86608 | 94545 | 02209 | 09599 | 16712 | 23545 | 30097 | 36366 | 27 |
| 28 | 1870069 | 1878539 | 1886742 | 1894675 | 1902335 | 1909720 | 1916828 | 1923657 | 1930204 | 1936468 | 28 |
| 29 | 70212 | 78678 | 86877 | 94805 | 02460 | 09841 | 16944 | 23768 | 30311 | 36570 | 29 |
| 30 | 70356 | 78817 | 87011 | 94934 | 02585 | 09961 | 17060 | 23880 | 30418 | 36672 | 30 |
| 31 | 1870499 | 1878956 | 1887145 | 1895064 | 1902711 | 1910082 | 1917176 | 1923991 | 1930524 | 1936774 | 31 |
| 32 | 70642 | 79095 | 87279 | 95194 | 02836 | 10202 | 17292 | 24102 | 30631 | 36876 | 32 |
| 33 | 70785 | 79233 | 87413 | 95323 | 02961 | 10323 | 17408 | 24213 | 30737 | 36977 | 33 |
| 34 | 1870928 | 1879372 | 1887548 | 1895453 | 1903086 | 1910443 | 1917523 | 1924324 | 1930843 | 1937079 | 34 |
| 35 | 71071 | 79510 | 87682 | 95582 | 03211 | 10563 | 17639 | 24435 | 30950 | 37181 | 35 |
| 36 | 71214 | 79649 | 87815 | 95712 | 03335 | 10684 | 17755 | 24546 | 31056 | 37282 | 36 |
| 37 | 1871357 | 1879787 | 1887949 | 1895841 | 1903460 | 1910804 | 1917870 | 1924657 | 1931162 | 1937383 | 37 |
| 38 | 71499 | 79925 | 88083 | 95970 | 03585 | 10924 | 17986 | 24768 | 31268 | 37485 | 38 |
| 39 | 71642 | 80063 | 88217 | 96099 | 03709 | 11044 | 18101 | 24878 | 31374 | 37586 | 39 |
| 40 | 1871784 | 1880201 | 1888350 | 1896229 | 1903834 | 1911164 | 1918216 | 1924989 | 1931480 | 1937687 | 40 |
| 41 | 71927 | 80339 | 88484 | 96358 | 03958 | 11284 | 18331 | 25099 | 31586 | 37788 | 41 |
| 42 | 72069 | 80477 | 88617 | 96486 | 04083 | 11403 | 18446 | 25210 | 31691 | 37889 | 42 |
| 43 | 1872212 | 1880615 | 1888751 | 1896615 | 1904207 | 1911523 | 1918561 | 1925320 | 1931797 | 1937990 | 43 |
| 44 | 72354 | 80753 | 88884 | 96744 | 04331 | 11643 | 18676 | 25430 | 31902 | 38091 | 44 |
| 45 | 72496 | 80891 | 89017 | 96873 | 04455 | 11762 | 18791 | 25541 | 32008 | 38191 | 45 |
| 46 | 1872638 | 1881028 | 1889150 | 1897001 | 1904579 | 1911882 | 1918906 | 1925651 | 1932113 | 1938292 | 46 |
| 47 | 72780 | 81166 | 89283 | 97130 | 04703 | 12001 | 19021 | 25761 | 32219 | 38393 | 47 |
| 48 | 72922 | 81304 | 89416 | 97256 | 04827 | 12120 | 19135 | 25871 | 32324 | 38493 | 48 |
| 49 | 1873064 | 1881441 | 1889549 | 1897387 | 1904951 | 1912239 | 1919250 | 1925981 | 1932429 | 1938593 | 49 |
| 50 | 73206 | 81578 | 89682 | 97515 | 05075 | 12358 | 19364 | 26090 | 32534 | 38694 | 50 |
| 51 | 73347 | 81716 | 89815 | 97643 | 05198 | 12478 | 19479 | 26200 | 32639 | 38794 | 51 |
| 52 | 1873489 | 1881853 | 1889948 | 1897771 | 1905322 | 1912597 | 1919593 | 1926310 | 1932744 | 1938894 | 52 |
| 53 | 73631 | 81990 | 90080 | 97900 | 05445 | 12715 | 19707 | 26419 | 32849 | 38994 | 53 |
| 54 | 73772 | 82127 | 90213 | 98028 | 05569 | 12834 | 19822 | 26529 | 32954 | 39094 | 54 |
| 55 | 1873914 | 1882264 | 1890345 | 1898156 | 1905692 | 1912953 | 1919936 | 1926638 | 1933058 | 1939194 | 55 |
| 56 | 74055 | 82401 | 90478 | 98283 | 05815 | 13072 | 20050 | 26747 | 33163 | 39294 | 56 |
| 57 | 74196 | 82538 | 90610 | 98411 | 05939 | 13190 | 20164 | 26857 | 33267 | 39394 | 57 |
| 58 | 1874338 | 1882674 | 1890742 | 1898539 | 1906062 | 1913309 | 1920277 | 1926966 | 1933372 | 1939494 | 58 |
| 59 | 74479 | 82811 | 90874 | 98667 | 06185 | 13427 | 20391 | 27075 | 33476 | 39593 | 59 |
| 60 | 74620 | 82948 | 91007 | 98794 | 06308 | 13546 | 20505 | 27184 | 33580 | 39693 | 60 |

## Parts for Seconds. (v.)

| | 150° | | 151° | | 152° | | 153° | | 154° | | 155° | | 156° | | 157° | | 158° | | 159° | | 160° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| " | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | " |
| 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 2 |
| 3 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 3 |
| 4 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 | 4 |
| 5 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 5 |
| 6 | 15 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 10 | 10 | 10 | 6 |
| 7 | 17 | 17 | 16 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 7 |
| 8 | 19 | 19 | 19 | 19 | 18 | 18 | 18 | 17 | 17 | 17 | 16 | 16 | 16 | 15 | 15 | 15 | 15 | 14 | 14 | 14 | 13 | 8 |
| 9 | 22 | 21 | 21 | 21 | 20 | 20 | 20 | 19 | 19 | 19 | 18 | 18 | 18 | 17 | 17 | 17 | 16 | 16 | 16 | 15 | 15 | 9 |
| 10 | 24 | 24 | 24 | 23 | 23 | 22 | 22 | 22 | 21 | 21 | 20 | 20 | 20 | 19 | 19 | 19 | 18 | 18 | 17 | 17 | 17 | 10 |
| 11 | 27 | 26 | 26 | 25 | 25 | 25 | 24 | 24 | 23 | 23 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 20 | 19 | 19 | 18 | 11 |
| 12 | 29 | 29 | 28 | 28 | 27 | 27 | 26 | 26 | 25 | 25 | 25 | 24 | 24 | 23 | 23 | 22 | 22 | 21 | 21 | 20 | 20 | 12 |
| 13 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 27 | 27 | 26 | 26 | 25 | 25 | 24 | 24 | 23 | 23 | 22 | 22 | 13 |
| 14 | 34 | 33 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 29 | 28 | 28 | 27 | 27 | 26 | 25 | 25 | 24 | 24 | 23 | 14 |
| 15 | 36 | 36 | 35 | 35 | 34 | 34 | 33 | 32 | 32 | 31 | 31 | 30 | 30 | 29 | 28 | 28 | 27 | 27 | 26 | 25 | 25 | 15 |
| 16 | 39 | 38 | 38 | 37 | 36 | 36 | 35 | 35 | 34 | 33 | 33 | 32 | 32 | 31 | 30 | 30 | 29 | 28 | 28 | 27 | 27 | 16 |
| 17 | 41 | 41 | 40 | 39 | 39 | 38 | 37 | 37 | 36 | 35 | 35 | 34 | 34 | 33 | 32 | 32 | 31 | 30 | 30 | 29 | 28 | 17 |
| 18 | 44 | 43 | 42 | 42 | 41 | 40 | 40 | 39 | 38 | 38 | 37 | 36 | 35 | 35 | 34 | 33 | 33 | 32 | 31 | 31 | 30 | 18 |
| 19 | 46 | 45 | 45 | 44 | 43 | 43 | 42 | 41 | 40 | 40 | 39 | 38 | 37 | 37 | 36 | 35 | 35 | 34 | 33 | 32 | 32 | 19 |
| 20 | 48 | 48 | 47 | 46 | 46 | 45 | 44 | 43 | 42 | 42 | 41 | 40 | 39 | 39 | 38 | 37 | 36 | 36 | 35 | 34 | 33 | 20 |
| 21 | 51 | 50 | 49 | 49 | 48 | 47 | 46 | 45 | 45 | 44 | 43 | 42 | 41 | 41 | 40 | 39 | 38 | 37 | 36 | 36 | 35 | 21 |
| 22 | 53 | 53 | 52 | 51 | 50 | 49 | 48 | 48 | 47 | 46 | 45 | 44 | 43 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 22 |
| 23 | 56 | 55 | 54 | 53 | 52 | 51 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 44 | 43 | 42 | 41 | 40 | 39 | 38 | 23 |
| 24 | 58 | 57 | 56 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 45 | 44 | 43 | 42 | 41 | 40 | 24 |
| 25 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 42 | 41 | 25 |
| 26 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 44 | 43 | 26 |
| 27 | 65 | 64 | 63 | 62 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 47 | 46 | 45 | 27 |
| 28 | 68 | 67 | 66 | 65 | 64 | 63 | 62 | 61 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 51 | 50 | 49 | 48 | 46 | 28 |
| 29 | 70 | 69 | 68 | 67 | 66 | 65 | 64 | 63 | 62 | 61 | 59 | 58 | 57 | 56 | 55 | 54 | 53 | 52 | 50 | 49 | 48 | 29 |
| 30 | 73 | 72 | 71 | 69 | 68 | 67 | 66 | 65 | 64 | 63 | 61 | 60 | 59 | 58 | 57 | 56 | 55 | 53 | 52 | 51 | 50 | 30 |
| 31 | 75 | 74 | 73 | 72 | 71 | 69 | 68 | 67 | 66 | 65 | 64 | 62 | 61 | 60 | 59 | 58 | 56 | 55 | 54 | 53 | 51 | 31 |
| 32 | 78 | 76 | 75 | 74 | 73 | 72 | 70 | 69 | 68 | 67 | 66 | 64 | 63 | 62 | 61 | 59 | 58 | 57 | 56 | 54 | 53 | 32 |
| 33 | 80 | 79 | 78 | 76 | 75 | 74 | 73 | 71 | 70 | 69 | 68 | 66 | 65 | 64 | 63 | 61 | 60 | 59 | 57 | 56 | 55 | 33 |
| 34 | 82 | 81 | 80 | 79 | 77 | 76 | 75 | 74 | 72 | 71 | 70 | 68 | 67 | 66 | 64 | 63 | 62 | 60 | 59 | 58 | 56 | 34 |
| 35 | 85 | 84 | 82 | 81 | 80 | 78 | 77 | 76 | 74 | 73 | 72 | 70 | 69 | 68 | 66 | 65 | 64 | 62 | 61 | 59 | 58 | 35 |
| 36 | 87 | 86 | 85 | 83 | 82 | 81 | 79 | 78 | 76 | 75 | 74 | 72 | 71 | 70 | 68 | 67 | 65 | 64 | 63 | 61 | 60 | 36 |
| 37 | 90 | 88 | 87 | 86 | 84 | 83 | 81 | 80 | 79 | 77 | 76 | 74 | 73 | 72 | 70 | 69 | 67 | 66 | 64 | 63 | 61 | 37 |
| 38 | 92 | 91 | 89 | 88 | 86 | 85 | 84 | 82 | 81 | 79 | 78 | 76 | 75 | 73 | 72 | 70 | 69 | 68 | 66 | 65 | 63 | 38 |
| 39 | 95 | 93 | 92 | 90 | 89 | 87 | 86 | 84 | 83 | 81 | 80 | 78 | 77 | 75 | 74 | 72 | 71 | 69 | 68 | 66 | 65 | 39 |
| 40 | 97 | 95 | 94 | 93 | 91 | 90 | 88 | 87 | 85 | 83 | 82 | 80 | 79 | 77 | 76 | 74 | 73 | 71 | 70 | 68 | 66 | 40 |
| 41 | 99 | 98 | 96 | 95 | 93 | 92 | 90 | 89 | 87 | 86 | 84 | 82 | 81 | 79 | 78 | 76 | 74 | 73 | 71 | 70 | 68 | 41 |
| 42 | 102 | 100 | 99 | 97 | 96 | 94 | 92 | 91 | 89 | 88 | 86 | 84 | 83 | 81 | 80 | 78 | 76 | 75 | 73 | 71 | 70 | 42 |
| 43 | 104 | 103 | 101 | 99 | 98 | 96 | 95 | 93 | 91 | 90 | 88 | 86 | 85 | 83 | 81 | 80 | 78 | 76 | 74 | 73 | 71 | 43 |
| 44 | 107 | 105 | 103 | 102 | 100 | 98 | 97 | 95 | 93 | 92 | 90 | 88 | 87 | 85 | 83 | 82 | 80 | 78 | 76 | 75 | 73 | 44 |
| 45 | 109 | 107 | 106 | 104 | 102 | 101 | 99 | 97 | 96 | 94 | 92 | 90 | 89 | 87 | 85 | 83 | 82 | 80 | 78 | 76 | 75 | 45 |
| 46 | 112 | 110 | 108 | 106 | 105 | 103 | 101 | 100 | 98 | 96 | 94 | 92 | 91 | 89 | 87 | 85 | 84 | 82 | 80 | 78 | 76 | 46 |
| 47 | 114 | 112 | 110 | 109 | 107 | 105 | 103 | 102 | 100 | 98 | 96 | 95 | 93 | 91 | 89 | 87 | 85 | 84 | 82 | 80 | 78 | 47 |
| 48 | 116 | 115 | 113 | 111 | 109 | 107 | 106 | 104 | 102 | 100 | 98 | 97 | 95 | 93 | 91 | 89 | 87 | 85 | 83 | 81 | 80 | 48 |
| 49 | 119 | 117 | 115 | 113 | 112 | 110 | 108 | 106 | 104 | 102 | 100 | 99 | 97 | 95 | 93 | 91 | 89 | 87 | 85 | 83 | 81 | 49 |
| 50 | 121 | 119 | 118 | 116 | 114 | 112 | 110 | 108 | 106 | 104 | 102 | 101 | 99 | 97 | 95 | 93 | 91 | 89 | 87 | 85 | 83 | 50 |
| 51 | 124 | 122 | 120 | 118 | 116 | 114 | 112 | 110 | 108 | 106 | 105 | 103 | 101 | 99 | 97 | 95 | 93 | 91 | 89 | 87 | 85 | 51 |
| 52 | 126 | 124 | 122 | 120 | 118 | 116 | 114 | 112 | 110 | 109 | 107 | 105 | 103 | 101 | 98 | 96 | 94 | 92 | 90 | 88 | 86 | 52 |
| 53 | 128 | 127 | 125 | 123 | 121 | 119 | 117 | 115 | 113 | 111 | 109 | 107 | 105 | 102 | 100 | 98 | 96 | 94 | 92 | 90 | 88 | 53 |
| 54 | 131 | 129 | 127 | 125 | 123 | 121 | 119 | 117 | 115 | 113 | 111 | 109 | 106 | 104 | 102 | 100 | 98 | 96 | 94 | 92 | 90 | 54 |
| 55 | 133 | 131 | 129 | 127 | 125 | 123 | 121 | 119 | 117 | 115 | 113 | 111 | 108 | 106 | 104 | 102 | 100 | 98 | 96 | 93 | 91 | 55 |
| 56 | 136 | 134 | 132 | 130 | 127 | 125 | 123 | 121 | 119 | 117 | 115 | 113 | 110 | 108 | 106 | 104 | 102 | 99 | 97 | 95 | 93 | 56 |
| 57 | 138 | 136 | 134 | 132 | 130 | 128 | 125 | 123 | 121 | 119 | 117 | 115 | 112 | 110 | 108 | 106 | 104 | 101 | 99 | 97 | 95 | 57 |
| 58 | 141 | 138 | 136 | 134 | 132 | 130 | 128 | 125 | 123 | 121 | 119 | 117 | 114 | 112 | 110 | 108 | 105 | 103 | 101 | 98 | 96 | 58 |
| 59 | 143 | 141 | 139 | 137 | 134 | 131 | 130 | 128 | 125 | 123 | 121 | 119 | 116 | 114 | 112 | 109 | 107 | 105 | 103 | 100 | 98 | 59 |
| 60 | 145 | 143 | 141 | 139 | 136 | 134 | 132 | 130 | 127 | 125 | 123 | 121 | 118 | 116 | 114 | 111 | 109 | 107 | 104 | 102 | 99 | 60 |

(v.) Nat. Versines.

| ′ | 160° | 161° | 162° | 163° | 164° | 165° | 166° | 167° | 168° | 169° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1939693 | 1945519 | 1951057 | 1956305 | 1961262 | 1965926 | 1970296 | 1974370 | 1978148 | 1981627 | 0 |
| 1 | 1939792 | 1945613 | 1951146 | 1956390 | 1961342 | 1966001 | 1970366 | 1974436 | 1978208 | 1981683 | 1 |
| 2 | 39891 | 45706 | 51236 | 56475 | 61422 | 66076 | 70436 | 74501 | 78268 | 81738 | 2 |
| 3 | 39991 | 45802 | 51326 | 56560 | 61502 | 66151 | 70507 | 74566 | 78329 | 81793 | 3 |
| 4 | 1940090 | 1945897 | 1951415 | 1956644 | 1961582 | 1966226 | 1970577 | 1974631 | 1978389 | 1981849 | 4 |
| 5 | 40189 | 45991 | 51505 | 56729 | 61662 | 66301 | 70647 | 74696 | 78449 | 81904 | 5 |
| 6 | 40288 | 46085 | 51594 | 56814 | 61741 | 66376 | 70717 | 74761 | 78509 | 81959 | 6 |
| 7 | 1940387 | 1946180 | 1951684 | 1956898 | 1961821 | 1966451 | 1970786 | 1974826 | 1978569 | 1982014 | 7 |
| 8 | 40486 | 46274 | 51773 | 56983 | 61901 | 66526 | 70856 | 74891 | 78629 | 82069 | 8 |
| 9 | 40585 | 46368 | 51862 | 57067 | 61980 | 66600 | 70926 | 74956 | 78689 | 82123 | 9 |
| 10 | 1940684 | 1946462 | 1951951 | 1957151 | 1962059 | 1966675 | 1970995 | 1975020 | 1978748 | 1982178 | 10 |
| 11 | 40782 | 46556 | 52040 | 57235 | 62139 | 66749 | 71065 | 75085 | 78808 | 82233 | 11 |
| 12 | 40881 | 46649 | 52129 | 57320 | 62218 | 66823 | 71134 | 75149 | 78867 | 82287 | 12 |
| 13 | 1940979 | 1946743 | 1952218 | 1957404 | 1962297 | 1966898 | 1971204 | 1975214 | 1978927 | 1982342 | 13 |
| 14 | 41078 | 46837 | 52307 | 57488 | 62376 | 66972 | 71273 | 75278 | 78986 | 82396 | 14 |
| 15 | 41176 | 46930 | 52396 | 57571 | 62455 | 67046 | 71342 | 75342 | 79046 | 82450 | 15 |
| 16 | 1941274 | 1947024 | 1952484 | 1957655 | 1962534 | 1967120 | 1971411 | 1975407 | 1979105 | 1982506 | 16 |
| 17 | 41372 | 47117 | 52573 | 57739 | 62613 | 67194 | 71480 | 75471 | 79164 | 82559 | 17 |
| 18 | 41471 | 47210 | 52662 | 57823 | 62692 | 67268 | 71549 | 75535 | 79223 | 82613 | 18 |
| 19 | 1941569 | 1947304 | 1952750 | 1957906 | 1962770 | 1967342 | 1971618 | 1975599 | 1979282 | 1982667 | 19 |
| 20 | 41667 | 47397 | 52838 | 57990 | 62849 | 67415 | 71687 | 75662 | 79341 | 82721 | 20 |
| 21 | 41764 | 47490 | 52926 | 58073 | 62928 | 67489 | 71755 | 75726 | 79399 | 82774 | 21 |
| 22 | 1941862 | 1947583 | 1953015 | 1958156 | 1963006 | 1967562 | 1971824 | 1975790 | 1979458 | 1982828 | 22 |
| 23 | 41960 | 47676 | 53103 | 58239 | 63084 | 67636 | 71893 | 75853 | 79517 | 82882 | 23 |
| 24 | 42058 | 47768 | 53191 | 58323 | 63163 | 67709 | 71961 | 75917 | 79575 | 82935 | 24 |
| 25 | 1942155 | 1947861 | 1953279 | 1958406 | 1963241 | 1967783 | 1972029 | 1975980 | 1979634 | 1982989 | 25 |
| 26 | 42253 | 47954 | 53366 | 58489 | 63319 | 67856 | 72098 | 76044 | 79692 | 83042 | 26 |
| 27 | 42350 | 48046 | 53454 | 58572 | 63397 | 67929 | 72166 | 76107 | 79750 | 83096 | 27 |
| 28 | 1942447 | 1948139 | 1953542 | 1958654 | 1963475 | 1968002 | 1972234 | 1976170 | 1979809 | 1983149 | 28 |
| 29 | 42544 | 48231 | 53629 | 58737 | 63553 | 68075 | 72302 | 76233 | 79867 | 83202 | 29 |
| 30 | 42642 | 48324 | 53717 | 58820 | 63631 | 68148 | 72370 | 76296 | 79925 | 83255 | 30 |
| 31 | 1942739 | 1948416 | 1953804 | 1958902 | 1963708 | 1968220 | 1972438 | 1976359 | 1979983 | 1983308 | 31 |
| 32 | 42836 | 48508 | 53892 | 58985 | 63786 | 68293 | 72506 | 76422 | 80041 | 83361 | 32 |
| 33 | 42932 | 48600 | 53979 | 59067 | 63863 | 68366 | 72573 | 76485 | 80098 | 83414 | 33 |
| 34 | 1943029 | 1948692 | 1954066 | 1959150 | 1963941 | 1968438 | 1972641 | 1976547 | 1980156 | 1983466 | 34 |
| 35 | 43126 | 48784 | 54153 | 59232 | 64018 | 68511 | 72708 | 76610 | 80214 | 83519 | 35 |
| 36 | 43223 | 48876 | 54240 | 59314 | 64095 | 68583 | 72776 | 76672 | 80271 | 83572 | 36 |
| 37 | 1943319 | 1948968 | 1954327 | 1959396 | 1964173 | 1968656 | 1972843 | 1976735 | 1980329 | 1983624 | 37 |
| 38 | 43416 | 49060 | 54414 | 59478 | 64250 | 68728 | 72911 | 76797 | 80386 | 83676 | 38 |
| 39 | 43512 | 49151 | 54501 | 59560 | 64327 | 68800 | 72978 | 76859 | 80443 | 83729 | 39 |
| 40 | 1943609 | 1949243 | 1954588 | 1959642 | 1964404 | 1968872 | 1973045 | 1976922 | 1980501 | 1983781 | 40 |
| 41 | 43705 | 49334 | 54674 | 59724 | 64481 | 68944 | 73112 | 76984 | 80558 | 83833 | 41 |
| 42 | 43801 | 49426 | 54761 | 59805 | 64557 | 69016 | 73179 | 77046 | 80615 | 83885 | 42 |
| 43 | 1943897 | 1949517 | 1954847 | 1959887 | 1964634 | 1969088 | 1973246 | 1977108 | 1980672 | 1983937 | 43 |
| 44 | 43993 | 49608 | 54934 | 59968 | 64711 | 69159 | 73313 | 77169 | 80729 | 83989 | 44 |
| 45 | 44089 | 49699 | 55020 | 60050 | 64787 | 69231 | 73379 | 77231 | 80785 | 84041 | 45 |
| 46 | 1944185 | 1949790 | 1955106 | 1960131 | 1964864 | 1969302 | 1973446 | 1977293 | 1980842 | 1984092 | 46 |
| 47 | 44281 | 49881 | 55192 | 60213 | 64940 | 69374 | 73512 | 77364 | 80899 | 84144 | 47 |
| 48 | 44376 | 49972 | 55278 | 60294 | 65016 | 69445 | 73579 | 77416 | 80955 | 84196 | 48 |
| 49 | 1944472 | 1950063 | 1955364 | 1960375 | 1965093 | 1969517 | 1973645 | 1977477 | 1981012 | 1984247 | 49 |
| 50 | 44568 | 50154 | 55450 | 60456 | 65169 | 69588 | 73712 | 77539 | 81068 | 84299 | 50 |
| 51 | 44663 | 50244 | 55536 | 60537 | 65245 | 69659 | 73778 | 77600 | 81124 | 84350 | 51 |
| 52 | 1944758 | 1950335 | 1955622 | 1960618 | 1965321 | 1969730 | 1973844 | 1977661 | 1981181 | 1984401 | 52 |
| 53 | 44854 | 50425 | 55707 | 60698 | 65397 | 69801 | 73910 | 77722 | 81237 | 84452 | 53 |
| 54 | 44949 | 50516 | 55793 | 60779 | 65473 | 69872 | 73976 | 77783 | 81293 | 84503 | 54 |
| 55 | 1945044 | 1950606 | 1955879 | 1960860 | 1965548 | 1969943 | 1974042 | 1977844 | 1981349 | 1984554 | 55 |
| 56 | 45139 | 50696 | 55964 | 60940 | 65624 | 70014 | 74108 | 77905 | 81405 | 84605 | 56 |
| 57 | 45234 | 50787 | 56049 | 61021 | 65700 | 70084 | 74173 | 77966 | 81460 | 84656 | 57 |
| 58 | 1945329 | .950877 | 1956135 | 1961101 | 1965775 | 1970155 | 1974239 | 1978026 | 1981516 | 1984707 | 58 |
| 59 | 45424 | 50967 | 56220 | 61182 | 65850 | 70225 | 74305 | 78087 | 81572 | 84757 | 59 |
| 60 | 45519 | · 51057 | 56305 | 61262 | 65926 | 70296 | 74370 | 78148 | 81627 | 84808 | 60 |

Parts for Seconds. (v.)

| " | 160° | | 161° | | 162° | | 163° | | 164° | | 165° | | 166° | | 167° | | 168° | | 169° | | 170° | " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | |
| 1 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 3 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 4 | 7 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 4 |
| 5 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 | 5 | 4 | 4 | 5 |
| 6 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 5 | 5 | 6 |
| 7 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 7 |
| 8 | 13 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | 7 | 7 | 8 |
| 9 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 11 | 11 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 9 |
| 10 | 17 | 16 | 16 | 15 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 9 | 9 | 8 | 10 |
| 11 | 18 | 18 | 17 | 17 | 16 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 11 |
| 12 | 20 | 19 | 19 | 18 | 18 | 17 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 10 | 12 |
| 13 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 18 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 11 | 11 | 13 |
| 14 | 23 | 23 | 22 | 22 | 21 | 20 | 20 | 19 | 19 | 18 | 18 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 12 | 12 | 14 |
| 15 | 25 | 24 | 24 | 23 | 22 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 18 | 17 | 16 | 16 | 15 | 15 | 14 | 13 | 13 | 15 |
| 16 | 27 | 26 | 25 | 25 | 24 | 23 | 23 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 15 | 15 | 14 | 13 | 16 |
| 17 | 28 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 23 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 17 | 16 | 16 | 15 | 14 | 17 |
| 18 | 30 | 29 | 28 | 28 | 27 | 26 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 20 | 19 | 18 | 17 | 17 | 16 | 15 | 18 |
| 19 | 32 | 31 | 30 | 29 | 28 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 22 | 22 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 19 |
| 20 | 33 | 32 | 32 | 31 | 30 | 29 | 28 | 28 | 27 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 19 | 19 | 18 | 17 | 20 |
| 21 | 35 | 34 | 33 | 32 | 31 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 19 | 18 | 21 |
| 22 | 36 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 19 | 22 |
| 23 | 38 | 37 | 36 | 35 | 34 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 23 |
| 24 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 24 |
| 25 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 25 |
| 26 | 43 | 42 | 41 | 40 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 26 |
| 27 | 45 | 44 | 43 | 42 | 41 | 39 | 38 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 27 |
| 28 | 46 | 45 | 44 | 43 | 42 | 41 | 40 | 39 | 37 | 36 | 35 | 34 | 33 | 32 | 31 | 29 | 28 | 27 | 26 | 25 | 24 | 28 |
| 29 | 48 | 47 | 46 | 45 | 43 | 42 | 41 | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 32 | 30 | 29 | 28 | 27 | 26 | 24 | 29 |
| 30 | 50 | 49 | 47 | 46 | 45 | 44 | 43 | 41 | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 28 | 27 | 25 | 30 |
| 31 | 51 | 50 | 49 | 48 | 46 | 45 | 44 | 43 | 41 | 40 | 39 | 38 | 36 | 35 | 34 | 33 | 31 | 30 | 29 | 27 | 26 | 31 |
| 32 | 53 | 52 | 51 | 49 | 48 | 47 | 45 | 44 | 43 | 41 | 40 | 39 | 38 | 36 | 35 | 34 | 32 | 31 | 30 | 28 | 27 | 32 |
| 33 | 55 | 53 | 52 | 51 | 49 | 48 | 47 | 45 | 44 | 43 | 41 | 40 | 39 | 37 | 36 | 35 | 33 | 32 | 31 | 29 | 28 | 33 |
| 34 | 56 | 55 | 54 | 52 | 51 | 50 | 48 | 47 | 45 | 44 | 43 | 41 | 40 | 38 | 37 | 36 | 34 | 33 | 31 | 30 | 29 | 34 |
| 35 | 58 | 57 | 55 | 54 | 52 | 51 | 50 | 48 | 47 | 45 | 44 | 42 | 41 | 40 | 38 | 37 | 35 | 34 | 32 | 31 | 29 | 35 |
| 36 | 60 | 58 | 57 | 55 | 54 | 52 | 51 | 50 | 48 | 47 | 45 | 44 | 42 | 41 | 39 | 38 | 36 | 35 | 33 | 32 | 30 | 36 |
| 37 | 61 | 60 | 58 | 57 | 55 | 54 | 52 | 51 | 49 | 48 | 46 | 45 | 43 | 42 | 40 | 39 | 37 | 36 | 34 | 33 | 31 | 37 |
| 38 | 63 | 61 | 60 | 58 | 57 | 55 | 54 | 52 | 51 | 49 | 48 | 46 | 45 | 43 | 41 | 40 | 38 | 37 | 35 | 34 | 32 | 38 |
| 39 | 65 | 63 | 62 | 60 | 58 | 57 | 55 | 54 | 52 | 50 | 49 | 47 | 46 | 44 | 43 | 41 | 39 | 38 | 36 | 34 | 33 | 39 |
| 40 | 66 | 65 | 63 | 62 | 60 | 58 | 57 | 55 | 53 | 52 | 50 | 49 | 47 | 45 | 44 | 42 | 40 | 39 | 37 | 35 | 34 | 40 |
| 41 | 68 | 66 | 65 | 63 | 61 | 60 | 58 | 56 | 55 | 53 | 51 | 50 | 48 | 46 | 45 | 43 | 41 | 40 | 38 | 36 | 35 | 41 |
| 42 | 70 | 68 | 66 | 65 | 63 | 61 | 60 | 58 | 56 | 54 | 53 | 51 | 49 | 48 | 46 | 44 | 42 | 41 | 39 | 37 | 35 | 42 |
| 43 | 71 | 70 | 68 | 66 | 65 | 63 | 61 | 59 | 57 | 56 | 54 | 52 | 50 | 49 | 47 | 45 | 43 | 42 | 40 | 38 | 36 | 43 |
| 44 | 73 | 71 | 69 | 68 | 66 | 64 | 62 | 61 | 59 | 57 | 55 | 53 | 52 | 50 | 48 | 46 | 44 | 43 | 41 | 39 | 37 | 44 |
| 45 | 75 | 73 | 71 | 69 | 67 | 66 | 64 | 62 | 60 | 58 | 56 | 55 | 53 | 51 | 49 | 47 | 45 | 44 | 42 | 40 | 38 | 45 |
| 46 | 76 | 74 | 73 | 71 | 69 | 67 | 65 | 63 | 61 | 60 | 58 | 56 | 54 | 52 | 50 | 48 | 46 | 44 | 43 | 41 | 39 | 46 |
| 47 | 78 | 76 | 74 | 72 | 70 | 69 | 67 | 65 | 63 | 61 | 59 | 57 | 55 | 53 | 51 | 49 | 47 | 45 | 43 | 42 | 40 | 47 |
| 48 | 80 | 78 | 76 | 74 | 72 | 70 | 68 | 66 | 64 | 62 | 60 | 58 | 56 | 54 | 52 | 50 | 48 | 46 | 44 | 42 | 40 | 48 |
| 49 | 81 | 79 | 77 | 75 | 73 | 71 | 69 | 68 | 65 | 63 | 61 | 59 | 57 | 55 | 53 | 51 | 49 | 47 | 45 | 43 | 41 | 49 |
| 50 | 83 | 80 | 79 | 77 | 75 | 73 | 71 | 69 | 67 | 65 | 63 | 61 | 59 | 57 | 55 | 52 | 50 | 48 | 46 | 44 | 42 | 50 |
| 51 | 85 | 83 | 80 | 78 | 76 | 74 | 72 | 70 | 68 | 66 | 64 | 62 | 60 | 58 | 56 | 54 | 51 | 49 | 46 | 45 | 43 | 51 |
| 52 | 86 | 84 | 82 | 80 | 78 | 76 | 74 | 72 | 69 | 67 | 65 | 63 | 61 | 59 | 57 | 55 | 52 | 50 | 48 | 46 | 44 | 52 |
| 53 | 88 | 86 | 84 | 82 | 79 | 77 | 75 | 73 | 71 | 69 | 67 | 64 | 62 | 60 | 58 | 56 | 53 | 51 | 48 | 47 | 45 | 53 |
| 54 | 90 | 87 | 85 | 83 | 80 | 79 | 77 | 74 | 72 | 70 | 68 | 66 | 63 | 61 | 59 | 57 | 54 | 52 | 50 | 48 | 45 | 54 |
| 55 | 91 | 89 | 87 | 85 | 82 | 80 | 78 | 76 | 73 | 71 | 69 | 67 | 65 | 62 | 60 | 58 | 55 | 53 | 51 | 49 | 46 | 55 |
| 56 | 93 | 91 | 88 | 86 | 84 | 82 | 79 | 77 | 74 | 72 | 70 | 68 | 66 | 63 | 61 | 59 | 56 | 54 | 51 | 49 | 47 | 56 |
| 57 | 95 | 92 | 90 | 88 | 85 | 83 | 81 | 78 | 76 | 74 | 72 | 69 | 67 | 65 | 62 | 60 | 57 | 55 | 52 | 50 | 48 | 57 |
| 58 | 96 | 94 | 92 | 89 | 87 | 85 | 82 | 80 | 77 | 75 | 73 | 70 | 68 | 66 | 63 | 61 | 58 | 56 | 53 | 51 | 49 | 58 |
| 59 | 98 | 95 | 93 | 91 | 88 | 86 | 84 | 81 | 79 | 76 | 74 | 72 | 69 | 67 | 64 | 62 | 59 | 57 | 54 | 52 | 50 | 59 |
| 60 | 99 | 97 | 95 | 92 | 90 | 87 | 85 | 83 | 80 | 78 | 75 | 73 | 70 | 68 | 65 | 63 | 60 | 58 | 55 | 53 | 50 | 60 |

(v.) Nat. Versines.

| ′ | 170° | 171° | 172° | 173° | 174° | 175° | 176° | 177° | 178° | 179° | ′ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 1984808 | 1987688 | 1990268 | 1992546 | 1994522 | 1996195 | 1997564 | 1998630 | 1999391 | 1999848 | 0 |
| 1 | 1984858 | 1987734 | 1990309 | 1992582 | 1994552 | 1996220 | 1997584 | 1998645 | 1999401 | 1999853 | 1 |
| 2 | 84909 | 87779 | 90349 | 92617 | 94583 | 96245 | 97605 | 98660 | 99411 | 99858 | 2 |
| 3 | 84959 | 87825 | 90389 | 92652 | 94613 | 96270 | 97625 | 98675 | 99421 | 99863 | 3 |
| 4 | 1985009 | 1987870 | 1990429 | 1992687 | 1994643 | 1996295 | 1997645 | 1998690 | 1999431 | 1999867 | 4 |
| 5 | 85059 | 87915 | 90469 | 92722 | 94673 | 96320 | 97665 | 98705 | 99441 | 99872 | 5 |
| 6 | 85109 | 87960 | 90510 | 92757 | 94703 | 96345 | 97684 | 98719 | 99450 | 99877 | 6 |
| 7 | 1985159 | 1988005 | 1990549 | 1992792 | 1994733 | 1996370 | 1997704 | 1998734 | 1999460 | 1999881 | 7 |
| 8 | 85209 | 88050 | 90589 | 92827 | 94763 | 96395 | 97724 | 98749 | 99469 | 99886 | 8 |
| 9 | 85259 | 88095 | 90629 | 92862 | 94792 | 96420 | 97743 | 98763 | 99479 | 99890 | 9 |
| 10 | 1985309 | 1988139 | 1990669 | 1992896 | 1994822 | 1996444 | 1997763 | 1998778 | 1999488 | 1999894 | 10 |
| 11 | 85358 | 88184 | 90708 | 92931 | 94851 | 96469 | 97782 | 98792 | 99497 | 99898 | 11 |
| 12 | 85408 | 88228 | 90748 | 92966 | 94881 | 96493 | 97802 | 98806 | 99507 | 99903 | 12 |
| 13 | 1985457 | 1988273 | 1990787 | 1993000 | 1994910 | 1996517 | 1997821 | 1998820 | 1999516 | 1999907 | 13 |
| 14 | 85507 | 88317 | 90827 | 93034 | 94939 | 96541 | 97840 | 98834 | 99525 | 99911 | 14 |
| 15 | 85556 | 88362 | 90866 | 93069 | 94969 | 96566 | 97859 | 98848 | 99534 | 99914 | 15 |
| 16 | 1985605 | 1988406 | 1990905 | 1993103 | 1994998 | 1996590 | 1997878 | 1998862 | 1999542 | 1999918 | 16 |
| 17 | 85654 | 88450 | 90944 | 93137 | 95027 | 96614 | 97897 | 98876 | 99551 | 99922 | 17 |
| 18 | 85704 | 88494 | 90983 | 93171 | 95056 | 96637 | 97916 | 98890 | 99560 | 99925 | 18 |
| 19 | 1985752 | 1988538 | 1991022 | 1993205 | 1995084 | 1996661 | 1997934 | 1998904 | 1999568 | 1999929 | 19 |
| 20 | 85801 | 88582 | 91061 | 93238 | 95113 | 96685 | 97953 | 98917 | 99577 | 99932 | 20 |
| 21 | 85850 | 88626 | 91100 | 93272 | 95142 | 96709 | 97972 | 98931 | 99585 | 99936 | 21 |
| 22 | 1985899 | 1988669 | 1991138 | 1993306 | 1995171 | 1996732 | 1997990 | 1998944 | 1999594 | 1999939 | 22 |
| 23 | 85948 | 88713 | 91177 | 93339 | 95199 | 96756 | 98008 | 98957 | 99602 | 99942 | 23 |
| 24 | 85996 | 88756 | 91216 | 93373 | 95227 | 96779 | 98027 | 98971 | 99610 | 99945 | 24 |
| 25 | 1986045 | 1988800 | 1991254 | 1993406 | 1995256 | 1996802 | 1998045 | 1998984 | 1999618 | 1999948 | 25 |
| 26 | 86093 | 88843 | 91292 | 93440 | 95284 | 96825 | 98063 | 98997 | 99626 | 99951 | 26 |
| 27 | 86141 | 88887 | 91331 | 93473 | 95312 | 96849 | 98081 | 99010 | 99634 | 99954 | 27 |
| 28 | 1986189 | 1988930 | 1991369 | 1993506 | 1995340 | 1996872 | 1998099 | 1999023 | 1999642 | 1999957 | 28 |
| 29 | 86238 | 88973 | 91407 | 93539 | 95368 | 96895 | 98117 | 99036 | 99650 | 99959 | 29 |
| 30 | 86286 | 89016 | 91445 | 93572 | 95396 | 96917 | 98135 | 99048 | 99657 | 99962 | 30 |
| 31 | 1986334 | 1989059 | 1991483 | 1993605 | 1995424 | 1996940 | 1998153 | 1999061 | 1999665 | 1999964 | 31 |
| 32 | 86382 | 89102 | 91521 | 93638 | 95452 | 96963 | 98170 | 99073 | 99672 | 99967 | 32 |
| 33 | 86429 | 89145 | 91558 | 93670 | 95480 | 96985 | 98188 | 99086 | 99680 | 99969 | 33 |
| 34 | 1986477 | 1989187 | 1991596 | 1993703 | 1995507 | 1997008 | 1998205 | 1999098 | 1999687 | 1999971 | 34 |
| 35 | 86525 | 89230 | 91634 | 93736 | 95535 | 97030 | 98223 | 99111 | 99694 | 99974 | 35 |
| 36 | 86572 | 89272 | 91671 | 93768 | 95562 | 97053 | 98240 | 99123 | 99702 | 99976 | 36 |
| 37 | 1986620 | 1989315 | 1991709 | 1993800 | 1995589 | 1997075 | 1998257 | 1999135 | 1999709 | 1999978 | 37 |
| 38 | 86667 | 89357 | 91746 | 93833 | 95617 | 97097 | 98274 | 99147 | 99716 | 99980 | 38 |
| 39 | 86714 | 89399 | 91783 | 93865 | 95644 | 97119 | 98291 | 99159 | 99722 | 99981 | 39 |
| 40 | 1986762 | 1989442 | 1991820 | 1993897 | 1995671 | 1997141 | 1998308 | 1999171 | 1999729 | 1999983 | 40 |
| 41 | 86809 | 89484 | 91857 | 93929 | 95698 | 97163 | 98325 | 99183 | 99736 | 99985 | 41 |
| 42 | 86856 | 89526 | 91894 | 93961 | 95725 | 97185 | 98342 | 99194 | 99743 | 99986 | 42 |
| 43 | 1986903 | 1989568 | 1991931 | 1993993 | 1995752 | 1997207 | 1998359 | 1999206 | 1999749 | 1999988 | 43 |
| 44 | 86950 | 89610 | 91968 | 94025 | 95778 | 97229 | 98375 | 99218 | 99756 | 99989 | 44 |
| 45 | 86996 | 89651 | 92005 | 94056 | 95805 | 97250 | 98392 | 99229 | 99762 | 99991 | 45 |
| 46 | 1987043 | 1989693 | 1992042 | 1994088 | 1995832 | 1997272 | 1998408 | 1999240 | 1999768 | 1999992 | 46 |
| 47 | 87090 | 89735 | 92078 | 94120 | 95858 | 97293 | 98425 | 99252 | 99775 | 99993 | 47 |
| 48 | 87136 | 89776 | 92115 | 94151 | 95884 | 97315 | 98441 | 99263 | 99781 | 99994 | 48 |
| 49 | 1987183 | 1989818 | 1992151 | 1994182 | 1995911 | 1997336 | 1998457 | 1999274 | 1999787 | 1999995 | 49 |
| 50 | 87229 | 89859 | 92187 | 94214 | 95937 | 97357 | 98473 | 99285 | 99793 | 99996 | 50 |
| 51 | 87275 | 89900 | 92224 | 94245 | 95963 | 97378 | 98489 | 99296 | 99799 | 99997 | 51 |
| 52 | 1987322 | 1989942 | 1992260 | 1994276 | 1995989 | 1997399 | 1998505 | 1999307 | 1999804 | 1999997 | 52 |
| 53 | 87368 | 89983 | 92296 | 94307 | 96015 | 97420 | 98521 | 99318 | 99810 | 99998 | 53 |
| 54 | 87414 | 90024 | 92332 | 94338 | 96041 | 97441 | 98537 | 99328 | 99816 | 99999 | 54 |
| 55 | 1987460 | 1990065 | 1992368 | 1994369 | 1996067 | 1997462 | 1998552 | 1999339 | 1999821 | 1999999 | 55 |
| 56 | 87506 | 90106 | 92404 | 94400 | 96093 | 97482 | 98568 | 99350 | 99827 | 99999 | 56 |
| 57 | 87551 | 90146 | 92439 | 94430 | 96118 | 97503 | 98584 | 99360 | 99832 | 2000000 | 57 |
| 58 | 1987597 | 1990187 | 1992475 | 1994461 | 1996144 | 1997523 | 1998599 | 1999370 | 1999837 | 2000000 | 58 |
| 59 | 87643 | 90228 | 92511 | 94491 | 96169 | 97544 | 98614 | 99381 | 99843 | 00000 | 59 |
| 60 | 87688 | 90268 | 92546 | 94522 | 96195 | 97564 | 98630 | 99391 | 99848 | 00000 | 60 |

## Parts for Seconds. (").

| " | 170° | | 171° | | 172° | | 173° | | 174° | | 175° | | 176° | | 177° | | 178° | | 179° | | 180° | " |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | 30′ | 0′ | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| 4 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 4 |
| 5 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 5 |
| 6 | 5 | 5 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 6 |
| 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 7 |
| 8 | 7 | 6 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 8 |
| 9 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 9 |
| 10 | 8 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 10 |
| 11 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 11 |
| 12 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 2 | 1 | 1 | 0 | 0 | 12 |
| 13 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 6 | 5 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 0 | 0 | 13 |
| 14 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 2 | 1 | 0 | 0 | 14 |
| 15 | 13 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 2 | 2 | 1 | 1 | 0 | 15 |
| 16 | 13 | 13 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 1 | 1 | 0 | 16 |
| 17 | 14 | 14 | 13 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 2 | 1 | 1 | 0 | 17 |
| 18 | 15 | 14 | 14 | 13 | 12 | 11 | 11 | 10 | 9 | 8 | 8 | 7 | 6 | 5 | 5 | 4 | 3 | 2 | 1 | 1 | 0 | 18 |
| 19 | 16 | 15 | 14 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 6 | 6 | 5 | 4 | 3 | 2 | 2 | 1 | 0 | 19 |
| 20 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 11 | 10 | 9 | 8 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 2 | 1 | 0 | 20 |
| 21 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 3 | 2 | 1 | 0 | 21 |
| 22 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 22 |
| 23 | 19 | 18 | 17 | 16 | 15 | 14 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 23 |
| 24 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 24 |
| 25 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | 25 |
| 26 | 22 | 21 | 20 | 19 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 5 | 4 | 3 | 2 | 1 | 0 | 26 |
| 27 | 23 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 3 | 2 | 1 | 0 | 27 |
| 28 | 24 | 22 | 21 | 20 | 19 | 18 | 16 | 15 | 14 | 13 | 12 | 11 | 9 | 8 | 7 | 6 | 5 | 3 | 2 | 1 | 0 | 28 |
| 29 | 24 | 23 | 22 | 21 | 19 | 18 | 17 | 16 | 15 | 13 | 12 | 11 | 10 | 9 | 7 | 6 | 5 | 4 | 2 | 1 | 0 | 29 |
| 30 | 25 | 24 | 23 | 21 | 20 | 19 | 18 | 16 | 15 | 14 | 13 | 11 | 10 | 9 | 8 | 6 | 5 | 4 | 2 | 1 | 0 | 30 |
| 31 | 26 | 25 | 23 | 22 | 21 | 20 | 18 | 17 | 16 | 14 | 13 | 12 | 10 | 9 | 8 | 7 | 5 | 4 | 3 | 1 | 0 | 31 |
| 32 | 27 | 26 | 24 | 23 | 22 | 20 | 19 | 17 | 16 | 15 | 13 | 12 | 11 | 9 | 8 | 7 | 5 | 4 | 3 | 1 | 0 | 32 |
| 33 | 28 | 26 | 25 | 24 | 22 | 21 | 19 | 18 | 17 | 15 | 14 | 12 | 11 | 10 | 8 | 7 | 6 | 4 | 3 | 1 | 0 | 33 |
| 34 | 29 | 27 | 26 | 24 | 23 | 21 | 20 | 19 | 17 | 16 | 14 | 13 | 11 | 10 | 9 | 7 | 6 | 4 | 3 | 1 | 0 | 34 |
| 35 | 29 | 28 | 26 | 25 | 24 | 22 | 21 | 19 | 18 | 16 | 15 | 13 | 12 | 10 | 9 | 7 | 6 | 4 | 3 | 1 | 0 | 35 |
| 36 | 30 | 29 | 27 | 26 | 24 | 23 | 21 | 20 | 18 | 17 | 15 | 14 | 12 | 11 | 9 | 8 | 6 | 5 | 3 | 1 | 0 | 36 |
| 37 | 31 | 30 | 28 | 26 | 25 | 23 | 22 | 20 | 19 | 17 | 16 | 14 | 12 | 11 | 9 | 8 | 6 | 5 | 3 | 1 | 0 | 37 |
| 38 | 32 | 30 | 29 | 27 | 26 | 24 | 22 | 21 | 19 | 18 | 16 | 14 | 13 | 11 | 10 | 8 | 6 | 5 | 3 | 2 | 0 | 38 |
| 39 | 33 | 31 | 30 | 28 | 26 | 25 | 23 | 21 | 20 | 18 | 16 | 15 | 13 | 11 | 10 | 8 | 7 | 5 | 3 | 2 | 0 | 39 |
| 40 | 34 | 32 | 30 | 29 | 27 | 25 | 24 | 22 | 20 | 18 | 17 | 15 | 13 | 12 | 10 | 8 | 7 | 5 | 3 | 2 | 0 | 40 |
| 41 | 35 | 33 | 31 | 29 | 28 | 26 | 24 | 22 | 21 | 19 | 17 | 16 | 14 | 12 | 10 | 9 | 7 | 5 | 3 | 2 | 0 | 41 |
| 42 | 35 | 34 | 32 | 30 | 28 | 27 | 25 | 23 | 21 | 19 | 18 | 16 | 14 | 12 | 11 | 9 | 7 | 5 | 3 | 2 | 0 | 42 |
| 43 | 36 | 34 | 33 | 31 | 29 | 27 | 25 | 24 | 22 | 20 | 18 | 16 | 14 | 13 | 11 | 9 | 7 | 5 | 4 | 2 | 0 | 43 |
| 44 | 37 | 35 | 33 | 31 | 30 | 28 | 26 | 24 | 22 | 20 | 19 | 17 | 15 | 13 | 11 | 9 | 7 | 6 | 4 | 2 | 0 | 44 |
| 45 | 38 | 36 | 34 | 32 | 30 | 28 | 27 | 25 | 23 | 21 | 19 | 17 | 15 | 13 | 11 | 9 | 8 | 6 | 4 | 2 | 0 | 45 |
| 46 | 39 | 37 | 35 | 33 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 17 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 46 |
| 47 | 40 | 38 | 36 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 20 | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 47 |
| 48 | 40 | 38 | 36 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 20 | 18 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 48 |
| 49 | 41 | 39 | 37 | 35 | 33 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 16 | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 0 | 49 |
| 50 | 42 | 40 | 38 | 36 | 34 | 32 | 29 | 27 | 25 | 23 | 21 | 19 | 17 | 15 | 13 | 10 | 8 | 6 | 4 | 2 | 0 | 50 |
| 51 | 43 | 41 | 39 | 36 | 34 | 32 | 30 | 28 | 26 | 24 | 21 | 19 | 17 | 15 | 13 | 11 | 9 | 6 | 4 | 2 | 0 | 51 |
| 52 | 44 | 42 | 39 | 37 | 35 | 33 | 31 | 28 | 26 | 24 | 22 | 20 | 18 | 15 | 13 | 11 | 9 | 7 | 4 | 2 | 0 | 52 |
| 53 | 45 | 42 | 40 | 38 | 36 | 33 | 31 | 29 | 27 | 25 | 22 | 20 | 18 | 16 | 13 | 11 | 9 | 7 | 4 | 2 | 0 | 53 |
| 54 | 45 | 43 | 41 | 39 | 36 | 34 | 32 | 30 | 27 | 25 | 23 | 20 | 18 | 16 | 14 | 11 | 9 | 7 | 4 | 2 | 0 | 54 |
| 55 | 46 | 44 | 42 | 39 | 37 | 35 | 32 | 30 | 28 | 25 | 23 | 21 | 19 | 16 | 14 | 12 | 9 | 7 | 5 | 2 | 0 | 55 |
| 56 | 47 | 45 | 42 | 40 | 38 | 35 | 33 | 31 | 28 | 26 | 24 | 21 | 19 | 17 | 14 | 12 | 9 | 7 | 5 | 2 | 0 | 56 |
| 57 | 48 | 46 | 43 | 41 | 38 | 36 | 34 | 31 | 29 | 26 | 24 | 22 | 19 | 17 | 14 | 12 | 10 | 7 | 5 | 2 | 0 | 57 |
| 58 | 49 | 46 | 44 | 42 | 39 | 37 | 34 | 32 | 29 | 27 | 24 | 22 | 20 | 17 | 15 | 12 | 10 | 7 | 5 | 2 | 0 | 58 |
| 59 | 50 | 47 | 45 | 42 | 40 | 37 | 35 | 32 | 30 | 27 | 25 | 22 | 20 | 17 | 15 | 12 | 10 | 7 | 5 | 2 | 0 | 59 |
| 60 | 50 | 48 | 45 | 43 | 40 | 38 | 35 | 33 | 30 | 28 | 25 | 23 | 20 | 18 | 15 | 13 | 10 | 8 | 5 | 2 | 0 | 60 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (4° and 5°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | Seconds of H P. | Corr | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | | | |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | ″ | ′ |
| 0′ | 42 1 | 1 17 | 43 1 | 1 20 | 44 1 | 1 23 | 45 0 | 1 26 | 46 0 | 1 29 | 47 0 | 1 32 | 48 0 | 1 34 | 49 0 | 1 37 | 1 | 1 | 0 |
| 2 | 42 5 | 1 18 | 43 5 | 1 21 | 44 5 | 1 24 | 45 4 | 1 27 | 46 4 | 1 30 | 47 4 | 1 33 | 48 4 | 1 36 | 49 4 | 1 38 | 2 | 2 | 0 |
| 4 | 42 9 | 1 19 | 43 9 | 1 22 | 44 9 | 1 25 | 45 9 | 1 28 | 46 8 | 1 31 | 47 8 | 1 34 | 48 8 | 1 37 | 49 8 | 1 40 | 3 | 3 | 0 |
| 6 | 42 13 | 1 20 | 43 13 | 1 23 | 44 13 | 1 26 | 45 13 | 1 29 | 46 12 | 1 32 | 47 12 | 1 35 | 48 12 | 1 38 | 49 12 | 1 41 | 4 | 4 | 0 |
| 8 | 42 17 | 1 21 | 43 17 | 1 24 | 44 17 | 1 27 | 45 17 | 1 30 | 46 17 | 1 33 | 47 16 | 1 36 | 48 16 | 1 39 | 49 16 | 1 42 | 5 | 5 | 0 |
| 10 | 42 21 | 1 22 | 43 21 | 1 25 | 44 21 | 1 28 | 45 21 | 1 31 | 46 21 | 1 34 | 47 20 | 1 37 | 48 20 | 1 40 | 49 20 | 1 43 | 6 | 6 | 0 |
| 12 | 42 25 | 1 23 | 43 25 | 1 27 | 44 25 | 1 29 | 45 25 | 1 32 | 46 25 | 1 35 | 47 24 | 1 38 | 48 24 | 1 41 | 49 24 | 1 44 | 7 | 7 | 0 |
| 14 | 42 29 | 1 25 | 43 29 | 1 28 | 44 29 | 1 31 | 45 29 | 1 34 | 46 29 | 1 37 | 47 29 | 1 40 | 48 28 | 1 43 | 49 28 | 1 46 | 8 | 8 | 0 |
| 16 | 42 33 | 1 26 | 43 33 | 1 29 | 44 33 | 1 32 | 45 33 | 1 35 | 46 33 | 1 38 | 47 33 | 1 41 | 48 32 | 1 44 | 49 32 | 1 47 | 9 | 9 | 1 |
| 18 | 42 37 | 1 27 | 43 37 | 1 30 | 44 37 | 1 33 | 45 37 | 1 36 | 46 37 | 1 39 | 47 37 | 1 42 | 48 37 | 1 45 | 49 36 | 1 48 | 10 | 10 | 1 |
| 20 | 42 41 | 1 28 | 43 41 | 1 31 | 44 41 | 1 34 | 45 41 | 1 37 | 46 41 | 1 40 | 47 41 | 1 43 | 48 41 | 1 46 | 49 40 | 1 49 | 11 | 11 | 1 |
| 22 | 42 45 | 1 29 | 43 45 | 1 32 | 44 45 | 1 35 | 45 45 | 1 38 | 46 45 | 1 41 | 47 44 | 1 44 | 48 44 | 1 47 | 49 44 | 1 51 | 12 | 12 | 1 |
| 24 | 42 49 | 1 30 | 43 49 | 1 33 | 44 48 | 1 36 | 45 48 | 1 39 | 46 48 | 1 42 | 47 48 | 1 45 | 48 48 | 1 49 | 49 48 | 1 52 | 13 | 13 | 1 |
| 26 | 42 52 | 1 31 | 43 52 | 1 34 | 44 52 | 1 37 | 45 52 | 1 40 | 46 52 | 1 43 | 47 52 | 1 47 | 48 52 | 1 50 | 49 51 | 1 53 | 14 | 14 | 1 |
| 28 | 42 56 | 1 32 | 43 56 | 1 35 | 44 56 | 1 38 | 45 56 | 1 41 | 46 55 | 1 45 | 47 55 | 1 48 | 48 55 | 1 51 | 49 55 | 1 54 | 15 | 15 | 1 |
| 30 | 43 0 | 1 33 | 44 0 | 1 36 | 44 59 | 1 39 | 45 59 | 1 43 | 46 59 | 1 46 | 47 59 | 1 49 | 48 59 | 1 52 | 49 59 | 1 55 | 16 | 16 | 1 |
| 32 | 43 3 | 1 34 | 44 3 | 1 37 | 45 3 | 1 41 | 46 3 | 1 44 | 47 3 | 1 47 | 48 3 | 1 50 | 49 2 | 1 53 | 50 2 | 1 57 | 17 | 17 | 1 |
| 34 | 43 7 | 1 35 | 44 7 | 1 38 | 45 7 | 1 42 | 46 7 | 1 45 | 47 6 | 1 48 | 48 6 | 1 51 | 49 6 | 1 55 | 50 6 | 1 58 | 18 | 18 | 1 |
| 36 | 43 11 | 1 36 | 44 11 | 1 40 | 45 10 | 1 43 | 46 10 | 1 46 | 47 10 | 1 49 | 48 10 | 1 52 | 49 10 | 1 56 | 50 10 | 1 59 | 19 | 19 | 1 |
| 38 | 43 14 | 1 37 | 44 14 | 1 41 | 45 14 | 1 44 | 46 14 | 1 47 | 47 14 | 1 50 | 48 13 | 1 54 | 49 13 | 1 57 | 50 13 | 2 0 | 20 | 20 | 2 |
| 40 | 43 18 | 1 38 | 44 18 | 1 42 | 45 18 | 1 45 | 46 17 | 1 48 | 47 17 | 1 51 | 48 17 | 1 55 | 49 17 | 1 58 | 50 17 | 2 1 | 21 | 21 | 2 |
| 42 | 43 21 | 1 39 | 44 21 | 1 43 | 45 21 | 1 46 | 46 21 | 1 49 | 47 21 | 1 53 | 48 20 | 1 56 | 49 20 | 1 59 | 50 20 | 2 3 | 22 | 22 | 2 |
| 44 | 43 24 | 1 41 | 44 24 | 1 44 | 45 24 | 1 47 | 46 24 | 1 50 | 47 24 | 1 54 | 48 24 | 1 57 | 49 23 | 2 0 | 50 23 | 2 4 | 23 | 23 | 2 |
| 46 | 43 28 | 1 42 | 44 28 | 1 45 | 45 27 | 1 48 | 46 27 | 1 52 | 47 27 | 1 55 | 48 27 | 1 58 | 49 27 | 2 2 | 50 26 | 2 5 | 24 | 24 | 2 |
| 48 | 43 31 | 1 43 | 44 31 | 1 46 | 45 31 | 1 49 | 46 30 | 1 53 | 47 30 | 1 56 | 48 30 | 1 59 | 49 30 | 2 3 | 50 30 | 2 6 | 25 | 25 | 2 |
| 50 | 43 34 | 1 44 | 44 34 | 1 47 | 45 34 | 1 50 | 46 34 | 1 54 | 47 33 | 1 57 | 48 33 | 2 1 | 49 33 | 2 4 | 50 33 | 2 7 | 26 | 26 | 2 |
| 52 | 43 37 | 1 45 | 44 37 | 1 48 | 45 37 | 1 52 | 46 37 | 1 55 | 47 37 | 1 58 | 48 36 | 2 2 | 49 36 | 2 5 | 50 36 | 2 9 | 27 | 27 | 2 |
| 54 | 43 41 | 1 46 | 44 40 | 1 49 | 45 40 | 1 53 | 46 40 | 1 56 | 47 40 | 2 0 | 48 40 | 2 3 | 49 40 | 2 6 | 50 39 | 2 10 | 28 | 28 | 2 |
| 56 | 43 44 | 1 47 | 44 44 | 1 50 | 45 44 | 1 54 | 46 43 | 1 57 | 47 43 | 2 1 | 48 43 | 2 4 | 49 43 | 2 8 | 50 43 | 2 11 | 29 | 29 | 2 |
| 58 | 43 47 | 1 48 | 44 47 | 1 51 | 45 47 | 1 55 | 46 47 | 1 58 | 47 46 | 2 2 | 48 46 | 2 5 | 49 46 | 2 9 | 50 46 | 2 12 | 30 | 30 | 2 |
| 5° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 31 | 31 | 2 |
| 0′ | 43 50 | 1 49 | 44 50 | 1 52 | 45 50 | 1 56 | 46 50 | 1 59 | 47 50 | 2 3 | 48 49 | 2 6 | 49 49 | 2 10 | 50 49 | 2 13 | 32 | 32 | 2 |
| 2 | 43 53 | 1 50 | 44 53 | 1 54 | 45 53 | 1 57 | 46 53 | 2 1 | 47 53 | 2 4 | 48 52 | 2 8 | 49 52 | 2 11 | 50 52 | 2 15 | 33 | 33 | 3 |
| 4 | 43 56 | 1 51 | 44 56 | 1 55 | 45 56 | 1 58 | 46 56 | 2 2 | 47 55 | 2 5 | 48 55 | 2 9 | 49 55 | 2 12 | 50 55 | 2 16 | 34 | 34 | 3 |
| 6 | 43 59 | 1 52 | 44 59 | 1 56 | 45 59 | 1 59 | 46 59 | 2 3 | 47 58 | 2 6 | 48 58 | 2 10 | 49 58 | 2 14 | 50 58 | 2 17 | 35 | 35 | 3 |
| 8 | 44 2 | 1 53 | 45 2 | 1 57 | 46 2 | 2 0 | 47 1 | 2 4 | 48 1 | 2 8 | 49 1 | 2 11 | 50 1 | 2 15 | 51 1 | 2 18 | 36 | 36 | 3 |
| 10 | 44 5 | 1 54 | 45 5 | 1 58 | 46 5 | 2 2 | 47 4 | 2 5 | 48 4 | 2 9 | 49 4 | 2 12 | 50 4 | 2 16 | 51 4 | 2 20 | 37 | 37 | 3 |
| 12 | 44 8 | 1 55 | 45 8 | 1 59 | 46 8 | 2 3 | 47 7 | 2 6 | 48 7 | 2 10 | 49 7 | 2 14 | 50 7 | 2 17 | 51 7 | 2 21 | 38 | 38 | 3 |
| 14 | 44 11 | 1 56 | 45 11 | 2 0 | 46 10 | 2 4 | 47 10 | 2 7 | 48 10 | 2 11 | 49 10 | 2 15 | 50 10 | 2 18 | 51 9 | 2 22 | 39 | 39 | 3 |
| 16 | 44 14 | 1 58 | 45 14 | 2 1 | 46 13 | 2 5 | 47 13 | 2 9 | 48 13 | 2 12 | 49 13 | 2 16 | 50 13 | 2 20 | 51 12 | 2 23 | 40 | 40 | 3 |
| 18 | 44 17 | 1 59 | 45 17 | 2 2 | 46 16 | 2 6 | 47 16 | 2 10 | 48 16 | 2 13 | 49 16 | 2 17 | 50 15 | 2 21 | 51 15 | 2 24 | 41 | 41 | 3 |
| 20 | 44 20 | 2 0 | 45 19 | 2 3 | 46 19 | 2 7 | 47 19 | 2 11 | 48 19 | 2 14 | 49 19 | 2 18 | 50 18 | 2 22 | 51 18 | 2 26 | 42 | 42 | 3 |
| 22 | 44 22 | 2 1 | 45 23 | 2 4 | 46 22 | 2 8 | 47 22 | 2 12 | 48 21 | 2 16 | 49 21 | 2 19 | 50 21 | 2 23 | 51 21 | 2 27 | 43 | 43 | 3 |
| 24 | 44 25 | 2 2 | 45 25 | 2 6 | 46 25 | 2 9 | 47 24 | 2 13 | 48 24 | 2 17 | 49 24 | 2 21 | 50 24 | 2 24 | 51 24 | 2 28 | 44 | 44 | 3 |
| 26 | 44 27 | 2 3 | 45 28 | 2 7 | 46 27 | 2 10 | 47 27 | 2 14 | 48 27 | 2 18 | 49 27 | 2 22 | 50 26 | 2 25 | 51 26 | 2 29 | 45 | 45 | 3 |
| 28 | 44 31 | 2 4 | 45 31 | 2 8 | 46 30 | 2 12 | 47 30 | 2 15 | 48 30 | 2 19 | 49 29 | 2 23 | 50 29 | 2 27 | 51 29 | 2 31 | 46 | 46 | 3 |
| 30 | 44 33 | 2 5 | 45 33 | 2 9 | 46 33 | 2 13 | 47 33 | 2 17 | 48 32 | 2 20 | 49 32 | 2 24 | 50 32 | 2 28 | 51 32 | 2 32 | 47 | 47 | 3 |
| 32 | 44 36 | 2 6 | 45 36 | 2 10 | 46 36 | 2 14 | 47 35 | 2 18 | 48 35 | 2 21 | 49 35 | 2 25 | 50 34 | 2 29 | 51 34 | 2 33 | 48 | 48 | 3 |
| 34 | 44 39 | 2 7 | 45 39 | 2 11 | 46 38 | 2 15 | 47 38 | 2 19 | 48 38 | 2 23 | 49 37 | 2 26 | 50 37 | 2 30 | 51 37 | 2 34 | 49 | 49 | 3 |
| 36 | 44 42 | 2 8 | 45 41 | 2 12 | 46 41 | 2 16 | 47 41 | 2 20 | 48 40 | 2 24 | 49 40 | 2 28 | 50 40 | 2 31 | 51 40 | 2 35 | 50 | 50 | 3 |
| 38 | 44 44 | 2 9 | 45 44 | 2 13 | 46 44 | 2 17 | 47 43 | 2 21 | 48 43 | 2 25 | 49 43 | 2 29 | 50 43 | 2 33 | 51 42 | 2 37 | 51 | 51 | 3 |
| 40 | 44 47 | 2 10 | 45 47 | 2 14 | 46 46 | 2 18 | 47 46 | 2 22 | 48 45 | 2 26 | 49 45 | 2 30 | 50 45 | 2 34 | 51 45 | 2 38 | 52 | 52 | 3 |
| 42 | 44 49 | 2 12 | 45 49 | 2 15 | 46 49 | 2 19 | 47 48 | 2 23 | 48 48 | 2 27 | 49 48 | 2 31 | 50 48 | 2 35 | 51 47 | 2 39 | 53 | 53 | 3 |
| 44 | 44 52 | 2 13 | 45 51 | 2 17 | 46 51 | 2 21 | 47 51 | 2 24 | 48 51 | 2 28 | 49 50 | 2 32 | 50 50 | 2 36 | 51 50 | 2 40 | 54 | 54 | 3 |
| 46 | 44 54 | 2 14 | 45 54 | 2 18 | 46 54 | 2 22 | 47 53 | 2 26 | 48 53 | 2 30 | 49 53 | 2 34 | 50 52 | 2 37 | 51 52 | 2 42 | 55 | 55 | 3 |
| 48 | 44 57 | 2 15 | 45 56 | 2 19 | 46 56 | 2 23 | 47 56 | 2 27 | 48 55 | 2 31 | 49 55 | 2 35 | 50 55 | 2 39 | 51 55 | 2 43 | 56 | 56 | 3 |
| 50 | 44 59 | 2 16 | 45 59 | 2 20 | 46 58 | 2 24 | 47 58 | 2 28 | 48 58 | 2 32 | 49 57 | 2 36 | 50 57 | 2 40 | 51 57 | 2 44 | 57 | 57 | 3 |
| 52 | 45 1 | 2 17 | 46 1 | 2 21 | 47 1 | 2 25 | 48 0 | 2 29 | 49 0 | 2 33 | 50 0 | 2 37 | 51 0 | 2 41 | 51 59 | 2 45 | 58 | 58 | 3 |
| 54 | 45 4 | 2 18 | 46 3 | 2 22 | 47 3 | 2 26 | 48 3 | 2 30 | 49 3 | 2 34 | 50 2 | 2 38 | 51 2 | 2 42 | 52 2 | 2 46 | 59 | 59 | 3 |
| 56 | 45 6 | 2 19 | 46 6 | 2 23 | 47 6 | 2 27 | 48 5 | 2 31 | 49 5 | 2 35 | 50 5 | 2 39 | 51 4 | 2 43 | 52 4 | 2 48 | 60 | 60 | 3 |
| 58 | 45 9 | 2 20 | 46 8 | 2 24 | 47 8 | 2 28 | 48 8 | 2 32 | 49 7 | 2 37 | 50 7 | 2 41 | 51 7 | 2 45 | 52 7 | 2 49 | | | |

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| 8 | 8 | 8 |
| 9 | 6 | 5 |
| 10 | 4 | 4 |
| 11 | 3 | 3 |
| 12 | 2 | 2 |
| 13 | 2 | 1 |
| 14 | 1 | 1 |
| 15 | 1 | 0 |
| 16 | 0 | 0 |

(6° and 7°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 45 11 | 2 21 | 46 11 | 2 25 | 47 10 | 2 30 | 48 10 | 2 34 | 49 10 | 2 33 | 50 10 | 2 42 | 51 9 | 2 46 | 52 9 | 2 50 |
| 2 | 45 13 | 2 22 | 46 13 | 2 26 | 47 12 | 2 31 | 48 12 | 2 35 | 49 12 | 2 39 | 50 12 | 2 43 | 51 11 | 2 47 | 52 11 | 2 51 |
| 4 | 45 15 | 2 23 | 46 15 | 2 28 | 47 15 | 2 32 | 48 14 | 2 36 | 49 14 | 2 40 | 50 14 | 2 44 | 51 13 | 2 48 | 52 13 | 2 52 |
| 6 | 45 17 | 2 25 | 46 17 | 2 29 | 47 17 | 2 33 | 48 16 | 2 37 | 49 16 | 2 41 | 50 16 | 2 45 | 51 15 | 2 49 | 52 15 | 2 54 |
| 8 | 45 19 | 2 26 | 46 19 | 2 30 | 47 19 | 2 34 | 48 18 | 2 38 | 49 18 | 2 42 | 50 18 | 2 46 | 51 17 | 2 51 | 52 17 | 2 55 |
| 10 | 45 21 | 2 27 | 46 21 | 2 31 | 47 21 | 2 35 | 48 20 | 2 39 | 49 20 | 2 43 | 50 20 | 2 48 | 51 20 | 2 52 | 52 19 | 2 56 |
| 12 | 45 24 | 2 28 | 46 23 | 2 32 | 47 23 | 2 36 | 48 23 | 2 40 | 49 22 | 2 45 | 50 22 | 2 49 | 51 22 | 2 53 | 52 21 | 2 57 |
| 14 | 45 25 | 2 29 | 46 25 | 2 33 | 47 25 | 2 37 | 48 25 | 2 42 | 49 24 | 2 46 | 50 24 | 2 50 | 51 24 | 2 54 | 52 23 | 2 59 |
| 16 | 45 28 | 2 30 | 46 27 | 2 34 | 47 27 | 2 38 | 48 27 | 2 43 | 49 26 | 2 47 | 50 26 | 2 51 | 51 26 | 2 55 | 52 25 | 3 0 |
| 18 | 45 30 | 2 31 | 46 30 | 2 35 | 47 29 | 2 39 | 48 29 | 2 44 | 49 29 | 2 48 | 50 28 | 2 52 | 51 28 | 2 57 | 52 27 | 3 1 |
| 20 | 45 32 | 2 32 | 46 32 | 2 36 | 47 31 | 2 41 | 48 31 | 2 45 | 49 31 | 2 49 | 50 30 | 2 53 | 51 30 | 2 58 | 52 30 | 3 2 |
| 22 | 45 34 | 2 33 | 46 34 | 2 37 | 47 33 | 2 42 | 48 33 | 2 46 | 49 33 | 2 50 | 50 32 | 2 55 | 51 32 | 2 59 | 52 32 | 3 3 |
| 24 | 45 36 | 2 34 | 46 36 | 2 38 | 47 35 | 2 43 | 48 35 | 2 47 | 49 35 | 2 52 | 50 34 | 2 56 | 51 34 | 3 0 | 52 34 | 3 5 |
| 26 | 45 38 | 2 35 | 46 38 | 2 40 | 47 37 | 2 44 | 48 37 | 2 48 | 49 37 | 2 53 | 50 36 | 2 57 | 51 36 | 3 1 | 52 36 | 3 6 |
| 28 | 45 40 | 2 36 | 46 40 | 2 41 | 47 39 | 2 45 | 48 39 | 2 49 | 49 39 | 2 54 | 50 38 | 2 58 | 51 38 | 3 3 | 52 37 | 3 7 |
| 30 | 45 42 | 2 37 | 46 42 | 2 42 | 47 41 | 2 46 | 48 41 | 2 51 | 49 40 | 2 55 | 50 40 | 2 59 | 51 40 | 3 4 | 52 39 | 3 8 |
| 32 | 45 44 | 2 38 | 46 44 | 2 43 | 47 43 | 2 47 | 48 43 | 2 52 | 49 42 | 2 56 | 50 42 | 3 1 | 51 42 | 3 5 | 52 41 | 3 10 |
| 34 | 45 46 | 2 40 | 46 46 | 2 44 | 47 45 | 2 48 | 48 45 | 2 53 | 49 44 | 2 57 | 50 44 | 3 2 | 51 44 | 3 6 | 52 43 | 3 11 |
| 36 | 45 48 | 2 41 | 46 48 | 2 45 | 47 47 | 2 50 | 48 47 | 2 54 | 49 46 | 2 58 | 50 46 | 3 3 | 51 46 | 3 7 | 52 45 | 3 12 |
| 38 | 45 50 | 2 42 | 46 50 | 2 46 | 47 49 | 2 51 | 48 49 | 2 55 | 49 48 | 3 0 | 50 48 | 3 4 | 51 48 | 3 9 | 52 47 | 3 13 |
| 40 | 45 52 | 2 43 | 46 52 | 2 47 | 47 51 | 2 52 | 48 51 | 2 56 | 49 50 | 3 1 | 50 50 | 3 5 | 51 50 | 3 10 | 52 49 | 3 14 |
| 42 | 45 54 | 2 44 | 46 53 | 2 48 | 47 53 | 2 53 | 48 53 | 2 57 | 49 52 | 3 2 | 50 52 | 3 6 | 51 51 | 3 11 | 52 51 | 3 16 |
| 44 | 45 56 | 2 45 | 46 55 | 2 49 | 47 55 | 2 54 | 48 54 | 2 58 | 49 54 | 3 3 | 50 54 | 3 8 | 51 53 | 3 12 | 52 53 | 3 17 |
| 46 | 45 57 | 2 46 | 46 57 | 2 50 | 47 57 | 2 55 | 48 56 | 3 0 | 49 56 | 3 4 | 50 55 | 3 9 | 51 55 | 3 13 | 52 55 | 3 18 |
| 48 | 45 59 | 2 47 | 46 59 | 2 51 | 47 58 | 2 56 | 48 58 | 3 1 | 49 57 | 3 5 | 50 57 | 3 10 | 51 57 | 3 15 | 52 56 | 3 19 |
| 50 | 46 1 | 2 48 | 47 0 | 2 52 | 48 0 | 2 57 | 49 0 | 3 2 | 49 59 | 3 6 | 50 59 | 3 11 | 51 58 | 3 16 | 52 58 | 3 20 |
| 52 | 46 3 | 2 49 | 47 2 | 2 53 | 48 2 | 2 58 | 49 1 | 3 3 | 50 1 | 3 8 | 51 1 | 3 12 | 52 0 | 3 17 | 53 0 | 3 22 |
| 54 | 46 4 | 2 50 | 47 4 | 2 54 | 48 4 | 2 59 | 49 3 | 3 4 | 50 3 | 3 9 | 51 2 | 3 13 | 52 2 | 3 18 | 53 2 | 3 23 |
| 56 | 46 6 | 2 51 | 47 6 | 2 55 | 48 5 | 3 0 | 49 5 | 3 5 | 50 5 | 3 10 | 51 4 | 3 15 | 52 4 | 3 19 | 53 3 | 3 24 |
| 58 | 46 8 | 2 52 | 47 8 | 2 56 | 48 7 | 3 1 | 49 7 | 3 6 | 50 6 | 3 11 | 51 6 | 3 16 | 52 5 | 3 21 | 53 5 | 3 25 |
| 7° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 46 10 | 2 53 | 47 9 | 2 57 | 48 9 | 3 2 | 49 8 | 3 7 | 50 8 | 3 12 | 51 8 | 3 17 | 52 7 | 3 22 | 53 7 | 3 27 |
| 2 | 46 11 | 2 54 | 47 11 | 2 59 | 48 11 | 3 3 | 49 10 | 3 8 | 50 10 | 3 13 | 51 9 | 3 18 | 52 9 | 3 23 | 53 8 | 3 28 |
| 4 | 46 13 | 2 55 | 47 13 | 3 0 | 48 12 | 3 5 | 49 12 | 3 10 | 50 11 | 3 14 | 51 11 | 3 19 | 52 10 | 3 24 | 53 10 | 3 29 |
| 6 | 46 15 | 2 56 | 47 14 | 3 1 | 48 14 | 3 6 | 49 13 | 3 11 | 50 13 | 3 16 | 51 12 | 3 20 | 52 12 | 3 25 | 53 12 | 3 30 |
| 8 | 46 16 | 2 57 | 47 16 | 3 2 | 48 16 | 3 7 | 49 15 | 3 12 | 50 15 | 3 17 | 51 14 | 3 22 | 52 14 | 3 27 | 53 13 | 3 31 |
| 10 | 46 18 | 2 58 | 47 18 | 3 3 | 48 17 | 3 8 | 49 17 | 3 13 | 50 16 | 3 18 | 51 16 | 3 23 | 52 15 | 3 28 | 53 15 | 3 33 |
| 12 | 46 20 | 3 0 | 47 19 | 3 5 | 48 19 | 3 9 | 49 18 | 3 14 | 50 18 | 3 19 | 51 17 | 3 24 | 52 17 | 3 29 | 53 17 | 3 34 |
| 14 | 46 21 | 3 1 | 47 21 | 3 6 | 48 20 | 3 11 | 49 20 | 3 16 | 50 20 | 3 20 | 51 19 | 3 25 | 52 19 | 3 30 | 53 18 | 3 35 |
| 16 | 46 23 | 3 2 | 47 23 | 3 7 | 48 22 | 3 12 | 49 22 | 3 17 | 50 21 | 3 22 | 51 21 | 3 26 | 52 20 | 3 31 | 53 20 | 3 36 |
| 18 | 46 25 | 3 3 | 47 24 | 3 8 | 48 24 | 3 13 | 49 23 | 3 18 | 50 23 | 3 23 | 51 22 | 3 28 | 52 22 | 3 33 | 53 21 | 3 38 |
| 20 | 46 26 | 3 4 | 47 26 | 3 9 | 48 25 | 3 14 | 49 25 | 3 19 | 50 24 | 3 24 | 51 23 | 3 29 | 52 23 | 3 34 | 53 23 | 3 39 |
| 22 | 46 28 | 3 5 | 47 27 | 3 10 | 48 27 | 3 15 | 49 26 | 3 20 | 50 26 | 3 25 | 51 25 | 3 30 | 52 25 | 3 35 | 53 24 | 3 40 |
| 24 | 46 29 | 3 7 | 47 29 | 3 11 | 48 28 | 3 16 | 49 28 | 3 21 | 50 27 | 3 26 | 51 27 | 3 31 | 52 26 | 3 36 | 53 26 | 3 41 |
| 26 | 46 31 | 3 8 | 47 30 | 3 13 | 48 30 | 3 18 | 49 29 | 3 23 | 50 29 | 3 27 | 51 28 | 3 32 | 52 28 | 3 37 | 53 27 | 3 42 |
| 28 | 46 32 | 3 9 | 47 32 | 3 14 | 48 31 | 3 19 | 49 31 | 3 24 | 50 30 | 3 29 | 51 30 | 3 34 | 52 29 | 3 39 | 53 29 | 3 44 |
| 30 | 46 34 | 3 10 | 47 33 | 3 15 | 48 33 | 3 20 | 49 32 | 3 25 | 50 32 | 3 30 | 51 31 | 3 35 | 52 31 | 3 40 | 53 30 | 3 45 |
| 32 | 46 35 | 3 11 | 47 35 | 3 16 | 48 34 | 3 21 | 49 34 | 3 26 | 50 33 | 3 31 | 51 33 | 3 36 | 52 32 | 3 41 | 53 32 | 3 46 |
| 34 | 46 37 | 3 12 | 47 36 | 3 17 | 48 36 | 3 22 | 49 35 | 3 27 | 50 35 | 3 32 | 51 34 | 3 37 | 52 34 | 3 42 | 53 33 | 3 47 |
| 36 | 46 38 | 3 13 | 47 38 | 3 18 | 48 37 | 3 23 | 49 36 | 3 28 | 50 36 | 3 33 | 51 35 | 3 38 | 52 35 | 3 43 | 53 34 | 3 49 |
| 38 | 46 40 | 3 14 | 47 39 | 3 19 | 48 38 | 3 24 | 49 38 | 3 29 | 50 37 | 3 34 | 51 37 | 3 40 | 52 37 | 3 45 | 53 36 | 3 50 |
| 40 | 46 41 | 3 15 | 47 40 | 3 20 | 48 40 | 3 25 | 49 39 | 3 30 | 50 39 | 3 36 | 51 38 | 3 41 | 52 38 | 3 46 | 53 37 | 3 51 |
| 42 | 46 42 | 3 16 | 47 42 | 3 21 | 48 41 | 3 27 | 49 41 | 3 32 | 50 40 | 3 37 | 51 40 | 3 42 | 52 39 | 3 47 | 53 39 | 3 52 |
| 44 | 46 43 | 3 17 | 47 43 | 3 22 | 48 43 | 3 28 | 49 42 | 3 33 | 50 42 | 3 38 | 51 41 | 3 43 | 52 41 | 3 48 | 53 40 | 3 53 |
| 46 | 46 44 | 3 18 | 47 44 | 3 24 | 48 44 | 3 29 | 49 43 | 3 34 | 50 43 | 3 39 | 51 42 | 3 44 | 52 42 | 3 49 | 53 41 | 3 55 |
| 48 | 46 46 | 3 19 | 47 46 | 3 26 | 48 45 | 3 30 | 49 45 | 3 35 | 50 44 | 3 40 | 51 44 | 3 45 | 52 43 | 3 51 | 53 43 | 3 56 |
| 50 | 46 47 | 3 21 | 47 47 | 3 26 | 48 47 | 3 31 | 49 46 | 3 36 | 50 45 | 3 41 | 51 45 | 3 47 | 52 45 | 3 52 | 53 44 | 3 57 |
| 52 | 46 48 | 3 22 | 47 48 | 3 27 | 48 48 | 3 32 | 49 47 | 3 37 | 50 47 | 3 42 | 51 46 | 3 48 | 52 46 | 3 53 | 53 45 | 3 58 |
| 54 | 46 49 | 3 23 | 47 50 | 3 28 | 48 49 | 3 33 | 49 49 | 3 38 | 50 48 | 3 44 | 51 48 | 3 49 | 52 47 | 3 54 | 53 46 | 3 59 |
| 56 | 46 50 | 3 24 | 47 51 | 3 29 | 48 51 | 3 34 | 49 50 | 3 40 | 50 49 | 3 45 | 51 49 | 3 50 | 52 48 | 3 55 | 53 48 | 4 1 |
| 58 | 46 51 | 3 25 | 47 52 | 3 30 | 48 52 | 3 35 | 49 51 | 3 41 | 50 51 | 3 46 | 51 50 | 3 51 | 52 50 | 3 57 | 53 49 | 4 2 |

| Seconds of H. P. | | |
|---|---|---|
| ″ | Corr. | A |
| | ′ | ″ |
| 1 | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 0 |
| 4 | 4 | 0 |
| 5 | 5 | 0 |
| 6 | 6 | 0 |
| 7 | 7 | 1 |
| 8 | 8 | 1 |
| 9 | 9 | 1 |
| 10 | 10 | 1 |
| 11 | 11 | 1 |
| 12 | 12 | 1 |
| 13 | 13 | 1 |
| 14 | 14 | 1 |
| 15 | 15 | 1 |
| 16 | 16 | 1 |
| 17 | 17 | 1 |
| 18 | 18 | 1 |
| 19 | 19 | 2 |
| 20 | 20 | 2 |
| 21 | 21 | 2 |
| 22 | 22 | 2 |
| 23 | 23 | 2 |
| 24 | 24 | 2 |
| 25 | 25 | 2 |
| 26 | 26 | 2 |
| 27 | 27 | 2 |
| 28 | 28 | 2 |
| 29 | 29 | 2 |
| 30 | 30 | 2 |
| 31 | 31 | 3 |
| 32 | 32 | 3 |
| 33 | 33 | 3 |
| 34 | 34 | 3 |
| 35 | 35 | 3 |
| 36 | 36 | 3 |
| 37 | 37 | 3 |
| 38 | 38 | 3 |
| 39 | 39 | 3 |
| 40 | 40 | 3 |
| 41 | 41 | 3 |
| 42 | 42 | 3 |
| 43 | 43 | 4 |
| 44 | 44 | 4 |
| 45 | 45 | 4 |
| 46 | 46 | 4 |
| 47 | 47 | 4 |
| 48 | 48 | 4 |
| 49 | 49 | 4 |
| 50 | 50 | 4 |
| 51 | 51 | 4 |
| 52 | 52 | 4 |
| 53 | 53 | 4 |
| 54 | 54 | 4 |
| 55 | 55 | 5 |
| 56 | 56 | 5 |
| 57 | 57 | 5 |
| 58 | 58 | 5 |
| 59 | 59 | 5 |

| Alt. | ☉ A | ✱ A |
|---|---|---|
| | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 10 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (8° and 9°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59 | | 60′ | | 61′ | | Seconds of H. P. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | ″ | Corr. | A |
| 8° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | | ′ | ″ |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | 1 | 1 | 0 |
| | | | | | | | | | | | | | | | | | 2 | 2 | 0 |
| 0′ | 46 54 | 3 26 | 47 54 | 3 31 | 48 53 | 3 36 | 49 53 | 3 42 | 50 52 | 3 47 | 51 51 | 3 52 | 52 51 | 3 58 | 53 50 | 4 3 | 3 | 3 | 0 |
| 2 | 46 55 | 3 27 | 47 55 | 3 32 | 48 54 | 3 38 | 49 54 | 3 43 | 50 53 | 3 48 | 51 53 | 3 54 | 52 52 | 3 59 | 53 51 | 4 4 | 4 | 4 | 0 |
| 4 | 46 57 | 3 28 | 47 56 | 3 33 | 48 55 | 3 39 | 49 55 | 3 44 | 50 54 | 3 49 | 51 54 | 3 55 | 52 53 | 4 0 | 53 53 | 4 6 | 5 | 5 | 1 |
| 6 | 46 58 | 3 29 | 47 57 | 3 34 | 48 57 | 3 40 | 49 56 | 3 45 | 50 55 | 3 51 | 51 55 | 3 56 | 52 54 | 4 1 | 53 54 | 4 7 | 6 | 6 | 1 |
| 8 | 46 59 | 3 30 | 47 58 | 3 36 | 48 58 | 3 41 | 49 57 | 3 46 | 50 56 | 3 52 | 51 56 | 3 57 | 52 55 | 4 2 | 53 55 | 4 8 | 7 | 7 | 1 |
| 10 | 47 0 | 3 31 | 47 59 | 3 37 | 48 59 | 3 42 | 49 58 | 3 47 | 50 57 | 3 53 | 51 57 | 3 58 | 52 56 | 4 4 | 53 56 | 4 9 | 8 | 8 | 1 |
| | | | | | | | | | | | | | | | | | 9 | 9 | 1 |
| 12 | 47 1 | 3 32 | 48 0 | 3 38 | 49 0 | 3 43 | 49 59 | 3 49 | 50 58 | 3 54 | 51 58 | 3 59 | 52 58 | 4 5 | 53 57 | 4 10 | 10 | 10 | 1 |
| 14 | 47 2 | 3 33 | 48 2 | 3 39 | 49 1 | 3 44 | 50 0 | 3 50 | 50 59 | 3 55 | 51 59 | 4 1 | 52 59 | 4 6 | 53 58 | 4 12 | 11 | 11 | 1 |
| 16 | 47 3 | 3 34 | 48 3 | 3 40 | 49 2 | 3 45 | 50 2 | 3 51 | 51 0 | 3 56 | 52 0 | 4 2 | 53 0 | 4 7 | 53 59 | 4 13 | 12 | 12 | 1 |
| | | | | | | | | | | | | | | | | | 13 | 13 | 1 |
| 18 | 47 4 | 3 36 | 48 4 | 3 41 | 49 3 | 3 47 | 50 3 | 3 52 | 51 1 | 3 57 | 52 1 | 4 3 | 53 1 | 4 8 | 54 0 | 4 14 | 14 | 14 | 2 |
| 20 | 47 6 | 3 37 | 48 5 | 3 42 | 49 4 | 3 48 | 50 4 | 3 53 | 51 3 | 3 59 | 52 3 | 4 4 | 53 2 | 4 10 | 54 1 | 4 15 | 15 | 15 | 2 |
| 22 | 47 7 | 3 38 | 48 6 | 3 43 | 49 6 | 3 49 | 50 5 | 3 54 | 51 4 | 4 0 | 52 4 | 4 5 | 53 3 | 4 11 | 54 2 | 4 17 | 16 | 16 | 2 |
| | | | | | | | | | | | | | | | | | 17 | 17 | 2 |
| 24 | 47 8 | 3 39 | 48 7 | 3 44 | 49 7 | 3 50 | 50 6 | 3 55 | 51 5 | 4 1 | 52 5 | 4 6 | 53 4 | 4 12 | 54 4 | 4 18 | 18 | 18 | 2 |
| 26 | 47 9 | 3 40 | 48 8 | 3 45 | 49 8 | 3 51 | 50 7 | 3 57 | 51 6 | 4 2 | 52 6 | 4 8 | 53 5 | 4 13 | 54 5 | 4 19 | 19 | 19 | 2 |
| 28 | 47 10 | 3 41 | 48 9 | 3 47 | 49 9 | 3 52 | 50 8 | 3 58 | 51 8 | 4 3 | 52 7 | 4 9 | 53 6 | 4 14 | 54 6 | 4 20 | 20 | 20 | 2 |
| | | | | | | | | | | | | | | | | | 21 | 21 | 2 |
| 30 | 47 11 | 3 42 | 48 11 | 3 48 | 49 10 | 3 53 | 50 9 | 3 59 | 51 9 | 4 4 | 52 8 | 4 10 | 53 7 | 4 16 | 54 7 | 4 21 | 22 | 22 | 2 |
| 32 | 47 12 | 3 43 | 48 12 | 3 49 | 49 11 | 3 54 | 50 10 | 4 0 | 51 10 | 4 6 | 52 9 | 4 11 | 53 8 | 4 17 | 54 8 | 4 23 | 23 | 23 | 2 |
| 34 | 47 14 | 3 44 | 48 13 | 3 50 | 49 12 | 3 55 | 50 11 | 4 1 | 51 11 | 4 7 | 52 10 | 4 12 | 53 9 | 4 18 | 54 9 | 4 24 | 24 | 24 | 2 |
| | | | | | | | | | | | | | | | | | 25 | 25 | 3 |
| 36 | 47 15 | 3 45 | 48 14 | 3 51 | 49 13 | 3 57 | 50 12 | 4 2 | 51 12 | 4 8 | 52 11 | 4 14 | 53 11 | 4 19 | 54 10 | 4 25 | 26 | 26 | 3 |
| 38 | 47 16 | 3 46 | 48 15 | 3 52 | 49 14 | 3 58 | 50 14 | 4 3 | 51 13 | 4 9 | 52 12 | 4 15 | 53 12 | 4 20 | 54 11 | 4 26 | 27 | 27 | 3 |
| 40 | 47 17 | 3 47 | 48 16 | 3 53 | 49 15 | 3 59 | 50 15 | 4 4 | 51 14 | 4 10 | 52 13 | 4 16 | 53 13 | 4 22 | 54 12 | 4 27 | 28 | 28 | 3 |
| 42 | 47 18 | 3 48 | 48 17 | 3 54 | 49 17 | 4 0 | 50 16 | 4 6 | 51 15 | 4 11 | 52 14 | 4 17 | 53 14 | 4 23 | 54 13 | 4 29 | 29 | 29 | 3 |
| 44 | 47 19 | 3 50 | 48 18 | 3 55 | 49 18 | 4 1 | 50 17 | 4 7 | 51 16 | 4 13 | 52 15 | 4 18 | 53 15 | 4 24 | 54 14 | 4 30 | 30 | 30 | 3 |
| 46 | 47 20 | 3 51 | 48 19 | 3 56 | 49 19 | 4 2 | 50 18 | 4 8 | 51 17 | 4 14 | 52 16 | 4 19 | 53 16 | 4 25 | 54 15 | 4 31 | 31 | 0 | 3 |
| 48 | 47 21 | 3 52 | 48 20 | 3 57 | 49 20 | 4 3 | 50 19 | 4 9 | 51 18 | 4 15 | 52 17 | 4 21 | 53 17 | 4 26 | 54 16 | 4 32 | 32 | 31 | 3 |
| 50 | 47 22 | 3 53 | 48 21 | 3 59 | 49 21 | 4 4 | 50 20 | 4 10 | 51 19 | 4 16 | 52 18 | 4 22 | 53 18 | 4 28 | 54 17 | 4 33 | 33 | 32 | 3 |
| 52 | 47 23 | 3 54 | 48 22 | 4 0 | 49 22 | 4 5 | 50 21 | 4 11 | 51 20 | 4 17 | 52 19 | 4 23 | 53 19 | 4 29 | 54 18 | 4 35 | 34 | 33 | 3 |
| | | | | | | | | | | | | | | | | | 35 | 34 | 4 |
| 54 | 47 24 | 3 55 | 48 23 | 4 1 | 49 23 | 4 7 | 50 22 | 4 12 | 51 21 | 4 18 | 52 20 | 4 24 | 53 20 | 4 30 | 54 19 | 4 36 | 36 | 35 | 4 |
| 56 | 47 25 | 3 56 | 48 24 | 4 2 | 49 24 | 4 8 | 50 23 | 4 14 | 51 22 | 4 19 | 52 21 | 4 25 | 53 21 | 4 31 | 54 20 | 4 37 | 37 | 36 | 4 |
| 58 | 47 26 | 3 57 | 48 25 | 4 3 | 49 25 | 4 9 | 50 24 | 4 15 | 51 23 | 4 21 | 52 22 | 4 27 | 53 22 | 4 32 | 54 21 | 4 38 | 38 | 37 | 4 |
| | | | | | | | | | | | | | | | | | 39 | 38 | 4 |
| 9° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 40 | 39 | 4 |
| 0′ | 47 27 | 3 58 | 48 26 | 4 4 | 49 26 | 4 10 | 50 25 | 4 16 | 51 24 | 4 22 | 52 23 | 4 28 | 53 23 | 4 34 | 54 22 | 4 40 | 41 | 40 | 4 |
| 2 | 47 28 | 3 59 | 48 27 | 4 5 | 49 27 | 4 11 | 50 26 | 4 17 | 51 25 | 4 23 | 52 24 | 4 29 | 53 24 | 4 35 | 54 23 | 4 41 | 42 | 41 | 4 |
| 4 | 47 29 | 4 0 | 48 28 | 4 6 | 49 28 | 4 12 | 50 27 | 4 18 | 51 26 | 4 24 | 52 25 | 4 30 | 53 25 | 4 36 | 54 24 | 4 42 | 43 | 42 | 4 |
| | | | | | | | | | | | | | | | | | 44 | 43 | 4 |
| 6 | 47 30 | 4 1 | 48 29 | 4 7 | 49 29 | 4 13 | 50 28 | 4 19 | 51 27 | 4 25 | 52 26 | 4 31 | 53 26 | 4 37 | 54 25 | 4 43 | 45 | 44 | 4 |
| 8 | 47 31 | 4 2 | 48 30 | 4 8 | 49 30 | 4 14 | 50 29 | 4 20 | 51 28 | 4 26 | 52 27 | 4 32 | 53 27 | 4 38 | 54 26 | 4 44 | 46 | 45 | 5 |
| 10 | 47 32 | 4 4 | 48 31 | 4 10 | 49 30 | 4 16 | 50 30 | 4 22 | 51 29 | 4 28 | 52 28 | 4 34 | 53 27 | 4 40 | 54 27 | 4 46 | 47 | 46 | 5 |
| | | | | | | | | | | | | | | | | | 48 | 47 | 5 |
| 12 | 47 33 | 4 5 | 48 32 | 4 11 | 49 31 | 4 17 | 50 31 | 4 23 | 51 30 | 4 29 | 52 29 | 4 35 | 53 28 | 4 41 | 54 28 | 4 47 | 49 | 48 | 5 |
| 14 | 47 34 | 4 6 | 48 33 | 4 12 | 49 32 | 4 18 | 50 32 | 4 24 | 51 31 | 4 30 | 52 30 | 4 36 | 53 29 | 4 42 | 54 29 | 4 48 | 50 | 49 | 5 |
| 16 | 47 35 | 4 7 | 48 34 | 4 13 | 49 33 | 4 19 | 50 33 | 4 25 | 51 32 | 4 31 | 52 31 | 4 37 | 53 30 | 4 43 | 54 30 | 4 49 | 51 | 50 | 5 |
| | | | | | | | | | | | | | | | | | 52 | 51 | 5 |
| 18 | 47 36 | 4 8 | 48 35 | 4 14 | 49 34 | 4 20 | 50 34 | 4 26 | 51 33 | 4 32 | 52 32 | 4 38 | 53 31 | 4 44 | 54 31 | 4 51 | 53 | 52 | 5 |
| 20 | 47 37 | 4 9 | 48 36 | 4 15 | 49 35 | 4 21 | 50 35 | 4 27 | 51 34 | 4 34 | 52 33 | 4 39 | 53 32 | 4 46 | 54 32 | 4 52 | 54 | 53 | 5 |
| 22 | 47 38 | 4 10 | 48 37 | 4 16 | 49 36 | 4 22 | 50 35 | 4 28 | 51 35 | 4 35 | 52 34 | 4 41 | 53 33 | 4 47 | 54 32 | 4 53 | 55 | 54 | 5 |
| | | | | | | | | | | | | | | | | | 56 | 55 | 6 |
| 24 | 47 39 | 4 11 | 48 38 | 4 17 | 49 37 | 4 23 | 50 36 | 4 30 | 51 35 | 4 36 | 52 35 | 4 42 | 53 34 | 4 48 | 54 33 | 4 54 | 57 | 56 | 6 |
| 26 | 47 39 | 4 12 | 48 39 | 4 18 | 49 38 | 4 25 | 50 37 | 4 31 | 51 36 | 4 37 | 52 35 | 4 43 | 53 35 | 4 49 | 54 34 | 4 55 | 58 | 57 | 6 |
| 28 | 47 40 | 4 13 | 48 39 | 4 19 | 49 39 | 4 26 | 50 38 | 4 32 | 51 37 | 4 38 | 52 36 | 4 44 | 53 35 | 4 50 | 54 35 | 4 57 | 59 | 58 | 6 |
| | | | | | | | | | | | | | | | | | | | |
| 30 | 47 41 | 4 14 | 48 40 | 4 21 | 49 39 | 4 27 | 50 39 | 4 33 | 51 38 | 4 39 | 52 37 | 4 45 | 53 36 | 4 52 | 54 35 | 4 58 | | | |
| 32 | 47 42 | 4 15 | 48 41 | 4 22 | 49 40 | 4 28 | 50 39 | 4 34 | 51 38 | 4 40 | 52 38 | 4 47 | 53 37 | 4 53 | 54 36 | 4 59 | Alt. | A | A |
| 34 | 47 43 | 4 16 | 48 42 | 4 23 | 49 41 | 4 29 | 50 40 | 4 35 | 51 39 | 4 41 | 52 38 | 4 48 | 53 38 | 4 54 | 54 37 | 5 0 | ° | ′ | ″ |
| | | | | | | | | | | | | | | | | | 3 | 0 | 8 |
| 36 | 47 43 | 4 18 | 48 43 | 4 24 | 49 42 | 4 30 | 50 41 | 4 36 | 51 40 | 4 43 | 52 39 | 4 49 | 53 38 | 4 55 | 54 38 | 5 1 | 4 | 6 | 5 |
| 38 | 47 44 | 4 19 | 48 43 | 4 25 | 49 42 | 4 31 | 50 42 | 4 37 | 51 41 | 4 44 | 52 40 | 4 50 | 53 39 | 4 56 | 54 38 | 5 3 | 5 | 4 | 4 |
| 40 | 47 45 | 4 20 | 48 44 | 4 26 | 49 43 | 4 32 | 50 42 | 4 39 | 51 41 | 4 45 | 52 41 | 4 51 | 53 40 | 4 57 | 54 39 | 5 4 | 6 | 3 | 3 |
| | | | | | | | | | | | | | | | | | 7 | 3 | 2 |
| 42 | 47 46 | 4 21 | 48 45 | 4 27 | 49 44 | 4 33 | 50 43 | 4 40 | 51 42 | 4 46 | 52 41 | 4 52 | 53 40 | 4 59 | 54 40 | 5 5 | 8 | 2 | 2 |
| 44 | 47 46 | 4 22 | 48 45 | 4 28 | 49 45 | 4 35 | 50 44 | 4 41 | 51 43 | 4 47 | 52 42 | 4 54 | 53 41 | 5 0 | 54 40 | 5 6 | 9 | 2 | 1 |
| 46 | 47 47 | 4 23 | 48 46 | 4 29 | 49 45 | 4 36 | 50 44 | 4 42 | 51 43 | 4 48 | 52 43 | 4 55 | 53 42 | 5 1 | 54 41 | 5 8 | 10 | 2 | 1 |
| | | | | | | | | | | | | | | | | | 20 | 2 | 0 |
| 48 | 47 48 | 4 24 | 48 47 | 4 30 | 49 46 | 4 37 | 50 45 | 4 43 | 51 44 | 4 49 | 52 43 | 4 56 | 53 42 | 5 2 | 54 42 | 5 9 | 30 | 3 | 0 |
| 50 | 47 48 | 4 25 | 48 47 | 4 31 | 49 46 | 4 38 | 50 46 | 4 44 | 51 45 | 4 51 | 52 44 | 4 57 | 53 43 | 5 3 | 54 42 | 5 10 | 40 | 3 | 0 |
| 52 | 47 49 | 4 26 | 48 48 | 4 33 | 49 47 | 4 39 | 50 46 | 4 45 | 51 45 | 4 52 | 52 45 | 4 58 | 53 44 | 5 5 | 54 43 | 5 11 | 50 | 4 | 0 |
| | | | | | | | | | | | | | | | | | 60 | 4 | 0 |
| 54 | 47 50 | 4 27 | 48 49 | 4 34 | 49 48 | 4 40 | 50 47 | 4 47 | 51 46 | 4 53 | 52 45 | 4 59 | 53 44 | 5 6 | 54 43 | 5 12 | 70 | 5 | 0 |
| 56 | 47 50 | 4 28 | 48 49 | 4 35 | 49 49 | 4 41 | 50 48 | 4 48 | 51 47 | 4 54 | 52 46 | 5 1 | 53 45 | 5 7 | 54 44 | 5 14 | 80 | 5 | 0 |
| 58 | 47 51 | 4 29 | 48 50 | 4 36 | 49 49 | 4 42 | 50 48 | 4 49 | 51 47 | 4 55 | 52 47 | 5 2 | 53 46 | 5 8 | 54 45 | 5 15 | 90 | 5 | 0 |

(10° and 11°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App Alt | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60 | | 61′ | | Seconds of H. P. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | ″ | Cor. | A |
| 10 | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | ″ | ″ |
| | | | | | | | | | | | | | | | | | 1 | 1 | 0 |
| | | | | | | | | | | | | | | | | | 2 | 2 | 0 |
| 0′ | 47 52 | 4 30 | 48 51 | 4 37 | 49 50 | 4 43 | 50 49 | 4 50 | 51 48 | 4 56 | 52 47 | 5 3 | 53 46 | 5 9 | 54 45 | 5 16 | 3 | 3 | 0 |
| 2 | 47 52 | 4 31 | 48 51 | 4 38 | 49 51 | 4 45 | 50 50 | 4 51 | 51 49 | 4 58 | 52 48 | 5 4 | 53 47 | 5 11 | 54 46 | 5 17 | 4 | 4 | 0 |
| 4 | 47 53 | 4 33 | 48 52 | 4 39 | 49 51 | 4 46 | 50 50 | 4 52 | 51 49 | 4 59 | 52 48 | 5 5 | 53 48 | 5 12 | 54 47 | 5 18 | 5 | 5 | 1 |
| 6 | 47 54 | 4 34 | 48 53 | 4 40 | 49 52 | 4 47 | 50 51 | 4 53 | 51 50 | 5 0 | 52 49 | 5 6 | 53 48 | 5 13 | 54 47 | 5 20 | 6 | 6 | 1 |
| 8 | 47 54 | 4 35 | 48 53 | 4 41 | 49 52 | 4 48 | 50 52 | 4 54 | 51 51 | 5 1 | 52 50 | 5 8 | 53 49 | 5 14 | 54 48 | 5 21 | 7 | 7 | 1 |
| 10 | 47 55 | 4 36 | 48 54 | 4 42 | 49 53 | 4 49 | 50 52 | 4 55 | 51 51 | 5 2 | 52 50 | 5 9 | 53 49 | 5 15 | 54 49 | 5 22 | 8 | 8 | 1 |
| | | | | | | | | | | | | | | | | | 9 | 9 | 1 |
| 12 | 47 56 | 4 37 | 48 55 | 4 43 | 49 54 | 4 50 | 50 53 | 4 57 | 51 52 | 5 3 | 52 51 | 5 10 | 53 50 | 5 16 | 54 49 | 5 23 | 10 | 10 | 1 |
| 14 | 47 56 | 4 38 | 48 55 | 4 44 | 49 54 | 4 51 | 50 54 | 4 58 | 51 53 | 5 4 | 52 52 | 5 11 | 53 51 | 5 18 | 54 50 | 5 24 | 11 | 11 | 1 |
| 16 | 47 57 | 4 39 | 48 56 | 4 46 | 49 55 | 4 52 | 50 54 | 4 59 | 51 53 | 5 6 | 52 52 | 5 12 | 53 51 | 5 19 | 54 50 | 5 26 | 12 | 12 | 1 |
| | | | | | | | | | | | | | | | | | 13 | 13 | 2 |
| 18 | 47 58 | 4 40 | 48 57 | 4 47 | 49 56 | 4 53 | 50 55 | 5 0 | 51 54 | 5 7 | 52 53 | 5 13 | 53 52 | 5 20 | 54 51 | 5 27 | 14 | 14 | 2 |
| 20 | 47 58 | 4 41 | 48 57 | 4 48 | 49 56 | 4 54 | 50 55 | 5 1 | 51 54 | 5 8 | 52 54 | 5 14 | 53 53 | 5 21 | 54 52 | 5 28 | 15 | 15 | 2 |
| 22 | 47 59 | 4 42 | 48 58 | 4 49 | 49 57 | 4 56 | 50 56 | 5 2 | 51 55 | 5 9 | 52 54 | 5 16 | 53 53 | 5 22 | 54 52 | 5 29 | 16 | 16 | 2 |
| | | | | | | | | | | | | | | | | | 17 | 17 | 2 |
| 24 | 48 0 | 4 43 | 48 59 | 4 50 | 49 58 | 4 57 | 50 57 | 5 3 | 51 56 | 5 10 | 52 55 | 5 17 | 53 54 | 5 24 | 54 53 | 5 31 | 18 | 18 | 2 |
| 26 | 48 0 | 4 44 | 48 59 | 4 51 | 49 58 | 4 58 | 50 57 | 5 5 | 51 56 | 5 11 | 52 55 | 5 18 | 53 54 | 5 25 | 54 54 | 5 32 | 19 | 19 | 2 |
| 28 | 48 1 | 4 45 | 49 0 | 4 52 | 49 59 | 4 59 | 50 58 | 5 6 | 51 57 | 5 12 | 52 56 | 5 19 | 53 55 | 5 26 | 54 54 | 5 33 | 20 | 20 | 2 |
| | | | | | | | | | | | | | | | | | | | |
| 30 | 48 2 | 4 46 | 49 1 | 4 53 | 50 0 | 5 0 | 50 59 | 5 7 | 51 58 | 5 14 | 52 57 | 5 20 | 53 56 | 5 27 | 54 55 | 5 34 | 21 | 20 | 3 |
| 32 | 48 2 | 4 47 | 49 1 | 4 54 | 50 0 | 5 1 | 50 59 | 5 8 | 51 58 | 5 15 | 52 57 | 5 22 | 53 56 | 5 28 | 54 55 | 5 35 | 22 | 21 | 3 |
| 34 | 48 3 | 4 49 | 49 2 | 4 55 | 50 1 | 5 2 | 51 0 | 5 9 | 51 59 | 5 16 | 52 58 | 5 23 | 53 57 | 5 30 | 54 56 | 5 37 | 23 | 22 | 3 |
| | | | | | | | | | | | | | | | | | 24 | 23 | 3 |
| 36 | 48 4 | 4 50 | 49 3 | 4 56 | 50 2 | 5 3 | 51 1 | 5 10 | 52 0 | 5 17 | 52 59 | 5 24 | 53 58 | 5 31 | 54 57 | 5 38 | 25 | 24 | 3 |
| 38 | 48 4 | 4 51 | 49 3 | 4 58 | 50 2 | 5 4 | 51 1 | 5 11 | 52 0 | 5 18 | 52 59 | 5 25 | 53 58 | 5 32 | 54 57 | 5 39 | 26 | 25 | 3 |
| 40 | 48 5 | 4 52 | 49 4 | 4 59 | 50 3 | 5 6 | 51 2 | 5 12 | 52 1 | 5 19 | 53 0 | 5 26 | 53 59 | 5 33 | 54 58 | 5 40 | 27 | 26 | 3 |
| | | | | | | | | | | | | | | | | | 28 | 27 | 3 |
| 42 | 48 5 | 4 53 | 49 4 | 5 0 | 50 3 | 5 7 | 51 2 | 5 14 | 52 1 | 5 21 | 53 0 | 5 27 | 53 59 | 5 34 | 54 58 | 5 41 | 29 | 28 | 3 |
| 44 | 48 6 | 4 54 | 49 5 | 5 1 | 50 4 | 5 8 | 51 3 | 5 15 | 52 2 | 5 22 | 53 1 | 5 29 | 54 0 | 5 36 | 54 59 | 5 43 | 30 | 29 | 4 |
| 46 | 48 7 | 4 55 | 49 6 | 5 2 | 50 4 | 5 9 | 51 3 | 5 16 | 52 2 | 5 23 | 53 1 | 5 30 | 54 0 | 5 37 | 54 59 | 5 44 | 31 | 30 | 4 |
| | | | | | | | | | | | | | | | | | | | |
| 48 | 48 7 | 4 56 | 49 6 | 5 3 | 50 5 | 5 10 | 51 4 | 5 17 | 52 3 | 5 24 | 53 2 | 5 31 | 54 1 | 5 38 | 55 0 | 5 45 | 32 | 31 | 4 |
| 50 | 48 8 | 4 57 | 49 7 | 5 4 | 50 6 | 5 11 | 51 4 | 5 18 | 52 3 | 5 25 | 53 2 | 5 32 | 54 1 | 5 39 | 55 0 | 5 46 | 33 | 32 | 4 |
| 52 | 48 8 | 4 58 | 49 7 | 5 5 | 50 6 | 5 12 | 51 5 | 5 19 | 52 4 | 5 26 | 53 3 | 5 33 | 54 2 | 5 40 | 55 1 | 5 47 | 34 | 33 | 4 |
| | | | | | | | | | | | | | | | | | 35 | 34 | 4 |
| 54 | 48 9 | 4 59 | 49 8 | 5 6 | 50 7 | 5 13 | 51 6 | 5 20 | 52 5 | 5 27 | 53 3 | 5 34 | 54 2 | 5 42 | 55 1 | 5 49 | 36 | 35 | 4 |
| 56 | 48 9 | 5 0 | 49 8 | 5 7 | 50 7 | 5 14 | 51 6 | 5 22 | 52 5 | 5 29 | 53 4 | 5 36 | 54 3 | 5 43 | 55 2 | 5 50 | 37 | 36 | 4 |
| 58 | 48 10 | 5 1 | 49 9 | 5 9 | 50 8 | 5 16 | 51 7 | 5 23 | 52 6 | 5 30 | 53 4 | 5 37 | 54 3 | 5 44 | 55 2 | 5 51 | 38 | 37 | 4 |
| | | | | | | | | | | | | | | | | | 39 | 38 | 5 |
| 11° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 40 | 39 | 5 |
| 0 | 48 10 | 5 2 | 49 9 | 5 10 | 50 8 | 5 17 | 51 7 | 5 24 | 52 6 | 5 31 | 53 5 | 5 38 | 54 4 | 5 45 | 55 3 | 5 52 | 41 | 40 | 5 |
| 2 | 48 11 | 5 4 | 49 10 | 5 11 | 50 9 | 5 18 | 51 8 | 5 25 | 52 7 | 5 32 | 53 5 | 5 39 | 54 4 | 5 46 | 55 3 | 5 53 | 42 | 41 | 5 |
| 4 | 48 11 | 5 5 | 49 10 | 5 12 | 50 9 | 5 19 | 51 8 | 5 26 | 52 7 | 5 33 | 53 6 | 5 40 | 54 5 | 5 47 | 55 4 | 5 55 | 43 | 42 | 5 |
| | | | | | | | | | | | | | | | | | 44 | 43 | 5 |
| 6 | 48 12 | 5 6 | 49 11 | 5 13 | 50 9 | 5 20 | 51 8 | 5 27 | 52 7 | 5 34 | 53 6 | 5 41 | 54 5 | 5 49 | 55 4 | 5 56 | 45 | 44 | 5 |
| 8 | 48 12 | 5 7 | 49 11 | 5 14 | 50 10 | 5 21 | 51 9 | 5 28 | 52 8 | 5 35 | 53 7 | 5 43 | 54 5 | 5 50 | 55 4 | 5 57 | 46 | 45 | 5 |
| 10 | 48 13 | 5 8 | 49 11 | 5 15 | 50 10 | 5 22 | 51 9 | 5 29 | 52 8 | 5 37 | 53 7 | 5 44 | 54 6 | 5 51 | 55 5 | 5 58 | 47 | 46 | 6 |
| | | | | | | | | | | | | | | | | | 48 | 47 | 6 |
| 12 | 48 13 | 5 9 | 49 12 | 5 16 | 50 11 | 5 23 | 51 10 | 5 31 | 52 8 | 5 38 | 53 7 | 5 45 | 54 6 | 5 52 | 55 5 | 5 59 | 49 | 48 | 6 |
| 14 | 48 13 | 5 10 | 49 12 | 5 17 | 50 11 | 5 24 | 51 10 | 5 32 | 52 9 | 5 39 | 53 8 | 5 46 | 54 7 | 5 53 | 55 6 | 6 1 | 50 | 49 | 6 |
| 16 | 48 14 | 5 11 | 49 13 | 5 18 | 50 12 | 5 25 | 51 10 | 5 33 | 52 9 | 5 40 | 53 8 | 5 47 | 54 7 | 5 55 | 55 6 | 6 2 | 51 | 50 | 6 |
| | | | | | | | | | | | | | | | | | 52 | 51 | 6 |
| 18 | 48 14 | 5 12 | 49 13 | 5 19 | 50 12 | 5 27 | 51 11 | 5 34 | 52 10 | 5 41 | 53 9 | 5 48 | 54 7 | 5 56 | 55 6 | 6 3 | 53 | 52 | 6 |
| 20 | 48 15 | 5 13 | 49 13 | 5 20 | 50 12 | 5 28 | 51 11 | 5 35 | 52 10 | 5 42 | 53 9 | 5 50 | 54 8 | 5 57 | 55 7 | 6 4 | 54 | 53 | 6 |
| 22 | 48 15 | 5 14 | 49 14 | 5 21 | 50 13 | 5 29 | 51 12 | 5 36 | 52 10 | 5 43 | 53 9 | 5 51 | 54 8 | 5 58 | 55 7 | 6 5 | 55 | 54 | 6 |
| | | | | | | | | | | | | | | | | | 56 | 55 | 7 |
| 24 | 48 16 | 5 15 | 49 14 | 5 23 | 50 13 | 5 30 | 51 12 | 5 37 | 52 11 | 5 45 | 53 10 | 5 52 | 54 9 | 5 59 | 55 7 | 6 7 | 57 | 56 | 7 |
| 26 | 48 16 | 5 16 | 49 15 | 5 24 | 50 14 | 5 31 | 51 12 | 5 38 | 52 11 | 5 46 | 53 10 | 5 53 | 54 9 | 6 0 | 55 8 | 6 8 | 58 | 57 | 7 |
| 28 | 48 16 | 5 17 | 49 15 | 5 25 | 50 14 | 5 32 | 51 13 | 5 39 | 52 12 | 5 47 | 53 10 | 5 54 | 54 9 | 6 2 | 55 8 | 6 9 | 59 | 58 | 7 |
| | | | | | | | | | | | | | | | | | | | |
| 30 | 48 17 | 5 18 | 49 16 | 5 26 | 50 14 | 5 33 | 51 13 | 5 41 | 52 12 | 5 48 | 53 11 | 5 55 | 54 10 | 6 3 | 55 8 | 6 10 | | | |
| 32 | 48 17 | 5 19 | 49 16 | 5 27 | 50 15 | 5 34 | 51 14 | 5 42 | 52 12 | 5 49 | 53 11 | 5 57 | 54 10 | 6 4 | 55 9 | 6 11 | | | |
| 34 | 48 18 | 5 20 | 49 16 | 5 28 | 50 15 | 5 35 | 51 14 | 5 43 | 52 13 | 5 50 | 53 12 | 5 58 | 54 10 | 6 5 | 55 9 | 6 13 | | | |
| | | | | | | | | | | | | | | | | | | | |
| 36 | 48 18 | 5 21 | 49 17 | 5 29 | 50 16 | 5 36 | 51 14 | 5 44 | 52 13 | 5 51 | 53 12 | 5 59 | 54 11 | 6 6 | 55 10 | 6 14 | | | |
| 38 | 48 19 | 5 22 | 49 17 | 5 30 | 50 16 | 5 38 | 51 15 | 5 45 | 52 14 | 5 53 | 53 12 | 6 0 | 54 11 | 6 8 | 55 10 | 6 15 | | | |
| 40 | 48 19 | 5 23 | 49 18 | 5 31 | 50 16 | 5 39 | 51 15 | 5 46 | 52 14 | 5 54 | 53 13 | 6 1 | 54 11 | 6 9 | 55 10 | 6 16 | | | |
| | | | | | | | | | | | | | | | | | | | |
| 42 | 48 19 | 5 25 | 49 18 | 5 32 | 50 17 | 5 40 | 51 15 | 5 47 | 52 14 | 5 55 | 53 13 | 6 2 | 54 12 | 6 10 | 55 11 | 6 18 | | | |
| 44 | 48 20 | 5 26 | 49 18 | 5 33 | 50 17 | 5 41 | 51 16 | 5 48 | 52 15 | 5 56 | 53 13 | 6 4 | 54 12 | 6 11 | 55 11 | 6 19 | | | |
| 46 | 48 20 | 5 27 | 49 19 | 5 34 | 50 17 | 5 42 | 51 16 | 5 49 | 52 15 | 5 57 | 53 14 | 6 5 | 54 12 | 6 12 | 55 11 | 6 20 | | | |
| | | | | | | | | | | | | | | | | | | | |
| 48 | 48 20 | 5 28 | 49 19 | 5 35 | 50 18 | 5 43 | 51 16 | 5 51 | 52 15 | 5 58 | 53 14 | 6 6 | 54 13 | 6 13 | 55 11 | 6 21 | | | |
| 50 | 48 20 | 5 29 | 49 19 | 5 36 | 50 18 | 5 44 | 51 17 | 5 52 | 52 15 | 5 59 | 53 14 | 6 7 | 54 13 | 6 15 | 55 12 | 6 22 | | | |
| 52 | 48 21 | 5 30 | 49 19 | 5 38 | 50 18 | 5 45 | 51 17 | 5 53 | 52 16 | 6 1 | 53 14 | 6 8 | 54 13 | 6 16 | 55 12 | 6 23 | | | |
| | | | | | | | | | | | | | | | | | | | |
| 54 | 48 21 | 5 31 | 49 20 | 5 39 | 50 18 | 5 46 | 51 17 | 5 54 | 52 16 | 6 2 | 53 15 | 6 9 | 54 13 | 6 17 | 55 12 | 6 25 | | | |
| 56 | 48 21 | 5 32 | 49 20 | 5 40 | 50 19 | 5 47 | 51 17 | 5 55 | 52 16 | 6 3 | 53 15 | 6 10 | 54 14 | 6 18 | 55 12 | 6 26 | | | |
| 58 | 48 22 | 5 33 | 49 20 | 5 41 | 50 19 | 5 49 | 51 18 | 5 56 | 52 16 | 6 4 | 53 15 | 6 12 | 54 14 | 6 19 | 55 13 | 6 27 | | | |

| ° Alt. | ☽ | A |
|---|---|---|
| | ″ | ″ |
| 0 | 3 | 8 |
| 2 | 4 | 6 |
| 4 | 5 | 4 |
| 6 | 6 | 3 |
| 8 | 7 | 3 |
| 10 | 8 | 2 |
| 12 | 9 | 2 |
| 14 | 10 | 2 |
| 16 | 11 | 2 |
| 18 | 12 | 2 |
| 20 | 13 | 2 |
| 22 | 14 | 2 |
| 24 | 15 | 2 |
| 26 | 16 | 2 |
| 28 | 17 | 2 |
| 30 | 18 | 2 |
| 32 | 19 | 2 |
| 34 | 20 | 2 |
| 36 | 21 | 2 |
| 38 | 22 | 2 |
| 40 | 23 | 2 |
| 42 | 24 | 2 |
| 44 | 25 | 2 |
| 46 | 26 | 2 |
| 48 | 27 | 2 |
| 50 | 28 | 2 |
| 52 | 29 | 2 |
| 54 | 30 | 2 |
| 56 | 31 | 2 |
| 58 | 32 | 2 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (12° and 13°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 48 22 | 5 34 | 49 21 | 5 42 | 50 19 | 5 50 | 51 18 | 5 57 | 52 17 | 6 5 | 53 15 | 6 13 | 54 14 | 6 20 | 55 13 | 6 28 |
| 2 | 48 22 | 5 35 | 49 21 | 5 43 | 50 20 | 5 51 | 51 18 | 5 59 | 52 17 | 6 6 | 53 16 | 6 14 | 54 14 | 6 22 | 55 13 | 6 29 |
| 4 | 48 23 | 5 36 | 49 21 | 5 44 | 50 20 | 5 52 | 51 19 | 6 0 | 52 17 | 6 7 | 53 16 | 6 15 | 54 15 | 6 23 | 55 13 | 6 31 |
| 6 | 48 23 | 5 38 | 49 22 | 5 45 | 50 20 | 5 53 | 51 19 | 6 1 | 52 18 | 6 9 | 53 16 | 6 16 | 54 15 | 6 24 | 55 14 | 6 32 |
| 8 | 48 23 | 5 39 | 49 22 | 5 46 | 50 21 | 5 54 | 51 19 | 6 2 | 52 18 | 6 10 | 53 17 | 6 17 | 54 15 | 6 25 | 55 14 | 6 33 |
| 10 | 48 24 | 5 40 | 49 22 | 5 47 | 50 21 | 5 55 | 51 20 | 6 3 | 52 18 | 6 11 | 53 17 | 6 19 | 54 16 | 6 26 | 55 14 | 6 34 |
| 12 | 48 24 | 5 41 | 49 23 | 5 49 | 50 21 | 5 56 | 51 20 | 6 4 | 52 19 | 6 12 | 53 17 | 6 20 | 54 16 | 6 28 | 55 15 | 6 35 |
| 14 | 48 25 | 5 42 | 49 23 | 5 50 | 50 22 | 5 58 | 51 20 | 6 5 | 52 19 | 6 13 | 53 18 | 6 21 | 54 16 | 6 29 | 55 15 | 6 37 |
| 16 | 48 25 | 5 43 | 49 23 | 5 51 | 50 22 | 5 59 | 51 21 | 6 6 | 52 19 | 6 14 | 53 18 | 6 22 | 54 16 | 6 30 | 55 15 | 6 38 |
| 18 | 48 25 | 5 44 | 49 24 | 5 52 | 50 22 | 6 0 | 51 21 | 6 8 | 52 19 | 6 15 | 53 18 | 6 23 | 54 17 | 6 31 | 55 16 | 6 39 |
| 20 | 48 25 | 5 45 | 49 24 | 5 53 | 50 22 | 6 1 | 51 21 | 6 9 | 52 20 | 6 17 | 53 18 | 6 24 | 54 17 | 6 32 | 55 16 | 6 40 |
| 22 | 48 25 | 5 46 | 49 24 | 5 54 | 50 23 | 6 2 | 51 21 | 6 10 | 52 20 | 6 18 | 53 19 | 6 26 | 54 17 | 6 34 | 55 16 | 6 41 |
| 24 | 48 26 | 5 47 | 49 24 | 5 55 | 50 23 | 6 3 | 51 22 | 6 11 | 52 20 | 6 19 | 53 19 | 6 27 | 54 18 | 6 35 | 55 16 | 6 43 |
| 26 | 48 26 | 5 48 | 49 25 | 5 56 | 50 23 | 6 4 | 51 22 | 6 12 | 52 21 | 6 20 | 53 19 | 6 28 | 54 18 | 6 36 | 55 16 | 6 44 |
| 28 | 48 26 | 5 49 | 49 25 | 5 57 | 50 24 | 6 5 | 51 22 | 6 13 | 52 21 | 6 21 | 53 19 | 6 29 | 54 18 | 6 37 | 55 17 | 6 45 |
| 30 | 48 27 | 5 50 | 49 25 | 5 58 | 50 24 | 6 6 | 51 22 | 6 14 | 52 21 | 6 22 | 53 20 | 6 30 | 54 18 | 6 38 | 55 17 | 6 46 |
| 32 | 48 27 | 5 51 | 49 26 | 5 59 | 50 24 | 6 7 | 51 23 | 6 15 | 52 21 | 6 23 | 53 20 | 6 31 | 54 19 | 6 39 | 55 17 | 6 47 |
| 34 | 48 27 | 5 52 | 49 26 | 6 0 | 50 24 | 6 8 | 51 23 | 6 16 | 52 22 | 6 25 | 53 20 | 6 33 | 54 19 | 6 41 | 55 17 | 6 49 |
| 36 | 48 28 | 5 53 | 49 26 | 6 1 | 50 25 | 6 10 | 51 23 | 6 18 | 52 22 | 6 26 | 53 20 | 6 34 | 54 19 | 6 42 | 55 18 | 6 50 |
| 38 | 48 28 | 5 54 | 49 26 | 6 3 | 50 25 | 6 11 | 51 24 | 6 19 | 52 22 | 6 27 | 53 21 | 6 35 | 54 19 | 6 43 | 55 18 | 6 51 |
| 40 | 48 28 | 5 55 | 49 27 | 6 4 | 50 25 | 6 12 | 51 24 | 6 20 | 52 22 | 6 28 | 53 21 | 6 36 | 54 19 | 6 44 | 55 18 | 6 52 |
| 42 | 48 28 | 5 57 | 49 27 | 6 5 | 50 25 | 6 13 | 51 24 | 6 21 | 52 23 | 6 29 | 53 21 | 6 37 | 54 20 | 6 45 | 55 18 | 6 53 |
| 44 | 48 29 | 5 58 | 49 27 | 6 6 | 50 26 | 6 14 | 51 24 | 6 22 | 52 23 | 6 30 | 53 21 | 6 38 | 54 20 | 6 46 | 55 18 | 6 55 |
| 46 | 48 29 | 5 59 | 49 27 | 6 7 | 50 26 | 6 15 | 51 24 | 6 23 | 52 23 | 6 31 | 53 21 | 6 39 | 54 20 | 6 48 | 55 19 | 6 56 |
| 48 | 48 29 | 6 0 | 49 28 | 6 8 | 50 26 | 6 16 | 51 25 | 6 24 | 52 23 | 6 32 | 53 22 | 6 41 | 54 20 | 6 49 | 55 19 | 6 57 |
| 50 | 48 29 | 6 1 | 49 28 | 6 9 | 50 26 | 6 17 | 51 25 | 6 25 | 52 23 | 6 34 | 53 22 | 6 42 | 54 20 | 6 50 | 55 19 | 6 58 |
| 52 | 48 29 | 6 2 | 49 28 | 6 10 | 50 26 | 6 18 | 51 25 | 6 27 | 52 23 | 6 35 | 53 22 | 6 43 | 54 21 | 6 51 | 55 19 | 6 59 |
| 54 | 48 30 | 6 3 | 49 28 | 6 11 | 50 27 | 6 19 | 51 25 | 6 28 | 52 24 | 6 36 | 53 22 | 6 44 | 54 21 | 6 52 | 55 19 | 7 1 |
| 56 | 48 30 | 6 4 | 49 28 | 6 12 | 50 27 | 6 20 | 51 25 | 6 29 | 52 24 | 6 37 | 53 22 | 6 45 | 54 21 | 6 54 | 55 19 | 7 2 |
| 58 | 48 30 | 6 5 | 49 29 | 6 13 | 50 27 | 6 22 | 51 26 | 6 30 | 52 24 | 6 38 | 53 23 | 6 46 | 54 21 | 6 55 | 55 20 | 7 3 |

| 13° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 48 29 | 6 6 | 49 29 | 6 14 | 50 27 | 6 23 | 51 26 | 6 31 | 52 24 | 6 39 | 53 23 | 6 48 | 54 21 | 6 56 | 55 20 | 7 4 |
| 2 | 48 30 | 6 7 | 49 29 | 6 15 | 50 27 | 6 24 | 51 26 | 6 32 | 52 24 | 6 40 | 53 23 | 6 49 | 54 21 | 6 57 | 55 20 | 7 5 |
| 4 | 48 31 | 6 8 | 49 29 | 6 17 | 50 28 | 6 25 | 51 26 | 6 33 | 52 24 | 6 42 | 53 23 | 6 50 | 54 21 | 6 58 | 55 20 | 7 7 |
| 6 | 48 31 | 6 9 | 49 29 | 6 18 | 50 28 | 6 26 | 51 26 | 6 34 | 52 25 | 6 43 | 53 23 | 6 51 | 54 22 | 6 59 | 55 20 | 7 8 |
| 8 | 48 31 | 6 10 | 49 29 | 6 19 | 50 28 | 6 27 | 51 26 | 6 35 | 52 25 | 6 44 | 53 23 | 6 52 | 54 22 | 7 0 | 55 20 | 7 9 |
| 10 | 48 31 | 6 11 | 49 30 | 6 20 | 50 28 | 6 28 | 51 26 | 6 37 | 52 25 | 6 45 | 53 23 | 6 53 | 54 22 | 7 2 | 55 20 | 7 10 |
| 12 | 48 31 | 6 12 | 49 30 | 6 21 | 50 28 | 6 29 | 51 27 | 6 38 | 52 25 | 6 46 | 53 24 | 6 55 | 54 22 | 7 3 | 55 20 | 7 11 |
| 14 | 48 32 | 6 14 | 49 30 | 6 22 | 50 28 | 6 30 | 51 27 | 6 39 | 52 25 | 6 47 | 53 24 | 6 56 | 54 22 | 7 4 | 55 21 | 7 13 |
| 16 | 48 32 | 6 15 | 49 30 | 6 23 | 50 29 | 6 31 | 51 27 | 6 40 | 52 25 | 6 48 | 53 24 | 6 57 | 54 22 | 7 5 | 55 21 | 7 14 |
| 18 | 48 32 | 6 16 | 49 30 | 6 24 | 50 29 | 6 33 | 51 27 | 6 41 | 52 26 | 6 50 | 53 24 | 6 58 | 54 22 | 7 7 | 55 21 | 7 15 |
| 20 | 48 32 | 6 17 | 49 30 | 6 25 | 50 29 | 6 34 | 51 27 | 6 42 | 52 26 | 6 51 | 53 24 | 6 59 | 54 23 | 7 8 | 55 21 | 7 16 |
| 22 | 48 32 | 6 18 | 49 31 | 6 26 | 50 29 | 6 35 | 51 27 | 6 43 | 52 26 | 6 52 | 53 24 | 7 0 | 54 23 | 7 9 | 55 21 | 7 17 |
| 24 | 48 32 | 6 19 | 49 31 | 6 27 | 50 29 | 6 36 | 51 28 | 6 44 | 52 26 | 6 53 | 53 24 | 7 1 | 54 23 | 7 10 | 55 21 | 7 19 |
| 26 | 48 32 | 6 20 | 49 31 | 6 28 | 50 29 | 6 37 | 51 28 | 6 46 | 52 26 | 6 54 | 53 24 | 7 3 | 54 23 | 7 11 | 55 21 | 7 20 |
| 28 | 48 33 | 6 21 | 49 31 | 6 29 | 50 29 | 6 38 | 51 28 | 6 47 | 52 26 | 6 55 | 53 25 | 7 4 | 54 23 | 7 12 | 55 21 | 7 21 |
| 30 | 48 33 | 6 22 | 49 31 | 6 31 | 50 29 | 6 39 | 51 28 | 6 48 | 52 26 | 6 56 | 53 25 | 7 5 | 54 23 | 7 14 | 55 21 | 7 22 |
| 32 | 48 33 | 6 23 | 49 31 | 6 32 | 50 30 | 6 40 | 51 28 | 6 49 | 52 26 | 6 57 | 53 25 | 7 6 | 54 23 | 7 15 | 55 22 | 7 23 |
| 34 | 48 33 | 6 24 | 49 31 | 6 33 | 50 30 | 6 41 | 51 28 | 6 50 | 52 26 | 6 59 | 53 25 | 7 7 | 54 23 | 7 16 | 55 22 | 7 25 |
| 36 | 48 33 | 6 25 | 49 31 | 6 34 | 50 30 | 6 42 | 51 28 | 6 51 | 52 27 | 7 0 | 53 25 | 7 8 | 54 23 | 7 17 | 55 22 | 7 26 |
| 38 | 48 33 | 6 26 | 49 32 | 6 35 | 50 30 | 6 44 | 51 28 | 6 52 | 52 27 | 7 1 | 53 25 | 7 10 | 54 23 | 7 18 | 55 22 | 7 27 |
| 40 | 48 33 | 6 27 | 49 32 | 6 36 | 50 30 | 6 45 | 51 28 | 6 53 | 52 27 | 7 2 | 53 25 | 7 11 | 54 23 | 7 19 | 55 22 | 7 28 |
| 42 | 48 34 | 6 28 | 49 32 | 6 37 | 50 30 | 6 46 | 51 29 | 6 54 | 52 27 | 7 3 | 53 25 | 7 12 | 54 24 | 7 21 | 55 22 | 7 29 |
| 44 | 48 34 | 6 29 | 49 32 | 6 38 | 50 30 | 6 47 | 51 29 | 6 56 | 52 27 | 7 4 | 53 25 | 7 13 | 54 24 | 7 22 | 55 22 | 7 30 |
| 46 | 48 34 | 6 30 | 49 32 | 6 39 | 50 30 | 6 48 | 51 29 | 6 57 | 52 27 | 7 5 | 53 25 | 7 14 | 54 24 | 7 23 | 55 22 | 7 32 |
| 48 | 48 34 | 6 31 | 49 32 | 6 40 | 50 31 | 6 49 | 51 29 | 6 58 | 52 27 | 7 7 | 53 25 | 7 15 | 54 24 | 7 24 | 55 22 | 7 33 |
| 50 | 48 34 | 6 32 | 49 32 | 6 41 | 50 31 | 6 50 | 51 29 | 6 59 | 52 27 | 7 8 | 53 25 | 7 16 | 54 24 | 7 25 | 55 22 | 7 34 |
| 52 | 48 34 | 6 34 | 49 32 | 6 42 | 50 31 | 6 51 | 51 29 | 7 0 | 52 27 | 7 9 | 53 26 | 7 18 | 54 24 | 7 26 | 55 22 | 7 35 |
| 54 | 48 34 | 6 35 | 49 33 | 6 43 | 50 31 | 6 52 | 51 29 | 7 1 | 52 27 | 7 10 | 53 26 | 7 19 | 54 24 | 7 28 | 55 22 | 7 36 |
| 56 | 48 34 | 6 36 | 49 33 | 6 45 | 50 31 | 6 53 | 51 29 | 7 2 | 52 27 | 7 11 | 53 26 | 7 20 | 54 24 | 7 29 | 55 22 | 7 3 |
| 58 | 48 35 | 6 37 | 49 33 | 6 46 | 50 31 | 6 54 | 51 29 | 7 3 | 52 28 | 7 12 | 53 26 | 7 21 | 54 24 | 7 30 | 55 22 | 7 39 |

| Seconds of H. P. | | |
|---|---|---|
| ″ | Cor. | A |
| | ″ | ′ |
| 1 | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 0 |
| 4 | 4 | 1 |
| 5 | 5 | 1 |
| 6 | 6 | 1 |
| 7 | 7 | 1 |
| 8 | 8 | 1 |
| 9 | 9 | 1 |
| 10 | 10 | 1 |
| 11 | 11 | 2 |
| 12 | 12 | 2 |
| 13 | 13 | 2 |
| 14 | 14 | 2 |
| 15 | 15 | 2 |
| 16 | 16 | 2 |
| 17 | 17 | 2 |
| 18 | 18 | 2 |
| 19 | 19 | 3 |
| 20 | 20 | 3 |
| 21 | 20 | 3 |
| 22 | 21 | 3 |
| 23 | 22 | 3 |
| 24 | 23 | 3 |
| 25 | 24 | 3 |
| 26 | 25 | 4 |
| 27 | 26 | 4 |
| 28 | 27 | 4 |
| 29 | 28 | 4 |
| 30 | 29 | 4 |
| 31 | 30 | 4 |
| 32 | 31 | 4 |
| 33 | 32 | 4 |
| 34 | 33 | 5 |
| 35 | 34 | 5 |
| 36 | 35 | 5 |
| 37 | 36 | 5 |
| 38 | 37 | 5 |
| 39 | 38 | 5 |
| 40 | 39 | 5 |
| 41 | 40 | 6 |
| 42 | 41 | 6 |
| 43 | 42 | 6 |
| 44 | 43 | 6 |
| 45 | 44 | 6 |
| 46 | 45 | 6 |
| 47 | 46 | 6 |
| 48 | 47 | 6 |
| 49 | 48 | 7 |
| 50 | 49 | 7 |
| 51 | 50 | 7 |
| 52 | 51 | 7 |
| 53 | 52 | 7 |
| 54 | 53 | 7 |
| 55 | 54 | 7 |
| 56 | 55 | 8 |
| 57 | 56 | 8 |
| 58 | 57 | 8 |
| 59 | 58 | 8 |
| 60 | 59 | 8 |

| Alt. ☉ | A ° |
|---|---|
| 3 | 8 |
| 4 | 6 |
| 5 | 4 |
| 6 | 3 |
| 7 | 2 |
| 8 | 2 |
| 9 | 2 |
| 10 | 2 |
| 20 | 2 |
| 30 | 3 |
| 40 | 3 |
| 50 | 4 |
| 60 | 4 |
| 70 | 5 |
| 90 | 5 |

(14° and 15°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14° | Corr. − | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 48 35 | 6 38 | 49 33 | 6 47 | 50 31 | 6 56 | 51 29 | 7 4 | 52 28 | 7 13 | 53 26 | 7 22 | 54 24 | 7 31 | 55 22 | 7 40 |
| 2 | 48 35 | 6 39 | 49 33 | 6 48 | 50 31 | 6 57 | 51 29 | 7 6 | 52 28 | 7 14 | 53 26 | 7 23 | 54 24 | 7 32 | 55 22 | 7 41 |
| 4 | 48 35 | 6 40 | 49 33 | 6 49 | 50 31 | 6 58 | 51 30 | 7 7 | 52 28 | 7 16 | 53 26 | 7 24 | 54 24 | 7 33 | 55 22 | 7 42 |
| 6 | 48 35 | 6 41 | 49 33 | 6 50 | 50 31 | 6 59 | 51 30 | 7 8 | 52 28 | 7 17 | 53 26 | 7 26 | 54 24 | 7 35 | 55 22 | 7 44 |
| 8 | 48 35 | 6 42 | 49 33 | 6 51 | 50 32 | 7 0 | 51 30 | 7 9 | 52 28 | 7 18 | 53 26 | 7 27 | 54 24 | 7 36 | 55 22 | 7 45 |
| 10 | 48 35 | 6 43 | 49 33 | 6 52 | 50 32 | 7 1 | 51 30 | 7 10 | 52 28 | 7 19 | 53 26 | 7 28 | 54 24 | 7 37 | 55 22 | 7 46 |
| 12 | 48 35 | 6 44 | 49 33 | 6 53 | 50 32 | 7 2 | 51 30 | 7 11 | 52 28 | 7 20 | 53 26 | 7 29 | 54 24 | 7 38 | 55 22 | 7 47 |
| 14 | 48 35 | 6 45 | 49 34 | 6 54 | 50 32 | 7 3 | 51 30 | 7 12 | 52 28 | 7 21 | 53 26 | 7 30 | 54 24 | 7 39 | 55 22 | 7 48 |
| 16 | 48 35 | 6 46 | 49 34 | 6 55 | 50 32 | 7 4 | 51 30 | 7 13 | 52 28 | 7 22 | 53 26 | 7 31 | 54 24 | 7 40 | 55 22 | 7 49 |
| 18 | 48 35 | 6 47 | 49 34 | 6 56 | 50 32 | 7 5 | 51 30 | 7 14 | 52 28 | 7 23 | 53 26 | 7 33 | 54 24 | 7 42 | 55 23 | 7 51 |
| 20 | 48 36 | 6 48 | 49 34 | 6 57 | 50 32 | 7 6 | 51 30 | 7 15 | 52 28 | 7 25 | 53 26 | 7 34 | 54 24 | 7 43 | 55 23 | 7 52 |
| 22 | 48 36 | 6 49 | 49 34 | 6 58 | 50 32 | 7 7 | 51 30 | 7 17 | 52 28 | 7 26 | 53 26 | 7 35 | 54 24 | 7 44 | 55 23 | 7 53 |
| 24 | 48 36 | 6 50 | 49 34 | 7 0 | 50 32 | 7 9 | 51 30 | 7 18 | 52 28 | 7 27 | 53 26 | 7 36 | 54 24 | 7 45 | 55 23 | 7 54 |
| 26 | 48 36 | 6 51 | 49 34 | 7 1 | 50 32 | 7 10 | 51 30 | 7 19 | 52 28 | 7 28 | 53 26 | 7 37 | 54 24 | 7 46 | 55 23 | 7 55 |
| 28 | 48 36 | 6 53 | 49 34 | 7 2 | 50 32 | 7 11 | 51 30 | 7 20 | 52 28 | 7 29 | 53 26 | 7 38 | 54 24 | 7 47 | 55 23 | 7 57 |
| 30 | 48 36 | 6 54 | 49 34 | 7 3 | 50 32 | 7 12 | 51 30 | 7 21 | 52 28 | 7 30 | 53 26 | 7 39 | 54 24 | 7 49 | 55 23 | 7 58 |
| 32 | 48 36 | 6 55 | 49 34 | 7 4 | 50 32 | 7 13 | 51 30 | 7 22 | 52 28 | 7 31 | 53 26 | 7 41 | 54 24 | 7 50 | 55 23 | 7 59 |
| 34 | 48 36 | 6 56 | 49 34 | 7 5 | 50 32 | 7 14 | 51 30 | 7 23 | 52 28 | 7 33 | 53 26 | 7 42 | 54 24 | 7 51 | 55 23 | 8 0 |
| 36 | 48 36 | 6 57 | 49 34 | 7 6 | 50 32 | 7 15 | 51 30 | 7 24 | 52 28 | 7 34 | 53 26 | 7 43 | 54 24 | 7 52 | 55 23 | 8 1 |
| 38 | 48 36 | 6 58 | 49 34 | 7 7 | 50 32 | 7 16 | 51 30 | 7 26 | 52 28 | 7 35 | 53 26 | 7 44 | 54 24 | 7 53 | 55 22 | 8 3 |
| 40 | 48 36 | 6 59 | 49 34 | 7 8 | 50 32 | 7 17 | 51 30 | 7 27 | 52 28 | 7 36 | 53 26 | 7 45 | 54 24 | 7 54 | 55 22 | 8 4 |
| 42 | 48 36 | 7 0 | 49 34 | 7 9 | 50 32 | 7 18 | 51 30 | 7 28 | 52 28 | 7 37 | 53 26 | 7 46 | 54 24 | 7 56 | 55 22 | 8 5 |
| 44 | 48 36 | 7 1 | 49 34 | 7 10 | 50 32 | 7 20 | 51 30 | 7 29 | 52 28 | 7 38 | 53 26 | 7 48 | 54 24 | 7 57 | 55 22 | 8 6 |
| 46 | 48 36 | 7 2 | 49 34 | 7 11 | 50 32 | 7 21 | 51 30 | 7 30 | 52 28 | 7 39 | 53 26 | 7 49 | 54 24 | 7 58 | 55 22 | 8 7 |
| 48 | 48 36 | 7 3 | 49 34 | 7 12 | 50 32 | 7 22 | 51 30 | 7 31 | 52 28 | 7 40 | 53 26 | 7 50 | 54 24 | 7 59 | 55 22 | 8 9 |
| 50 | 48 36 | 7 4 | 49 34 | 7 14 | 50 32 | 7 23 | 51 30 | 7 32 | 52 28 | 7 42 | 53 26 | 7 51 | 54 24 | 8 0 | 55 22 | 8 10 |
| 52 | 48 36 | 7 5 | 49 34 | 7 15 | 50 32 | 7 24 | 51 30 | 7 33 | 52 28 | 7 43 | 53 26 | 7 52 | 54 24 | 8 1 | 55 22 | 8 11 |
| 54 | 48 36 | 7 6 | 49 34 | 7 16 | 50 32 | 7 25 | 51 30 | 7 34 | 52 28 | 7 44 | 53 26 | 7 53 | 54 24 | 8 3 | 55 22 | 8 12 |
| 56 | 48 36 | 7 7 | 49 34 | 7 17 | 50 32 | 7 26 | 51 30 | 7 36 | 52 28 | 7 45 | 53 26 | 7 54 | 54 24 | 8 4 | 55 22 | 8 13 |
| 58 | 48 36 | 7 8 | 49 34 | 7 18 | 50 32 | 7 27 | 51 30 | 7 37 | 52 28 | 7 46 | 53 26 | 7 56 | 54 24 | 8 5 | 55 22 | 8 14 |
| 15° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 48 36 | 7 9 | 49 34 | 7 19 | 50 32 | 7 28 | 51 30 | 7 38 | 52 28 | 7 47 | 53 26 | 7 57 | 54 24 | 8 6 | 55 22 | 8 16 |
| 2 | 48 36 | 7 10 | 49 34 | 7 20 | 50 32 | 7 29 | 51 30 | 7 39 | 52 28 | 7 48 | 53 26 | 7 58 | 54 24 | 8 7 | 55 22 | 8 17 |
| 4 | 48 36 | 7 11 | 49 34 | 7 21 | 50 32 | 7 30 | 51 30 | 7 40 | 52 28 | 7 49 | 53 26 | 7 59 | 54 24 | 8 8 | 55 22 | 8 18 |
| 6 | 48 36 | 7 13 | 49 34 | 7 22 | 50 32 | 7 32 | 51 30 | 7 41 | 52 28 | 7 51 | 53 26 | 8 0 | 54 24 | 8 10 | 55 22 | 8 19 |
| 8 | 48 36 | 7 14 | 49 34 | 7 23 | 50 32 | 7 33 | 51 30 | 7 42 | 52 28 | 7 52 | 53 26 | 8 1 | 54 24 | 8 11 | 55 22 | 8 20 |
| 10 | 48 36 | 7 15 | 49 34 | 7 24 | 50 32 | 7 34 | 51 30 | 7 43 | 52 28 | 7 53 | 53 26 | 8 2 | 54 24 | 8 12 | 55 22 | 8 21 |
| 12 | 48 36 | 7 16 | 49 34 | 7 25 | 50 32 | 7 35 | 51 30 | 7 44 | 52 28 | 7 54 | 53 26 | 8 4 | 54 23 | 8 13 | 55 22 | 8 23 |
| 14 | 48 36 | 7 17 | 49 34 | 7 26 | 50 32 | 7 36 | 51 30 | 7 45 | 52 28 | 7 55 | 53 26 | 8 5 | 54 23 | 8 14 | 55 21 | 8 24 |
| 16 | 48 36 | 7 18 | 49 34 | 7 27 | 50 32 | 7 37 | 51 30 | 7 47 | 52 28 | 7 56 | 53 25 | 8 6 | 54 23 | 8 15 | 55 21 | 8 25 |
| 18 | 48 36 | 7 19 | 49 34 | 7 28 | 50 32 | 7 38 | 51 30 | 7 48 | 52 27 | 7 57 | 53 25 | 8 7 | 54 23 | 8 17 | 55 21 | 8 26 |
| 20 | 48 36 | 7 20 | 49 34 | 7 29 | 50 32 | 7 39 | 51 30 | 7 49 | 52 27 | 7 58 | 53 25 | 8 8 | 54 23 | 8 18 | 55 21 | 8 27 |
| 22 | 48 36 | 7 21 | 49 34 | 7 31 | 50 32 | 7 40 | 51 30 | 7 50 | 52 27 | 8 0 | 53 25 | 8 9 | 54 23 | 8 19 | 55 21 | 8 29 |
| 24 | 48 36 | 7 22 | 49 34 | 7 32 | 50 32 | 7 41 | 51 30 | 7 51 | 52 27 | 8 1 | 53 25 | 8 10 | 54 23 | 8 20 | 55 21 | 8 30 |
| 26 | 48 36 | 7 23 | 49 34 | 7 33 | 50 32 | 7 42 | 51 29 | 7 52 | 52 27 | 8 2 | 53 25 | 8 11 | 54 23 | 8 21 | 55 21 | 8 31 |
| 28 | 48 36 | 7 24 | 49 34 | 7 34 | 50 31 | 7 43 | 51 29 | 7 53 | 52 27 | 8 3 | 53 25 | 8 13 | 54 23 | 8 22 | 55 21 | 8 32 |
| 30 | 48 36 | 7 25 | 49 33 | 7 35 | 50 31 | 7 44 | 51 29 | 7 54 | 52 27 | 8 4 | 53 25 | 8 14 | 54 23 | 8 23 | 55 21 | 8 33 |
| 32 | 48 36 | 7 26 | 49 33 | 7 36 | 50 31 | 7 46 | 51 29 | 7 55 | 52 27 | 8 5 | 53 25 | 8 15 | 54 23 | 8 25 | 55 20 | 8 34 |
| 34 | 48 36 | 7 27 | 49 33 | 7 37 | 50 31 | 7 47 | 51 29 | 7 56 | 52 27 | 8 6 | 53 25 | 8 16 | 54 22 | 8 26 | 55 20 | 8 36 |
| 36 | 48 36 | 7 28 | 49 33 | 7 38 | 50 31 | 7 48 | 51 29 | 7 58 | 52 27 | 8 7 | 53 24 | 8 17 | 54 22 | 8 27 | 55 20 | 8 37 |
| 38 | 48 36 | 7 29 | 49 33 | 7 39 | 50 31 | 7 49 | 51 29 | 7 59 | 52 27 | 8 8 | 53 24 | 8 18 | 54 22 | 8 28 | 55 20 | 8 38 |
| 40 | 48 36 | 7 30 | 49 33 | 7 40 | 50 31 | 7 50 | 51 29 | 8 0 | 52 27 | 8 9 | 53 24 | 8 19 | 54 22 | 8 29 | 55 20 | 8 39 |
| 42 | 48 36 | 7 31 | 49 33 | 7 41 | 50 31 | 7 51 | 51 29 | 8 1 | 52 27 | 8 11 | 53 24 | 8 21 | 54 22 | 8 30 | 55 20 | 8 40 |
| 44 | 48 36 | 7 32 | 49 33 | 7 42 | 50 31 | 7 52 | 51 29 | 8 2 | 52 27 | 8 12 | 53 24 | 8 22 | 54 22 | 8 32 | 55 20 | 8 41 |
| 46 | 48 36 | 7 33 | 49 33 | 7 43 | 50 31 | 7 53 | 51 29 | 8 3 | 52 27 | 8 13 | 53 24 | 8 23 | 54 22 | 8 33 | 55 20 | 8 43 |
| 48 | 48 36 | 7 34 | 49 33 | 7 44 | 50 31 | 7 54 | 51 29 | 8 4 | 52 27 | 8 14 | 53 24 | 8 24 | 54 22 | 8 34 | 55 20 | 8 44 |
| 50 | 48 36 | 7 35 | 49 33 | 7 45 | 50 31 | 7 55 | 51 29 | 8 5 | 52 27 | 8 15 | 53 24 | 8 25 | 54 22 | 8 35 | 55 19 | 8 45 |
| 52 | 48 36 | 7 37 | 49 33 | 7 46 | 50 31 | 7 56 | 51 29 | 8 6 | 52 27 | 8 16 | 53 24 | 8 26 | 54 22 | 8 36 | 55 19 | 8 46 |
| 54 | 48 36 | 7 38 | 49 33 | 7 48 | 50 31 | 7 57 | 51 29 | 8 7 | 52 26 | 8 17 | 53 24 | 8 27 | 54 22 | 8 37 | 55 19 | 8 47 |
| 56 | 48 36 | 7 39 | 49 33 | 7 49 | 50 31 | 7 59 | 51 29 | 8 8 | 52 26 | 8 18 | 53 24 | 8 28 | 54 22 | 8 38 | 55 19 | 8 48 |
| 58 | 48 36 | 7 40 | 49 33 | 7 50 | 50 31 | 8 0 | 51 29 | 8 10 | 52 26 | 8 20 | 53 24 | 8 29 | 54 22 | 8 39 | 55 19 | 8 49 |

| Seconds of H. P. | | |
|---|---|---|
| ″ | Corr. | A |
| | ″ | ″ |
| 1 | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 0 |
| 4 | 4 | 1 |
| 5 | 5 | 1 |
| 6 | 6 | 1 |
| 7 | 7 | 1 |
| 8 | 8 | 1 |
| 9 | 9 | 1 |
| 10 | 10 | 2 |
| 11 | 11 | 2 |
| 12 | 12 | 2 |
| 13 | 13 | 2 |
| 14 | 14 | 2 |
| 15 | 14 | 2 |
| 16 | 15 | 2 |
| 17 | 16 | 3 |
| 18 | 17 | 3 |
| 19 | 18 | 3 |
| 20 | 19 | 3 |
| 21 | 20 | 3 |
| 22 | 21 | 3 |
| 23 | 22 | 4 |
| 24 | 23 | 4 |
| 25 | 24 | 4 |
| 26 | 25 | 4 |
| 27 | 26 | 4 |
| 28 | 27 | 4 |
| 29 | 28 | 4 |
| 30 | 29 | 5 |
| 31 | 30 | 5 |
| 32 | 31 | 5 |
| 33 | 32 | 5 |
| 34 | 33 | 5 |
| 35 | 34 | 5 |
| 36 | 35 | 5 |
| 37 | 36 | 6 |
| 38 | 37 | 6 |
| 39 | 38 | 6 |
| 40 | 39 | 6 |
| 41 | 40 | 6 |
| 42 | 41 | 6 |
| 43 | 42 | 7 |
| 44 | 42 | 7 |
| 45 | 43 | 7 |
| 46 | 44 | 7 |
| 47 | 45 | 7 |
| 48 | 46 | 7 |
| 49 | 47 | 7 |
| 50 | 48 | 8 |
| 51 | 49 | 8 |
| 52 | 50 | 8 |
| 53 | 51 | 8 |
| 54 | 52 | 8 |
| 55 | 53 | 8 |
| 56 | 54 | 8 |
| 57 | 55 | 9 |
| 58 | 56 | 9 |
| 59 | 57 | 9 |
| App. Alt. | = A | = A |
| ☉ | 8 | 8 |
| 3 | 6 | 5 |
| 4 | 4 | 4 |
| 5 | 3 | 3 |
| 6 | 2 | 2 |
| 7 | 2 | 1 |
| 8 | 2 | 1 |
| 9 | 2 | 0 |
| 10 | 3 | 0 |
| 20 | 4 | 0 |
| 30 | 5 | 0 |
| 40 | 6 | 0 |
| 50 | 7 | 0 |
| 60 | 8 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (16° and 17°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ Corr. + | A 60° | 55′ Corr. + | A 60° | 56′ Corr. + | A 60° | 57′ Corr. + | A 60° | 58′ Corr. + | A 60° | 59′ Corr. + | A 60° | 60′ Corr. + | A 60° | 61′ Corr. + | A 60° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 48 36 | 7 41 | 49 33 | 7 51 | 50 31 | 8 1 | 51 28 | 8 11 | 52 26 | 8 21 | 53 23 | 8 31 | 54 21 | 8 41 | 55 19 | 8 50 |
| 2 | 48 36 | 7 42 | 49 33 | 7 52 | 50 31 | 8 2 | 51 28 | 8 12 | 52 26 | 8 22 | 53 23 | 8 32 | 54 21 | 8 42 | 55 18 | 8 52 |
| 4 | 48 35 | 7 43 | 49 33 | 7 53 | 50 30 | 8 3 | 51 28 | 8 13 | 52 26 | 8 23 | 53 23 | 8 33 | 54 21 | 8 43 | 55 18 | 8 53 |
| 6 | 48 35 | 7 44 | 49 33 | 7 54 | 50 30 | 8 4 | 51 28 | 8 14 | 52 25 | 8 24 | 53 23 | 8 34 | 54 20 | 8 44 | 55 18 | 8 54 |
| 8 | 48 35 | 7 45 | 49 32 | 7 55 | 50 30 | 8 5 | 51 28 | 8 15 | 52 25 | 8 25 | 53 23 | 8 35 | 54 20 | 8 45 | 55 18 | 8 55 |
| 10 | 48 35 | 7 46 | 49 32 | 7 56 | 50 30 | 8 6 | 51 27 | 8 16 | 52 25 | 8 26 | 53 23 | 8 36 | 54 20 | 8 47 | 55 18 | 8 57 |
| 12 | 48 34 | 7 47 | 49 32 | 7 57 | 50 30 | 8 7 | 51 27 | 8 17 | 52 25 | 8 27 | 53 22 | 8 38 | 54 20 | 8 48 | 55 18 | 8 58 |
| 14 | 48 34 | 7 48 | 49 32 | 7 58 | 50 29 | 8 8 | 51 27 | 8 18 | 52 25 | 8 29 | 53 22 | 8 39 | 54 20 | 8 49 | 55 17 | 8 59 |
| 16 | 48 34 | 7 49 | 49 32 | 7 59 | 50 29 | 8 9 | 51 27 | 8 20 | 52 24 | 8 30 | 53 22 | 8 40 | 54 20 | 8 50 | 55 17 | 9 0 |
| 18 | 48 34 | 7 50 | 49 31 | 8 0 | 50 29 | 8 10 | 51 27 | 8 21 | 52 24 | 8 31 | 53 22 | 8 41 | 54 19 | 8 51 | 55 17 | 9 2 |
| 20 | 48 33 | 7 51 | 49 31 | 8 1 | 50 29 | 8 11 | 51 26 | 8 22 | 52 24 | 8 32 | 53 22 | 8 42 | 54 19 | 8 52 | 55 17 | 9 3 |
| 22 | 48 33 | 7 52 | 49 31 | 8 2 | 50 29 | 8 13 | 51 26 | 8 23 | 52 24 | 8 33 | 53 21 | 8 43 | 54 19 | 8 54 | 55 17 | 9 4 |
| 24 | 48 33 | 7 53 | 49 31 | 8 3 | 50 28 | 8 14 | 51 26 | 8 24 | 52 24 | 8 34 | 53 21 | 8 45 | 54 19 | 8 55 | 55 16 | 9 5 |
| 26 | 48 33 | 7 54 | 49 31 | 8 4 | 50 28 | 8 15 | 51 26 | 8 25 | 52 23 | 8 35 | 53 21 | 8 46 | 54 19 | 8 56 | 55 16 | 9 6 |
| 28 | 48 33 | 7 55 | 49 31 | 8 6 | 50 28 | 8 16 | 51 26 | 8 26 | 52 23 | 8 36 | 53 21 | 8 47 | 54 18 | 8 57 | 55 16 | 9 7 |
| 30 | 48 33 | 7 56 | 49 30 | 8 7 | 50 28 | 8 17 | 51 26 | 8 27 | 52 23 | 8 38 | 53 21 | 8 48 | 54 18 | 8 58 | 55 16 | 9 9 |
| 32 | 48 33 | 7 57 | 49 30 | 8 8 | 50 28 | 8 18 | 51 25 | 8 28 | 52 23 | 8 39 | 53 21 | 8 49 | 54 18 | 8 59 | 55 16 | 9 10 |
| 34 | 48 33 | 7 58 | 49 30 | 8 9 | 50 28 | 8 19 | 51 25 | 8 29 | 52 23 | 8 40 | 53 20 | 8 50 | 54 18 | 9 0 | 55 15 | 9 11 |
| 36 | 48 33 | 7 59 | 49 30 | 8 10 | 50 28 | 8 20 | 51 25 | 8 31 | 52 23 | 8 41 | 53 20 | 8 51 | 54 18 | 9 2 | 55 15 | 9 12 |
| 38 | 48 32 | 8 0 | 49 30 | 8 11 | 50 27 | 8 21 | 51 25 | 8 32 | 52 22 | 8 42 | 53 20 | 8 52 | 54 17 | 9 3 | 55 15 | 9 13 |
| 40 | 48 32 | 8 1 | 49 30 | 8 12 | 50 27 | 8 22 | 51 25 | 8 33 | 52 22 | 8 43 | 53 20 | 8 54 | 54 17 | 9 4 | 55 15 | 9 14 |
| 42 | 48 32 | 8 3 | 49 30 | 8 13 | 50 27 | 8 23 | 51 25 | 8 34 | 52 22 | 8 44 | 53 20 | 8 55 | 54 17 | 9 5 | 55 15 | 9 16 |
| 44 | 48 32 | 8 4 | 49 29 | 8 14 | 50 27 | 8 25 | 51 24 | 8 35 | 52 22 | 8 45 | 53 19 | 8 56 | 54 17 | 9 6 | 55 14 | 9 17 |
| 46 | 48 32 | 8 5 | 49 29 | 8 15 | 50 27 | 8 26 | 51 24 | 8 36 | 52 22 | 8 47 | 53 19 | 8 57 | 54 17 | 9 8 | 55 14 | 9 18 |
| 48 | 48 32 | 8 6 | 49 29 | 8 16 | 50 27 | 8 27 | 51 24 | 8 37 | 52 21 | 8 48 | 53 19 | 8 58 | 54 16 | 9 9 | 55 14 | 9 19 |
| 50 | 48 32 | 8 7 | 49 29 | 8 17 | 50 26 | 8 28 | 51 24 | 8 38 | 52 21 | 8 49 | 53 19 | 8 59 | 54 16 | 9 10 | 55 14 | 9 20 |
| 52 | 48 31 | 8 8 | 49 29 | 8 18 | 50 26 | 8 29 | 51 24 | 8 39 | 52 21 | 8 50 | 53 19 | 9 0 | 54 16 | 9 11 | 55 13 | 9 22 |
| 54 | 48 31 | 8 9 | 49 29 | 8 19 | 50 26 | 8 30 | 51 24 | 8 40 | 52 21 | 8 51 | 53 18 | 9 2 | 54 16 | 9 12 | 55 13 | 9 23 |
| 56 | 48 31 | 8 10 | 49 29 | 8 20 | 50 26 | 8 31 | 51 23 | 8 42 | 52 21 | 8 52 | 53 18 | 9 3 | 54 16 | 9 13 | 55 13 | 9 24 |
| 58 | 48 31 | 8 11 | 49 28 | 8 21 | 50 26 | 8 32 | 51 23 | 8 43 | 52 20 | 8 53 | 53 18 | 9 4 | 54 15 | 9 14 | 55 13 | 9 25 |
| 17° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 48 31 | 8 12 | 49 28 | 8 22 | 50 26 | 8 33 | 51 23 | 8 44 | 52 20 | 8 54 | 53 18 | 9 5 | 54 15 | 9 16 | 55 12 | 9 26 |
| 2 | 48 31 | 8 13 | 49 28 | 8 24 | 50 25 | 8 34 | 51 23 | 8 45 | 52 20 | 8 56 | 53 17 | 9 6 | 54 15 | 9 17 | 55 12 | 9 27 |
| 4 | 48 30 | 8 14 | 49 28 | 8 25 | 50 25 | 8 35 | 51 23 | 8 46 | 52 20 | 8 57 | 53 17 | 9 7 | 54 15 | 9 18 | 55 12 | 9 29 |
| 6 | 48 30 | 8 15 | 49 28 | 8 26 | 50 25 | 8 36 | 51 22 | 8 47 | 52 20 | 8 58 | 53 17 | 9 8 | 54 14 | 9 19 | 55 12 | 9 30 |
| 8 | 48 30 | 8 16 | 49 27 | 8 27 | 50 25 | 8 37 | 51 22 | 8 48 | 52 19 | 8 59 | 53 17 | 9 10 | 54 14 | 9 20 | 55 11 | 9 31 |
| 10 | 48 30 | 8 17 | 49 27 | 8 28 | 50 25 | 8 38 | 51 22 | 8 49 | 52 19 | 9 0 | 53 17 | 9 11 | 54 14 | 9 21 | 55 11 | 9 32 |
| 12 | 48 30 | 8 18 | 49 27 | 8 29 | 50 24 | 8 40 | 51 22 | 8 50 | 52 19 | 9 1 | 53 16 | 9 12 | 54 14 | 9 22 | 55 11 | 9 33 |
| 14 | 48 29 | 8 19 | 49 27 | 8 30 | 50 24 | 8 41 | 51 21 | 8 51 | 52 19 | 9 2 | 53 16 | 9 13 | 54 13 | 9 24 | 55 11 | 9 34 |
| 16 | 48 29 | 8 20 | 49 27 | 8 31 | 50 24 | 8 42 | 51 21 | 8 53 | 52 19 | 9 3 | 53 16 | 9 14 | 54 13 | 9 25 | 55 10 | 9 36 |
| 18 | 48 29 | 8 21 | 49 26 | 8 32 | 50 24 | 8 43 | 51 21 | 8 54 | 52 18 | 9 4 | 53 16 | 9 15 | 54 13 | 9 26 | 55 10 | 9 37 |
| 20 | 48 29 | 8 22 | 49 26 | 8 33 | 50 23 | 8 44 | 51 21 | 8 55 | 52 18 | 9 5 | 53 15 | 9 16 | 54 13 | 9 27 | 55 10 | 9 38 |
| 22 | 48 29 | 8 23 | 49 26 | 8 34 | 50 23 | 8 45 | 51 21 | 8 56 | 52 18 | 9 7 | 53 15 | 9 17 | 54 12 | 9 28 | 55 10 | 9 39 |
| 24 | 48 28 | 8 24 | 49 26 | 8 35 | 50 23 | 8 46 | 51 20 | 8 57 | 52 18 | 9 8 | 53 15 | 9 19 | 54 12 | 9 29 | 55 9 | 9 40 |
| 26 | 48 28 | 8 25 | 49 26 | 8 36 | 50 23 | 8 47 | 51 20 | 8 58 | 52 17 | 9 9 | 53 15 | 9 20 | 54 12 | 9 31 | 55 9 | 9 41 |
| 28 | 48 28 | 8 26 | 49 25 | 8 37 | 50 23 | 8 48 | 51 20 | 8 59 | 52 17 | 9 10 | 53 14 | 9 21 | 54 12 | 9 32 | 55 9 | 9 43 |
| 30 | 48 28 | 8 27 | 49 25 | 8 38 | 50 22 | 8 49 | 51 20 | 9 0 | 52 17 | 9 11 | 53 14 | 9 22 | 54 11 | 9 33 | 55 9 | 9 44 |
| 32 | 48 28 | 8 28 | 49 25 | 8 39 | 50 22 | 8 50 | 51 19 | 9 1 | 52 17 | 9 12 | 53 14 | 9 23 | 54 11 | 9 34 | 55 8 | 9 45 |
| 34 | 48 27 | 8 30 | 49 25 | 8 40 | 50 22 | 8 51 | 51 19 | 9 2 | 52 16 | 9 13 | 53 14 | 9 24 | 54 11 | 9 35 | 55 8 | 9 46 |
| 36 | 48 27 | 8 31 | 49 25 | 8 41 | 50 22 | 8 52 | 51 19 | 9 3 | 52 16 | 9 14 | 53 13 | 9 25 | 54 11 | 9 36 | 55 8 | 9 47 |
| 38 | 48 27 | 8 32 | 49 24 | 8 43 | 50 22 | 8 54 | 51 19 | 9 5 | 52 16 | 9 15 | 53 13 | 9 26 | 54 10 | 9 37 | 55 8 | 9 48 |
| 40 | 48 27 | 8 33 | 49 24 | 8 44 | 50 21 | 8 55 | 51 18 | 9 6 | 52 16 | 9 17 | 53 13 | 9 28 | 54 10 | 9 39 | 55 7 | 9 50 |
| 42 | 48 27 | 8 34 | 49 24 | 8 45 | 50 21 | 8 56 | 51 18 | 9 7 | 52 15 | 9 18 | 53 13 | 9 29 | 54 10 | 9 40 | 55 7 | 9 51 |
| 44 | 48 26 | 8 35 | 49 24 | 8 46 | 50 21 | 8 57 | 51 18 | 9 8 | 52 15 | 9 19 | 53 12 | 9 30 | 54 9 | 9 41 | 55 7 | 9 52 |
| 46 | 48 26 | 8 36 | 49 23 | 8 47 | 50 21 | 8 58 | 51 18 | 9 9 | 52 15 | 9 20 | 53 12 | 9 31 | 54 9 | 9 42 | 55 6 | 9 53 |
| 48 | 48 26 | 8 37 | 49 23 | 8 48 | 50 20 | 8 59 | 51 17 | 9 10 | 52 15 | 9 21 | 53 12 | 9 32 | 54 9 | 9 43 | 55 6 | 9 54 |
| 50 | 48 26 | 8 38 | 49 23 | 8 49 | 50 20 | 9 0 | 51 17 | 9 11 | 52 14 | 9 22 | 53 11 | 9 33 | 54 9 | 9 44 | 55 6 | 9 55 |
| 52 | 48 26 | 8 39 | 49 23 | 8 50 | 50 20 | 9 1 | 51 17 | 9 12 | 52 14 | 9 23 | 53 11 | 9 34 | 54 8 | 9 45 | 55 5 | 9 57 |
| 54 | 48 25 | 8 40 | 49 22 | 8 51 | 50 20 | 9 2 | 51 17 | 9 13 | 52 14 | 9 24 | 53 11 | 9 35 | 54 8 | 9 47 | 55 5 | 9 58 |
| 56 | 48 25 | 8 41 | 49 22 | 8 52 | 50 19 | 9 3 | 51 16 | 9 14 | 52 13 | 9 25 | 53 11 | 9 37 | 54 8 | 9 48 | 55 5 | 9 59 |
| 58 | 48 25 | 8 42 | 49 22 | 8 53 | 50 19 | 9 4 | 51 16 | 9 15 | 52 13 | 9 26 | 53 10 | 9 38 | 54 7 | 9 49 | 55 4 | 10 0 |

| Seconds of H. P. | ′ | 55 A ″ |
|---|---|---|
| 0″ | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 1 |
| 4 | 4 | 1 |
| 5 | 5 | 1 |
| 6 | 6 | 1 |
| 7 | 7 | 1 |
| 8 | 8 | 1 |
| 9 | 9 | 2 |
| 10 | 10 | 2 |
| 11 | 11 | 2 |
| 12 | 12 | 2 |
| 13 | 12 | 2 |
| 14 | 13 | 3 |
| 15 | 14 | 3 |
| 16 | 15 | 3 |
| 17 | 16 | 3 |
| 18 | 17 | 3 |
| 19 | 18 | 3 |
| 20 | 19 | 4 |
| 21 | 20 | 4 |
| 22 | 21 | 4 |
| 23 | 22 | 4 |
| 24 | 23 | 4 |
| 25 | 24 | 5 |
| 26 | 25 | 5 |
| 27 | 26 | 5 |
| 28 | 27 | 5 |
| 29 | 28 | 5 |
| 30 | 29 | 5 |
| 31 | 30 | 6 |
| 32 | 31 | 6 |
| 33 | 32 | 6 |
| 34 | 33 | 6 |
| 35 | 34 | 6 |
| 36 | 35 | 7 |
| 37 | 35 | 7 |
| 38 | 36 | 7 |
| 39 | 37 | 7 |
| 40 | 38 | 7 |
| 41 | 39 | 7 |
| 42 | 40 | 8 |
| 43 | 41 | 8 |
| 44 | 42 | 8 |
| 45 | 43 | 8 |
| 46 | 44 | 8 |
| 47 | 45 | 9 |
| 48 | 46 | 9 |
| 49 | 47 | 9 |
| 50 | 48 | 9 |
| 51 | 49 | 9 |
| 52 | 50 | 9 |
| 53 | 51 | 10 |
| 54 | 52 | 10 |
| 55 | 53 | 10 |
| 56 | 54 | 10 |
| 57 | 55 | 10 |
| 58 | 56 | 11 |
| 59 | 57 | 11 |
| | ☽ A | ☉ A |
| 0″ | 8′ | 8′ |
| 2 | 6 | 5 |
| 3 | 4 | 4 |
| 4 | 3 | 3 |
| 5 | 2 | 2 |
| 6 | 2 | 2 |
| 7 | 2 | 1 |
| 8 | 2 | 1 |
| 9 | 1 | 1 |
| 10 | 1 | 1 |
| 11 | 1 | 1 |
| 12 | 1 | 1 |
| 13 | 1 | 1 |
| 14 | 1 | 1 |
| 15 | 1 | 1 |
| 16 | 1 | 1 |
| 17 | 1 | 1 |
| 18 | 1 | 1 |
| 19 | 1 | 1 |
| 20 | 1 | 1 |
| 21 | 1 | 1 |
| 22 | 1 | 1 |
| 23 | 1 | 1 |
| 24 | 1 | 1 |
| 25 | 1 | 1 |
| 26 | 1 | 1 |
| 27 | 1 | 1 |
| 28 | 1 | 1 |
| 29 | 1 | 1 |
| 30 | 1 | 1 |
| 31 | 1 | 1 |
| 32 | 1 | 1 |
| 33 | 1 | 1 |
| 34 | 1 | 1 |
| 35 | 1 | 1 |
| 36 | 1 | 1 |
| 37 | 1 | 1 |
| 38 | 1 | 1 |
| 39 | 1 | 1 |
| 40 | 1 | 1 |
| 41 | 1 | 1 |
| 42 | 1 | 1 |
| 43 | 1 | 1 |
| 44 | 1 | 1 |
| 45 | 1 | 1 |
| 46 | 1 | 1 |
| 47 | 1 | 1 |
| 48 | 1 | 1 |
| 49 | 1 | 1 |
| 50 | 1 | 1 |
| 51 | 1 | 1 |
| 52 | 1 | 1 |
| 53 | 1 | 1 |
| 54 | 1 | 1 |
| 55 | 1 | 1 |
| 56 | 1 | 1 |
| 57 | 1 | 1 |
| 58 | 1 | 1 |
| 59 | 1 | 1 |
| 60 | 1 | 1 |

(18° and 19°) The Correction of the Moon's Altitude, and the Aux. Angle A (w.)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. − | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 48 25 | 8 43 | 49 22 | 8 54 | 50 19 | 9 5 | 51 16 | 9 16 | 52 13 | 9 28 | 53 10 | 9 39 | 54 7 | 9 50 | 55 4 | 10 1 |
| 2 | 48 24 | 8 44 | 49 22 | 8 55 | 50 19 | 9 6 | 51 16 | 9 18 | 52 13 | 9 29 | 53 10 | 9 40 | 54 7 | 9 51 | 55 4 | 10 2 |
| 4 | 48 24 | 8 45 | 49 21 | 8 56 | 50 18 | 9 7 | 51 15 | 9 19 | 52 12 | 9 30 | 53 9 | 9 41 | 54 6 | 9 52 | 55 3 | 10 4 |
| 6 | 48 24 | 8 46 | 49 21 | 8 57 | 50 18 | 9 8 | 51 15 | 9 20 | 52 12 | 9 31 | 53 9 | 9 42 | 54 6 | 9 53 | 55 3 | 10 5 |
| 8 | 48 24 | 8 47 | 49 21 | 8 58 | 50 18 | 9 10 | 51 15 | 9 21 | 52 12 | 9 32 | 53 9 | 9 43 | 54 6 | 9 55 | 55 3 | 10 6 |
| 10 | 48 23 | 8 48 | 49 20 | 8 59 | 50 17 | 9 11 | 51 14 | 9 22 | 52 11 | 9 33 | 53 8 | 9 44 | 54 5 | 9 56 | 55 3 | 10 7 |
| 12 | 48 23 | 8 49 | 49 20 | 9 0 | 50 17 | 9 12 | 51 14 | 9 23 | 52 11 | 9 34 | 53 8 | 9 46 | 54 5 | 9 57 | 55 2 | 10 8 |
| 14 | 48 23 | 8 50 | 49 20 | 9 1 | 50 17 | 9 13 | 51 14 | 9 24 | 52 11 | 9 35 | 53 8 | 9 47 | 54 5 | 9 58 | 55 2 | 10 9 |
| 16 | 48 23 | 8 51 | 49 20 | 9 2 | 50 17 | 9 14 | 51 14 | 9 25 | 52 11 | 9 36 | 53 8 | 9 48 | 54 5 | 9 59 | 55 2 | 10 10 |
| 18 | 48 22 | 8 52 | 49 19 | 9 4 | 50 16 | 9 15 | 51 13 | 9 26 | 52 10 | 9 38 | 53 7 | 9 49 | 54 4 | 10 0 | 55 1 | 10 12 |
| 20 | 48 22 | 8 53 | 49 19 | 9 5 | 50 16 | 9 16 | 51 13 | 9 27 | 52 10 | 9 39 | 53 7 | 9 50 | 54 4 | 10 1 | 55 1 | 10 13 |
| 22 | 48 22 | 8 54 | 49 19 | 9 6 | 50 16 | 9 17 | 51 13 | 9 28 | 52 10 | 9 40 | 53 7 | 9 51 | 54 4 | 10 3 | 55 1 | 10 14 |
| 24 | 48 22 | 8 55 | 49 19 | 9 7 | 50 15 | 9 18 | 51 12 | 9 29 | 52 9 | 9 41 | 53 6 | 9 52 | 54 3 | 10 4 | 55 0 | 10 15 |
| 26 | 48 21 | 8 56 | 49 18 | 9 8 | 50 15 | 9 19 | 51 12 | 9 31 | 52 9 | 9 42 | 53 6 | 9 53 | 54 3 | 10 5 | 55 0 | 10 16 |
| 28 | 48 21 | 8 57 | 49 18 | 9 9 | 50 15 | 9 20 | 51 12 | 9 32 | 52 9 | 9 43 | 53 6 | 9 55 | 54 3 | 10 6 | 55 0 | 10 17 |
| 30 | 48 21 | 8 58 | 49 18 | 9 10 | 50 15 | 9 21 | 51 12 | 9 33 | 52 8 | 9 44 | 53 5 | 9 56 | 54 2 | 10 7 | 54 59 | 10 19 |
| 32 | 48 20 | 8 59 | 49 17 | 9 11 | 50 14 | 9 22 | 51 11 | 9 34 | 52 8 | 9 45 | 53 5 | 9 57 | 54 2 | 10 8 | 54 59 | 10 20 |
| 34 | 48 20 | 9 0 | 49 17 | 9 12 | 50 14 | 9 23 | 51 11 | 9 35 | 52 8 | 9 46 | 53 5 | 9 58 | 54 2 | 10 9 | 54 58 | 10 21 |
| 36 | 48 20 | 9 1 | 49 17 | 9 13 | 50 14 | 9 24 | 51 11 | 9 36 | 52 7 | 9 47 | 53 4 | 9 59 | 54 1 | 10 11 | 54 58 | 10 22 |
| 38 | 48 20 | 9 2 | 49 17 | 9 14 | 50 13 | 9 26 | 51 10 | 9 37 | 52 7 | 9 49 | 53 4 | 10 0 | 54 1 | 10 12 | 54 58 | 10 23 |
| 40 | 48 19 | 9 3 | 49 16 | 9 15 | 50 13 | 9 27 | 51 10 | 9 38 | 52 7 | 9 50 | 53 4 | 10 1 | 54 0 | 10 13 | 54 57 | 10 24 |
| 42 | 48 19 | 9 5 | 49 16 | 9 16 | 50 13 | 9 28 | 51 10 | 9 39 | 52 6 | 9 51 | 53 3 | 10 2 | 54 0 | 10 14 | 54 57 | 10 26 |
| 44 | 48 19 | 9 6 | 49 16 | 9 17 | 50 13 | 9 29 | 51 9 | 9 40 | 52 6 | 9 52 | 53 3 | 10 4 | 54 0 | 10 15 | 54 57 | 10 27 |
| 46 | 48 19 | 9 7 | 49 15 | 9 18 | 50 12 | 9 30 | 51 9 | 9 41 | 52 6 | 9 53 | 53 3 | 10 5 | 53 59 | 10 16 | 54 56 | 10 28 |
| 48 | 48 18 | 9 8 | 49 15 | 9 19 | 50 12 | 9 31 | 51 9 | 9 43 | 52 6 | 9 54 | 53 2 | 10 6 | 53 59 | 10 17 | 54 56 | 10 29 |
| 50 | 48 18 | 9 9 | 49 15 | 9 20 | 50 12 | 9 32 | 51 8 | 9 44 | 52 5 | 9 55 | 53 2 | 10 7 | 53 59 | 10 19 | 54 56 | 10 30 |
| 52 | 48 18 | 9 10 | 49 15 | 9 21 | 50 11 | 9 33 | 51 8 | 9 45 | 52 5 | 9 56 | 53 2 | 10 8 | 53 58 | 10 20 | 54 55 | 10 31 |
| 54 | 48 18 | 9 11 | 49 14 | 9 22 | 50 11 | 9 34 | 51 8 | 9 46 | 52 5 | 9 57 | 53 1 | 10 9 | 53 58 | 10 21 | 54 55 | 10 33 |
| 56 | 48 17 | 9 12 | 49 14 | 9 23 | 50 11 | 9 35 | 51 7 | 9 47 | 52 4 | 9 58 | 53 1 | 10 10 | 53 58 | 10 22 | 54 55 | 10 34 |
| 58 | 48 17 | 9 13 | 49 14 | 9 25 | 50 10 | 9 36 | 51 7 | 9 48 | 52 4 | 10 0 | 53 1 | 10 11 | 53 57 | 10 23 | 54 54 | 10 35 |

| 19° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 48 17 | 9 14 | 49 13 | 9 26 | 50 10 | 9 37 | 51 7 | 9 49 | 52 4 | 10 1 | 53 0 | 10 13 | 53 57 | 10 24 | 54 54 | 10 36 |
| 2 | 48 16 | 9 15 | 49 13 | 9 27 | 50 10 | 9 38 | 51 7 | 9 50 | 52 3 | 10 2 | 53 0 | 10 14 | 53 57 | 10 25 | 54 53 | 10 37 |
| 4 | 48 16 | 9 16 | 49 13 | 9 28 | 50 9 | 9 39 | 51 6 | 9 51 | 52 3 | 10 3 | 53 0 | 10 15 | 53 56 | 10 27 | 54 53 | 10 38 |
| 6 | 48 16 | 9 17 | 49 12 | 9 29 | 50 9 | 9 40 | 51 6 | 9 52 | 52 3 | 10 4 | 52 59 | 10 16 | 53 56 | 10 28 | 54 53 | 10 40 |
| 8 | 48 15 | 9 18 | 49 12 | 9 30 | 50 9 | 9 42 | 51 5 | 9 53 | 52 2 | 10 5 | 52 59 | 10 17 | 53 56 | 10 29 | 54 52 | 10 41 |
| 10 | 48 15 | 9 19 | 49 12 | 9 31 | 50 8 | 9 43 | 51 5 | 9 54 | 52 2 | 10 6 | 52 58 | 10 18 | 53 55 | 10 30 | 54 52 | 10 42 |
| 12 | 46 15 | 9 20 | 49 11 | 9 32 | 50 8 | 9 44 | 51 5 | 9 56 | 52 1 | 10 7 | 52 58 | 10 19 | 53 55 | 10 31 | 54 51 | 10 43 |
| 14 | 48 14 | 9 21 | 49 11 | 9 33 | 50 8 | 9 45 | 51 4 | 9 57 | 52 1 | 10 8 | 52 58 | 10 20 | 53 54 | 10 32 | 54 51 | 10 44 |
| 16 | 48 14 | 9 22 | 49 11 | 9 34 | 50 7 | 9 46 | 51 4 | 9 58 | 52 1 | 10 10 | 52 57 | 10 21 | 53 54 | 10 33 | 54 51 | 10 45 |
| 18 | 48 14 | 9 23 | 49 10 | 9 35 | 50 7 | 9 47 | 51 4 | 9 59 | 52 0 | 10 11 | 52 57 | 10 23 | 53 54 | 10 35 | 54 50 | 10 46 |
| 20 | 48 13 | 9 24 | 49 10 | 9 36 | 50 7 | 9 48 | 51 3 | 10 0 | 52 0 | 10 12 | 52 57 | 10 24 | 53 53 | 10 36 | 54 50 | 10 48 |
| 22 | 48 13 | 9 25 | 49 10 | 9 37 | 50 6 | 9 49 | 51 3 | 10 1 | 52 0 | 10 13 | 52 56 | 10 25 | 53 53 | 10 37 | 54 49 | 10 49 |
| 24 | 48 13 | 9 26 | 49 9 | 9 38 | 50 6 | 9 50 | 51 3 | 10 2 | 51 59 | 10 14 | 52 56 | 10 26 | 53 52 | 10 38 | 54 49 | 10 50 |
| 26 | 48 12 | 9 27 | 49 9 | 9 39 | 50 6 | 9 51 | 51 2 | 10 3 | 51 59 | 10 15 | 52 55 | 10 27 | 53 52 | 10 39 | 54 49 | 10 51 |
| 28 | 48 12 | 9 28 | 49 9 | 9 40 | 50 5 | 9 52 | 51 2 | 10 4 | 51 59 | 10 16 | 52 55 | 10 28 | 53 52 | 10 40 | 54 48 | 10 52 |
| 30 | 48 12 | 9 29 | 49 8 | 9 41 | 50 5 | 9 53 | 51 1 | 10 5 | 51 58 | 10 17 | 52 55 | 10 29 | 53 51 | 10 41 | 54 48 | 10 53 |
| 32 | 48 11 | 9 30 | 49 8 | 9 42 | 50 5 | 9 54 | 51 1 | 10 6 | 51 58 | 10 18 | 52 54 | 10 30 | 53 51 | 10 42 | 54 47 | 10 54 |
| 34 | 48 11 | 9 31 | 49 8 | 9 43 | 50 4 | 9 55 | 51 1 | 10 7 | 51 57 | 10 19 | 52 54 | 10 31 | 53 50 | 10 44 | 54 47 | 10 56 |
| 36 | 48 11 | 9 32 | 49 7 | 9 44 | 50 4 | 9 56 | 51 0 | 10 8 | 51 57 | 10 21 | 52 54 | 10 33 | 53 50 | 10 45 | 54 47 | 10 57 |
| 38 | 48 11 | 9 33 | 49 7 | 9 45 | 50 4 | 9 57 | 51 0 | 10 10 | 51 57 | 10 22 | 52 53 | 10 34 | 53 50 | 10 46 | 54 46 | 10 58 |
| 40 | 48 10 | 9 34 | 49 7 | 9 46 | 50 3 | 9 58 | 51 0 | 10 11 | 51 56 | 10 23 | 52 53 | 10 35 | 53 49 | 10 47 | 54 46 | 10 59 |
| 42 | 48 10 | 9 35 | 49 6 | 9 47 | 50 3 | 10 0 | 50 59 | 10 12 | 51 56 | 10 24 | 52 52 | 10 36 | 53 49 | 10 48 | 54 45 | 11 0 |
| 44 | 48 10 | 9 36 | 49 6 | 9 48 | 50 2 | 10 1 | 50 59 | 10 13 | 51 56 | 10 25 | 52 52 | 10 37 | 53 48 | 10 49 | 54 45 | 11 1 |
| 46 | 48 9 | 9 37 | 49 6 | 9 49 | 50 2 | 10 2 | 50 59 | 10 14 | 51 55 | 10 26 | 52 52 | 10 38 | 53 48 | 10 50 | 54 45 | 11 3 |
| 48 | 48 9 | 9 38 | 49 5 | 9 50 | 50 2 | 10 3 | 50 58 | 10 15 | 51 55 | 10 27 | 52 51 | 10 39 | 53 48 | 10 51 | 54 44 | 11 4 |
| 50 | 48 8 | 9 39 | 49 5 | 9 51 | 50 1 | 10 4 | 50 58 | 10 16 | 51 54 | 10 28 | 52 51 | 10 40 | 53 47 | 10 53 | 54 44 | 11 5 |
| 52 | 48 8 | 9 40 | 49 5 | 9 52 | 50 1 | 10 5 | 50 57 | 10 17 | 51 54 | 10 29 | 52 50 | 10 41 | 53 47 | 10 54 | 54 43 | 11 6 |
| 54 | 48 8 | 9 41 | 49 4 | 9 53 | 50 1 | 10 6 | 50 57 | 10 18 | 51 54 | 10 30 | 52 50 | 10 42 | 53 46 | 10 55 | 54 43 | 11 7 |
| 56 | 48 7 | 9 42 | 49 4 | 9 54 | 50 0 | 10 7 | 50 57 | 10 19 | 51 53 | 10 31 | 52 50 | 10 43 | 53 46 | 10 56 | 54 42 | 11 8 |
| 58 | 48 7 | 9 43 | 49 4 | 9 55 | 50 0 | 10 8 | 50 56 | 10 20 | 51 53 | 10 32 | 52 49 | 10 45 | 53 46 | 10 57 | 54 42 | 11 10 |

| Seconds of H. P. | | |
|---|---|---|
| ″ | Cor | A |
| | ″ | ″ |
| 1 | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 1 |
| 4 | 4 | 1 |
| 5 | 5 | 1 |
| 6 | 6 | 1 |
| 7 | 7 | 1 |
| 8 | 8 | 2 |
| 9 | 9 | 2 |
| 10 | 9 | 2 |
| 11 | 10 | 2 |
| 12 | 11 | 2 |
| 13 | 12 | 3 |
| 14 | 13 | 3 |
| 15 | 14 | 3 |
| 16 | 15 | 3 |
| 17 | 16 | 3 |
| 18 | 17 | 4 |
| 19 | 18 | 4 |
| 20 | 19 | 4 |
| 21 | 20 | 4 |
| 22 | 21 | 4 |
| 23 | 22 | 5 |
| 24 | 23 | 5 |
| 25 | 24 | 5 |
| 26 | 25 | 5 |
| 27 | 26 | 5 |
| 28 | 27 | 6 |
| 29 | 28 | 6 |
| 30 | 28 | 6 |
| 31 | 29 | 6 |
| 32 | 30 | 6 |
| 33 | 31 | 7 |
| 34 | 32 | 7 |
| 35 | 33 | 7 |
| 36 | 34 | 7 |
| 37 | 35 | 7 |
| 38 | 36 | 8 |
| 39 | 37 | 8 |
| 40 | 38 | 8 |
| 41 | 39 | 8 |
| 42 | 40 | 8 |
| 43 | 41 | 9 |
| 44 | 42 | 9 |
| 45 | 43 | 9 |
| 46 | 44 | 9 |
| 47 | 44 | 9 |
| 48 | 45 | 10 |
| 49 | 46 | 10 |
| 50 | 47 | 10 |
| 51 | 48 | 10 |
| 52 | 49 | 10 |
| 53 | 50 | 11 |
| 54 | 51 | 11 |
| 55 | 52 | 11 |
| 56 | 53 | 11 |
| 57 | 54 | 11 |
| 58 | 55 | 12 |
| 59 | 56 | 12 |

| Alt. | A ☉ | A * |
|---|---|---|
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (20° and 21°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ Corr. + | A 60° | 55′ Corr. + | A 60° | 56′ Corr. + | A 60° | 57′ Corr. + | A 60° | 58′ Corr. + | A 60° | 59′ Corr. + | A 60° | 60′ Corr. + | A 60° | 61′ Corr. + | A 60° | Seconds of H. P. | Corr.ⁿ | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | ″ | ° |
| 0′ | 48 7 | 9 44 | 49 3 | 9 57 | 50 0 | 10 9 | 50 56 | 10 21 | 51 52 | 10 34 | 52 49 | 10 46 | 53 45 | 10 58 | 54 42 | 11 11 | 1 | 1 | 0 |
| 2 | 48 6 | 9 45 | 49 3 | 9 58 | 49 59 | 10 10 | 50 56 | 10 22 | 51 52 | 10 35 | 52 48 | 10 47 | 53 45 | 11 0 | 54 41 | 11 12 | 2 | 2 | 0 |
| 4 | 48 6 | 9 46 | 49 2 | 9 59 | 49 59 | 10 11 | 50 55 | 10 24 | 51 52 | 10 36 | 52 48 | 10 48 | 53 44 | 11 1 | 54 41 | 11 13 | 3 | 3 | 1 |
| 6 | 48 6 | 9 47 | 49 2 | 10 0 | 49 58 | 10 12 | 50 55 | 10 25 | 51 51 | 10 37 | 52 47 | 10 49 | 53 44 | 11 2 | 54 40 | 11 14 | 4 | 4 | 1 |
| 8 | 48 5 | 9 48 | 49 2 | 10 1 | 49 58 | 10 13 | 50 54 | 10 26 | 51 51 | 10 38 | 52 47 | 10 50 | 53 43 | 11 3 | 54 40 | 11 15 | 5 | 5 | 1 |
| 10 | 48 5 | 9 49 | 49 1 | 10 2 | 49 58 | 10 14 | 50 54 | 10 27 | 51 50 | 10 39 | 52 47 | 10 52 | 53 43 | 11 4 | 54 39 | 11 16 | 6 | 6 | 1 |
| 12 | 48 5 | 9 51 | 49 1 | 10 3 | 49 57 | 10 15 | 50 54 | 10 28 | 51 50 | 10 40 | 52 46 | 10 53 | 53 42 | 11 5 | 54 39 | 11 18 | 7 | 7 | 2 |
| 14 | 48 4 | 9 52 | 49 0 | 10 4 | 49 57 | 10 16 | 50 53 | 10 29 | 51 49 | 10 41 | 52 46 | 10 54 | 53 42 | 11 6 | 54 38 | 11 19 | 8 | 8 | 2 |
| 16 | 48 4 | 9 53 | 49 0 | 10 5 | 49 56 | 10 17 | 50 53 | 10 30 | 51 49 | 10 42 | 52 45 | 10 55 | 53 42 | 11 7 | 54 38 | 11 20 | 9 | 9 | 2 |
| 18 | 48 3 | 9 54 | 49 0 | 10 6 | 49 56 | 10 19 | 50 52 | 10 31 | 51 49 | 10 44 | 52 45 | 10 56 | 53 41 | 11 8 | 54 37 | 11 21 | 10 | 10 | 2 |
| 20 | 48 3 | 9 55 | 48 59 | 10 7 | 49 56 | 10 20 | 50 52 | 10 32 | 51 48 | 10 45 | 52 44 | 10 57 | 53 41 | 11 10 | 54 37 | 11 22 | 11 | 11 | 2 |
| 22 | 48 3 | 9 56 | 48 59 | 10 8 | 49 55 | 10 21 | 50 51 | 10 33 | 51 48 | 10 46 | 52 44 | 10 58 | 53 40 | 11 11 | 54 37 | 11 23 | 12 | 12 | 3 |
| 24 | 48 2 | 9 57 | 48 58 | 10 9 | 49 55 | 10 22 | 50 51 | 10 34 | 51 47 | 10 47 | 52 44 | 10 59 | 53 40 | 11 12 | 54 36 | 11 24 | 13 | 13 | 3 |
| 26 | 48 2 | 9 58 | 48 58 | 10 10 | 49 54 | 10 23 | 50 51 | 10 35 | 51 47 | 10 48 | 52 43 | 11 0 | 53 39 | 11 13 | 54 36 | 11 26 | 14 | 14 | 3 |
| 28 | 48 1 | 9 59 | 48 58 | 10 11 | 49 54 | 10 24 | 50 50 | 10 36 | 51 46 | 10 49 | 52 43 | 11 2 | 53 39 | 11 14 | 54 35 | 11 27 | 15 | 15 | 3 |
| 30 | 48 1 | 10 0 | 48 57 | 10 12 | 49 54 | 10 25 | 50 50 | 10 37 | 51 46 | 10 50 | 52 42 | 11 3 | 53 38 | 11 15 | 54 35 | 11 28 | 16 | 16 | 4 |
| 32 | 48 1 | 10 1 | 48 57 | 10 13 | 49 53 | 10 26 | 50 49 | 10 39 | 51 46 | 10 51 | 52 42 | 11 4 | 53 38 | 11 16 | 54 34 | 11 29 | 17 | 16 | 4 |
| 34 | 48 0 | 10 2 | 48 56 | 10 14 | 49 53 | 10 27 | 50 49 | 10 40 | 51 45 | 10 52 | 52 41 | 11 5 | 53 37 | 11 18 | 54 34 | 11 30 | 18 | 17 | 4 |
| 36 | 48 0 | 10 3 | 48 56 | 10 15 | 49 52 | 10 28 | 50 48 | 10 41 | 51 45 | 10 53 | 52 41 | 11 6 | 53 37 | 11 19 | 54 33 | 11 31 | 19 | 18 | 4 |
| 38 | 47 59 | 10 4 | 48 56 | 10 16 | 49 52 | 10 29 | 50 48 | 10 42 | 51 44 | 10 54 | 52 40 | 11 7 | 53 37 | 11 20 | 54 33 | 11 32 | 20 | 19 | 4 |
| 40 | 47 59 | 10 5 | 48 55 | 10 17 | 49 51 | 10 30 | 50 48 | 10 43 | 51 44 | 10 55 | 52 40 | 11 8 | 53 36 | 11 21 | 54 32 | 11 34 | 21 | 20 | 5 |
| 42 | 47 59 | 10 6 | 48 55 | 10 18 | 49 51 | 10 31 | 50 47 | 10 44 | 51 43 | 10 57 | 52 40 | 11 9 | 53 36 | 11 22 | 54 32 | 11 35 | 22 | 21 | 5 |
| 44 | 47 58 | 10 7 | 48 54 | 10 19 | 49 51 | 10 32 | 50 47 | 10 45 | 51 43 | 10 58 | 52 39 | 11 10 | 53 35 | 11 23 | 54 31 | 11 36 | 23 | 22 | 5 |
| 46 | 47 58 | 10 8 | 48 54 | 10 21 | 49 50 | 10 33 | 50 46 | 10 46 | 51 42 | 10 59 | 52 39 | 11 12 | 53 35 | 11 24 | 54 31 | 11 37 | 24 | 23 | 5 |
| 48 | 47 58 | 10 9 | 48 54 | 10 22 | 49 50 | 10 34 | 50 46 | 10 47 | 51 42 | 11 0 | 52 38 | 11 13 | 53 34 | 11 25 | 54 30 | 11 38 | 25 | 24 | 6 |
| 50 | 47 57 | 10 10 | 48 53 | 10 23 | 49 49 | 10 35 | 50 45 | 10 48 | 51 42 | 11 1 | 52 38 | 11 14 | 53 34 | 11 26 | 54 30 | 11 39 | 26 | 25 | 6 |
| 52 | 47 57 | 10 11 | 48 53 | 10 24 | 49 49 | 10 36 | 50 45 | 10 49 | 51 41 | 11 2 | 52 37 | 11 15 | 53 33 | 11 28 | 54 29 | 11 40 | 27 | 26 | 6 |
| 54 | 47 56 | 10 12 | 48 52 | 10 25 | 49 49 | 10 37 | 50 45 | 10 50 | 51 41 | 11 3 | 52 37 | 11 16 | 53 33 | 11 29 | 54 29 | 11 42 | 28 | 27 | 7 |
| 56 | 47 56 | 10 13 | 48 52 | 10 26 | 49 48 | 10 38 | 50 44 | 10 51 | 51 40 | 11 4 | 52 36 | 11 17 | 53 32 | 11 30 | 54 28 | 11 43 | 29 | 28 | 7 |
| 58 | 47 56 | 10 14 | 48 52 | 10 27 | 49 48 | 10 40 | 50 44 | 10 52 | 51 40 | 11 5 | 52 36 | 11 18 | 53 32 | 11 31 | 54 28 | 11 44 | 30 | 29 | 7 |
| 21° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 31 | 30 | 8 |
| 0′ | 47 55 | 10 15 | 48 51 | 10 28 | 49 47 | 10 41 | 50 43 | 10 53 | 51 39 | 11 6 | 52 35 | 11 19 | 53 31 | 11 32 | 54 27 | 11 45 | 32 | 31 | 8 |
| 2 | 47 55 | 10 16 | 48 51 | 10 29 | 49 47 | 10 42 | 50 43 | 10 55 | 51 39 | 11 7 | 52 35 | 11 20 | 53 31 | 11 33 | 54 27 | 11 46 | 33 | 32 | 8 |
| 4 | 47 54 | 10 17 | 48 50 | 10 30 | 49 46 | 10 43 | 50 42 | 10 56 | 51 38 | 11 9 | 52 34 | 11 21 | 53 30 | 11 34 | 54 26 | 11 47 | 34 | 33 | 9 |
| 6 | 47 54 | 10 18 | 48 50 | 10 31 | 49 46 | 10 44 | 50 42 | 10 57 | 51 38 | 11 10 | 52 34 | 11 23 | 53 30 | 11 35 | 54 26 | 11 48 | 35 | 34 | 9 |
| 8 | 47 53 | 10 19 | 48 49 | 10 32 | 49 45 | 10 45 | 50 41 | 10 58 | 51 37 | 11 11 | 52 33 | 11 24 | 53 29 | 11 36 | 54 25 | 11 49 | 36 | 35 | 9 |
| 10 | 47 53 | 10 20 | 48 49 | 10 33 | 49 45 | 10 46 | 50 41 | 10 59 | 51 37 | 11 12 | 52 33 | 11 25 | 53 29 | 11 38 | 54 25 | 11 51 | 37 | 36 | 10 |
| 12 | 47 52 | 10 21 | 48 48 | 10 34 | 49 44 | 10 47 | 50 40 | 11 0 | 51 36 | 11 13 | 52 32 | 11 26 | 53 28 | 11 39 | 54 24 | 11 52 | 38 | 37 | 10 |
| 14 | 47 52 | 10 22 | 48 48 | 10 35 | 49 44 | 10 48 | 50 40 | 11 1 | 51 36 | 11 14 | 52 32 | 11 27 | 53 28 | 11 40 | 54 24 | 11 53 | 39 | 38 | 10 |
| 16 | 47 52 | 10 23 | 48 48 | 10 36 | 49 43 | 10 49 | 50 39 | 11 2 | 51 35 | 11 15 | 52 31 | 11 28 | 53 27 | 11 41 | 54 23 | 11 54 | 40 | 39 | 10 |
| 18 | 47 51 | 10 24 | 48 47 | 10 37 | 49 43 | 10 50 | 50 39 | 11 3 | 51 35 | 11 16 | 52 31 | 11 29 | 53 27 | 11 42 | 54 23 | 11 55 | 41 | 40 | 11 |
| 20 | 47 51 | 10 25 | 48 47 | 10 38 | 49 43 | 10 51 | 50 38 | 11 4 | 51 34 | 11 17 | 52 30 | 11 30 | 53 26 | 11 43 | 54 22 | 11 56 | 42 | 41 | 11 |
| 22 | 47 50 | 10 26 | 48 46 | 10 39 | 49 42 | 10 52 | 50 38 | 11 5 | 51 34 | 11 18 | 52 30 | 11 31 | 53 26 | 11 44 | 54 22 | 11 57 | 43 | 42 | 11 |
| 24 | 47 50 | 10 27 | 48 46 | 10 40 | 49 42 | 10 53 | 50 37 | 11 6 | 51 33 | 11 19 | 52 29 | 11 32 | 53 25 | 11 45 | 54 21 | 11 58 | 44 | 43 | 12 |
| 26 | 47 49 | 10 28 | 48 45 | 10 41 | 49 41 | 10 54 | 50 37 | 11 7 | 51 33 | 11 20 | 52 29 | 11 33 | 53 25 | 11 47 | 54 21 | 12 0 | 45 | 44 | 12 |
| 28 | 47 49 | 10 29 | 48 45 | 10 42 | 49 41 | 10 55 | 50 37 | 11 8 | 51 32 | 11 21 | 52 28 | 11 34 | 53 24 | 11 48 | 54 20 | 12 1 | 46 | 45 | 12 |
| 30 | 47 49 | 10 30 | 48 44 | 10 43 | 49 40 | 10 56 | 50 36 | 11 9 | 51 32 | 11 22 | 52 28 | 11 36 | 53 24 | 11 49 | 54 19 | 12 2 | 47 | 46 | 13 |
| 32 | 47 48 | 10 31 | 48 44 | 10 44 | 49 40 | 10 57 | 50 36 | 11 10 | 51 31 | 11 24 | 52 27 | 11 37 | 53 23 | 11 50 | 54 19 | 12 3 | 48 | 47 | 13 |
| 34 | 47 48 | 10 32 | 48 44 | 10 45 | 49 39 | 10 58 | 50 35 | 11 11 | 51 31 | 11 25 | 52 27 | 11 38 | 53 23 | 11 51 | 54 18 | 12 4 | 49 | 48 | 13 |
| 36 | 47 47 | 10 33 | 48 43 | 10 46 | 49 39 | 10 59 | 50 35 | 11 13 | 51 30 | 11 26 | 52 26 | 11 39 | 53 22 | 11 52 | 54 18 | 12 5 | 50 | 49 | 14 |
| 38 | 47 47 | 10 34 | 48 43 | 10 47 | 49 38 | 11 0 | 50 34 | 11 14 | 51 30 | 11 27 | 52 26 | 11 40 | 53 22 | 11 53 | 54 17 | 12 6 | 51 | 50 | 14 |
| 40 | 47 46 | 10 35 | 48 42 | 10 48 | 49 38 | 11 1 | 50 34 | 11 15 | 51 29 | 11 28 | 52 25 | 11 41 | 53 21 | 11 54 | 54 17 | 12 8 | 52 | 51 | 14 |
| 42 | 47 46 | 10 36 | 48 42 | 10 49 | 49 37 | 11 3 | 50 33 | 11 16 | 51 29 | 11 29 | 52 25 | 11 42 | 53 20 | 11 56 | 54 16 | 12 9 | 53 | 52 | 15 |
| 44 | 47 45 | 10 37 | 48 41 | 10 50 | 49 37 | 11 4 | 50 33 | 11 17 | 51 28 | 11 30 | 52 24 | 11 43 | 53 20 | 11 57 | 54 16 | 12 10 | 54 | 53 | 15 |
| 46 | 47 45 | 10 38 | 48 41 | 10 51 | 49 36 | 11 5 | 50 32 | 11 18 | 51 28 | 11 31 | 52 24 | 11 44 | 53 19 | 11 58 | 54 15 | 12 11 | 55 | 54 | 15 |
| 48 | 47 45 | 10 39 | 48 40 | 10 52 | 49 36 | 11 6 | 50 32 | 11 19 | 51 27 | 11 32 | 52 23 | 11 46 | 53 19 | 11 59 | 54 15 | 12 12 | 56 | 55 | 16 |
| 50 | 47 44 | 10 40 | 48 40 | 10 53 | 49 35 | 11 7 | 50 31 | 11 20 | 51 27 | 11 33 | 52 23 | 11 47 | 53 18 | 12 0 | 54 14 | 12 13 | 57 | 56 | 16 |
| 52 | 47 44 | 10 41 | 48 39 | 10 54 | 49 35 | 11 8 | 50 31 | 11 21 | 51 26 | 11 34 | 52 22 | 11 48 | 53 18 | 12 1 | 54 13 | 12 15 | 58 | 57 | 16 |
| 54 | 47 43 | 10 42 | 48 39 | 10 55 | 49 35 | 11 9 | 50 30 | 11 22 | 51 26 | 11 36 | 52 22 | 11 49 | 53 17 | 12 2 | 54 13 | 12 16 | 59 | 58 | 17 |
| 56 | 47 43 | 10 43 | 48 38 | 10 56 | 49 34 | 11 10 | 50 30 | 11 23 | 51 25 | 11 37 | 52 21 | 11 50 | 53 17 | 12 3 | 54 12 | 12 17 | 60 | 59 | 17 |
| 58 | 47 42 | 10 44 | 48 38 | 10 57 | 49 34 | 11 11 | 50 29 | 11 24 | 51 25 | 11 38 | 52 21 | 11 51 | 53 16 | 12 5 | 54 12 | 12 18 | 60 | 59 | 17 |

(22° and 23°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 47 42 | 10 45 | 48 37 | 10 58 | 49 33 | 11 12 | 50 29 | 11 25 | 51 24 | 11 39 | 52 20 | 11 52 | 53 16 | 12 6 | 54 11 | 12 19 |
| 2 | 47 41 | 10 46 | 48 37 | 11 0 | 49 32 | 11 13 | 50 28 | 11 26 | 51 24 | 11 40 | 52 19 | 11 53 | 53 15 | 12 7 | 54 11 | 12 20 |
| 4 | 47 41 | 10 47 | 48 36 | 11 1 | 49 32 | 11 14 | 50 28 | 11 27 | 51 23 | 11 41 | 52 19 | 11 54 | 53 14 | 12 8 | 54 10 | 12 21 |
| 6 | 47 40 | 10 48 | 48 36 | 11 2 | 49 31 | 11 15 | 50 27 | 11 29 | 51 23 | 11 42 | 52 18 | 11 55 | 53 14 | 12 9 | 54 10 | 12 22 |
| 8 | 47 40 | 10 49 | 48 35 | 11 3 | 49 31 | 11 16 | 50 27 | 11 30 | 51 22 | 11 43 | 52 18 | 11 57 | 53 13 | 12 10 | 54 9 | 12 24 |
| 10 | 47 39 | 10 50 | 48 35 | 11 4 | 49 30 | 11 17 | 50 26 | 11 31 | 51 22 | 11 44 | 52 17 | 11 58 | 53 13 | 12 11 | 54 8 | 12 25 |
| 12 | 47 39 | 10 51 | 48 34 | 11 5 | 49 30 | 11 18 | 50 26 | 11 32 | 51 21 | 11 45 | 52 17 | 11 59 | 53 12 | 12 12 | 54 8 | 12 26 |
| 14 | 47 38 | 10 52 | 48 34 | 11 6 | 49 29 | 11 19 | 50 25 | 11 33 | 51 21 | 11 46 | 52 16 | 12 0 | 53 12 | 12 13 | 54 7 | 12 27 |
| 16 | 47 38 | 10 53 | 48 33 | 11 7 | 49 29 | 11 20 | 50 24 | 11 34 | 51 20 | 11 47 | 52 16 | 12 1 | 53 11 | 12 15 | 54 7 | 12 28 |
| 18 | 47 37 | 10 54 | 48 33 | 11 8 | 49 28 | 11 21 | 50 24 | 11 35 | 51 20 | 11 49 | 52 15 | 12 2 | 53 11 | 12 16 | 54 6 | 12 29 |
| 20 | 47 37 | 10 55 | 48 32 | 11 9 | 49 28 | 11 22 | 50 23 | 11 36 | 51 19 | 11 50 | 52 14 | 12 3 | 53 10 | 12 17 | 54 5 | 12 30 |
| 22 | 47 36 | 10 56 | 48 32 | 11 10 | 49 27 | 11 23 | 50 23 | 11 37 | 51 18 | 11 51 | 52 14 | 12 4 | 53 9 | 12 18 | 54 5 | 12 32 |
| 24 | 47 36 | 10 57 | 48 31 | 11 11 | 49 27 | 11 24 | 50 22 | 11 38 | 51 18 | 11 52 | 52 13 | 12 5 | 53 9 | 12 19 | 54 4 | 12 33 |
| 26 | 47 35 | 10 58 | 48 31 | 11 12 | 49 26 | 11 25 | 50 22 | 11 39 | 51 17 | 11 53 | 52 13 | 12 6 | 53 8 | 12 20 | 54 4 | 12 34 |
| 28 | 47 35 | 10 59 | 48 30 | 11 13 | 49 26 | 11 26 | 50 21 | 11 40 | 51 17 | 11 54 | 52 12 | 12 8 | 53 8 | 12 21 | 54 3 | 12 35 |
| 30 | 47 34 | 11 0 | 48 30 | 11 14 | 49 25 | 11 27 | 50 21 | 11 41 | 51 16 | 11 55 | 52 12 | 12 9 | 53 7 | 12 22 | 54 3 | 12 36 |
| 32 | 47 34 | 11 1 | 48 29 | 11 15 | 49 25 | 11 28 | 50 20 | 11 42 | 51 16 | 11 56 | 52 11 | 12 10 | 53 7 | 12 23 | 54 2 | 12 37 |
| 34 | 47 33 | 11 2 | 48 29 | 11 16 | 49 24 | 11 30 | 50 20 | 11 43 | 51 15 | 11 57 | 52 11 | 12 11 | 53 6 | 12 25 | 54 1 | 12 38 |
| 36 | 47 33 | 11 3 | 48 28 | 11 17 | 49 24 | 11 31 | 50 19 | 11 44 | 51 15 | 11 58 | 52 10 | 12 12 | 53 5 | 12 26 | 54 1 | 12 39 |
| 38 | 47 32 | 11 4 | 48 28 | 11 18 | 49 23 | 11 32 | 50 19 | 11 45 | 51 14 | 11 59 | 52 9 | 12 13 | 53 5 | 12 27 | 54 0 | 12 41 |
| 40 | 47 32 | 11 5 | 48 27 | 11 19 | 49 23 | 11 33 | 50 18 | 11 46 | 51 13 | 12 0 | 52 9 | 12 14 | 53 4 | 12 28 | 54 0 | 12 42 |
| 42 | 47 31 | 11 6 | 48 27 | 11 20 | 49 22 | 11 34 | 50 17 | 11 47 | 51 13 | 12 1 | 52 8 | 12 15 | 53 4 | 12 29 | 53 59 | 12 43 |
| 44 | 47 31 | 11 7 | 48 26 | 11 21 | 49 22 | 11 35 | 50 17 | 11 49 | 51 12 | 12 2 | 52 8 | 12 16 | 53 3 | 12 30 | 53 58 | 12 44 |
| 46 | 47 30 | 11 8 | 48 26 | 11 22 | 49 21 | 11 36 | 50 16 | 11 50 | 51 12 | 12 3 | 52 7 | 12 17 | 53 2 | 12 31 | 53 58 | 12 45 |
| 48 | 47 30 | 11 9 | 48 25 | 11 23 | 49 20 | 11 37 | 50 16 | 11 51 | 51 11 | 12 5 | 52 6 | 12 18 | 53 2 | 12 32 | 53 57 | 12 46 |
| 50 | 47 29 | 11 10 | 48 25 | 11 24 | 49 20 | 11 38 | 50 15 | 11 52 | 51 11 | 12 6 | 52 6 | 12 19 | 53 1 | 12 33 | 53 57 | 12 47 |
| 52 | 47 29 | 11 11 | 48 24 | 11 25 | 49 19 | 11 39 | 50 15 | 11 53 | 51 10 | 12 7 | 52 5 | 12 21 | 53 1 | 12 34 | 53 56 | 12 48 |
| 54 | 47 28 | 11 12 | 48 24 | 11 26 | 49 19 | 11 40 | 50 14 | 11 54 | 51 9 | 12 8 | 52 5 | 12 22 | 53 0 | 12 36 | 53 55 | 12 50 |
| 56 | 47 28 | 11 13 | 48 23 | 11 27 | 49 18 | 11 41 | 50 14 | 11 55 | 51 9 | 12 9 | 52 4 | 12 23 | 52 59 | 12 37 | 53 55 | 12 51 |
| 58 | 47 27 | 11 14 | 48 23 | 11 28 | 49 18 | 11 42 | 50 13 | 11 56 | 51 8 | 12 10 | 52 4 | 12 24 | 52 59 | 12 38 | 53 54 | 12 52 |
| 23° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 47 27 | 11 15 | 48 22 | 11 29 | 49 17 | 11 43 | 50 12 | 11 57 | 51 8 | 12 11 | 52 3 | 12 25 | 52 58 | 12 39 | 53 53 | 12 53 |
| 2 | 47 26 | 11 16 | 48 21 | 11 30 | 49 17 | 11 44 | 50 12 | 11 58 | 51 7 | 12 12 | 52 2 | 12 26 | 52 58 | 12 40 | 53 53 | 12 54 |
| 4 | 47 26 | 11 17 | 48 21 | 11 31 | 49 16 | 11 45 | 50 11 | 11 59 | 51 7 | 12 13 | 52 2 | 12 27 | 52 57 | 12 41 | 53 52 | 12 55 |
| 6 | 47 25 | 11 18 | 48 20 | 11 32 | 49 16 | 11 46 | 50 11 | 12 0 | 51 6 | 12 14 | 52 1 | 12 28 | 52 56 | 12 42 | 53 52 | 12 56 |
| 8 | 47 25 | 11 19 | 48 20 | 11 33 | 49 15 | 11 47 | 50 10 | 12 1 | 51 5 | 12 15 | 52 1 | 12 29 | 52 56 | 12 43 | 53 51 | 12 57 |
| 10 | 47 24 | 11 20 | 48 19 | 11 34 | 49 14 | 11 48 | 50 10 | 12 2 | 51 5 | 12 16 | 52 0 | 12 30 | 52 55 | 12 44 | 53 50 | 12 58 |
| 12 | 47 24 | 11 21 | 48 19 | 11 35 | 49 14 | 11 49 | 50 9 | 12 3 | 51 4 | 12 17 | 51 59 | 12 31 | 52 55 | 12 45 | 53 50 | 13 0 |
| 14 | 47 23 | 11 22 | 48 18 | 11 36 | 49 13 | 11 50 | 50 9 | 12 4 | 51 4 | 12 18 | 51 59 | 12 33 | 52 54 | 12 47 | 53 49 | 13 1 |
| 16 | 47 23 | 11 23 | 48 18 | 11 37 | 49 13 | 11 51 | 50 8 | 12 5 | 51 3 | 12 19 | 51 58 | 12 34 | 52 53 | 12 48 | 53 49 | 13 2 |
| 18 | 47 22 | 11 24 | 48 17 | 11 38 | 49 12 | 11 52 | 50 7 | 12 6 | 51 3 | 12 21 | 51 58 | 12 35 | 52 53 | 12 49 | 53 48 | 13 3 |
| 20 | 47 21 | 11 25 | 48 17 | 11 39 | 49 12 | 11 53 | 50 7 | 12 7 | 51 2 | 12 22 | 51 57 | 12 36 | 52 52 | 12 50 | 53 47 | 13 4 |
| 22 | 47 21 | 11 26 | 48 16 | 11 40 | 49 11 | 11 54 | 50 6 | 12 9 | 51 1 | 12 23 | 51 56 | 12 37 | 52 52 | 12 51 | 53 47 | 13 5 |
| 24 | 47 20 | 11 27 | 48 15 | 11 41 | 49 11 | 11 55 | 50 6 | 12 10 | 51 1 | 12 24 | 51 56 | 12 38 | 52 51 | 12 52 | 53 46 | 13 6 |
| 26 | 47 20 | 11 28 | 48 15 | 11 42 | 49 10 | 11 56 | 50 5 | 12 11 | 51 0 | 12 25 | 51 55 | 12 39 | 52 50 | 12 53 | 53 45 | 13 7 |
| 28 | 47 19 | 11 29 | 48 14 | 11 43 | 49 9 | 11 57 | 50 5 | 12 12 | 51 0 | 12 26 | 51 55 | 12 40 | 52 50 | 12 54 | 53 45 | 13 9 |
| 30 | 47 19 | 11 30 | 48 14 | 11 44 | 49 9 | 11 58 | 50 4 | 12 13 | 50 59 | 12 27 | 51 54 | 12 41 | 52 49 | 12 55 | 53 44 | 13 10 |
| 32 | 47 18 | 11 31 | 48 13 | 11 45 | 49 8 | 11 59 | 50 3 | 12 14 | 50 58 | 12 28 | 51 53 | 12 42 | 52 48 | 12 56 | 53 44 | 13 11 |
| 34 | 47 18 | 11 32 | 48 13 | 11 46 | 49 8 | 12 0 | 50 3 | 12 15 | 50 58 | 12 29 | 51 53 | 12 43 | 52 48 | 12 58 | 53 43 | 13 12 |
| 36 | 47 17 | 11 33 | 48 12 | 11 47 | 49 7 | 12 2 | 50 2 | 12 16 | 50 57 | 12 30 | 51 52 | 12 44 | 52 47 | 12 59 | 53 42 | 13 13 |
| 38 | 47 17 | 11 34 | 48 12 | 11 48 | 49 7 | 12 3 | 50 2 | 12 17 | 50 57 | 12 31 | 51 52 | 12 46 | 52 47 | 13 0 | 53 42 | 13 14 |
| 40 | 47 16 | 11 35 | 48 11 | 11 49 | 49 6 | 12 4 | 50 1 | 12 18 | 50 56 | 12 32 | 51 51 | 12 47 | 52 46 | 13 1 | 53 41 | 13 15 |
| 42 | 47 16 | 11 36 | 48 11 | 11 50 | 49 6 | 12 5 | 50 0 | 12 19 | 50 55 | 12 33 | 51 50 | 12 48 | 52 45 | 13 2 | 53 40 | 13 16 |
| 44 | 47 15 | 11 37 | 48 10 | 11 51 | 49 5 | 12 6 | 50 0 | 12 20 | 50 55 | 12 34 | 51 50 | 12 49 | 52 45 | 13 3 | 53 40 | 13 18 |
| 46 | 47 14 | 11 38 | 48 9 | 11 52 | 49 4 | 12 7 | 49 59 | 12 21 | 50 54 | 12 35 | 51 49 | 12 50 | 52 44 | 13 4 | 53 39 | 13 19 |
| 48 | 47 14 | 11 39 | 48 9 | 11 53 | 49 4 | 12 8 | 49 59 | 12 22 | 50 54 | 12 37 | 51 48 | 12 51 | 52 43 | 13 4 | 53 38 | 13 20 |
| 50 | 47 13 | 11 40 | 48 8 | 11 54 | 49 3 | 12 9 | 49 58 | 12 23 | 50 53 | 12 38 | 51 48 | 12 52 | 52 43 | 13 6 | 53 38 | 13 21 |
| 52 | 47 13 | 11 41 | 48 8 | 11 55 | 49 3 | 12 10 | 49 57 | 12 24 | 50 52 | 12 39 | 51 47 | 12 53 | 52 42 | 13 8 | 53 37 | 13 22 |
| 54 | 47 12 | 11 42 | 48 7 | 11 56 | 49 2 | 12 11 | 49 57 | 12 25 | 50 52 | 12 40 | 51 47 | 12 54 | 52 42 | 13 9 | 53 36 | 13 23 |
| 56 | 47 12 | 11 43 | 48 7 | 11 57 | 49 1 | 12 12 | 49 56 | 12 26 | 50 51 | 12 41 | 51 46 | 12 55 | 52 41 | 13 10 | 53 36 | 13 24 |
| 58 | 47 11 | 11 44 | 48 6 | 11 58 | 49 1 | 12 13 | 49 56 | 12 27 | 50 51 | 12 42 | 51 45 | 12 56 | 52 40 | 13 11 | 53 35 | 13 25 |

| Seconds of H. P. | | |
|---|---|---|
| ″ | Cor. | A |
| | ″ | ″ |
| 1 | 1 | 0 |
| 2 | 2 | 0 |
| 3 | 3 | 1 |
| 4 | 4 | 1 |
| 5 | 5 | 1 |
| 6 | 6 | 1 |
| 7 | 6 | 2 |
| 8 | 7 | 2 |
| 9 | 8 | 2 |
| 10 | 9 | 2 |
| 11 | 10 | 3 |
| 12 | 11 | 3 |
| 13 | 12 | 3 |
| 14 | 13 | 3 |
| 15 | 14 | 4 |
| 16 | 15 | 4 |
| 17 | 16 | 4 |
| 18 | 17 | 4 |
| 19 | 17 | 4 |
| 20 | 18 | 5 |
| 21 | 19 | 5 |
| 22 | 20 | 5 |
| 23 | 21 | 5 |
| 24 | 22 | 6 |
| 25 | 23 | 6 |
| 26 | 24 | 6 |
| 27 | 25 | 6 |
| 28 | 26 | 7 |
| 29 | 27 | 7 |
| 30 | 28 | 7 |
| 31 | 28 | 7 |
| 32 | 29 | 8 |
| 33 | 30 | 8 |
| 34 | 31 | 8 |
| 35 | 32 | 8 |
| 36 | 33 | 8 |
| 37 | 34 | 9 |
| 38 | 35 | 9 |
| 39 | 36 | 9 |
| 40 | 37 | 9 |
| 41 | 38 | 10 |
| 42 | 39 | 10 |
| 43 | 39 | 10 |
| 44 | 40 | 10 |
| 45 | 41 | 11 |
| 46 | 42 | 11 |
| 47 | 43 | 11 |
| 48 | 44 | 11 |
| 49 | 45 | 11 |
| 50 | 46 | 12 |
| 51 | 47 | 12 |
| 52 | 48 | 12 |
| 53 | 49 | 12 |
| 54 | 50 | 13 |
| 55 | 50 | 13 |
| 56 | 51 | 13 |
| 57 | 52 | 13 |
| 58 | 53 | 14 |
| 59 | 54 | 14 |
| App. Alt. | ☉ | ● |
| ′ | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (24° and 25°)

Minutes of Moon's Hor. Parallax.

| App. Alt. | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. − | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 47 11 | 11 45 | 48 5 | 11 59 | 49 0 | 12 14 | 49 55 | 12 28 | 50 50 | 12 43 | 51 45 | 12 57 | 52 40 | 13 12 | 53 34 | 13 26 |
| 2 | 47 10 | 11 46 | 48 5 | 12 0 | 49 0 | 12 15 | 49 54 | 12 29 | 50 49 | 12 44 | 51 44 | 12 58 | 52 39 | 13 13 | 53 34 | 13 28 |
| 4 | 47 9 | 11 47 | 48 4 | 12 1 | 48 59 | 12 16 | 49 54 | 12 30 | 50 49 | 12 45 | 51 43 | 13 0 | 52 38 | 13 14 | 53 33 | 13 29 |
| 6 | 47 9 | 11 48 | 48 4 | 12 2 | 48 58 | 12 17 | 49 53 | 12 31 | 50 48 | 12 46 | 51 43 | 13 1 | 52 38 | 13 15 | 53 32 | 13 30 |
| 8 | 47 8 | 11 49 | 48 3 | 12 3 | 48 58 | 12 18 | 49 53 | 12 33 | 50 47 | 12 47 | 51 42 | 13 2 | 52 37 | 13 16 | 53 32 | 13 31 |
| 10 | 47 8 | 11 50 | 48 2 | 12 4 | 48 57 | 12 19 | 49 52 | 12 34 | 50 47 | 12 48 | 51 41 | 13 3 | 52 36 | 13 17 | 53 31 | 13 32 |
| 12 | 47 7 | 11 51 | 48 2 | 12 5 | 48 57 | 12 20 | 49 51 | 12 35 | 50 46 | 12 49 | 51 41 | 13 4 | 52 36 | 13 19 | 53 30 | 13 33 |
| 14 | 47 7 | 11 52 | 48 1 | 12 6 | 48 56 | 12 21 | 49 51 | 12 36 | 50 45 | 12 50 | 51 40 | 13 5 | 52 35 | 13 20 | 53 30 | 13 34 |
| 16 | 47 6 | 11 53 | 48 1 | 12 7 | 48 55 | 12 22 | 49 50 | 12 37 | 50 45 | 12 51 | 51 40 | 13 6 | 52 34 | 13 21 | 53 29 | 13 35 |
| 18 | 47 5 | 11 54 | 48 0 | 12 8 | 48 55 | 12 23 | 49 50 | 12 38 | 50 44 | 12 52 | 51 39 | 13 7 | 52 34 | 13 22 | 53 28 | 13 36 |
| 20 | 47 5 | 11 55 | 48 0 | 12 9 | 48 54 | 12 24 | 49 49 | 12 39 | 50 44 | 12 53 | 51 38 | 13 8 | 52 33 | 13 23 | 53 28 | 13 38 |
| 22 | 47 4 | 11 56 | 47 59 | 12 10 | 48 54 | 12 25 | 49 48 | 12 40 | 50 43 | 12 55 | 51 38 | 13 9 | 52 32 | 13 24 | 53 27 | 13 39 |
| 24 | 47 4 | 11 57 | 47 58 | 12 11 | 48 53 | 12 26 | 49 48 | 12 41 | 50 42 | 12 56 | 51 37 | 13 10 | 52 32 | 13 25 | 53 26 | 13 40 |
| 26 | 47 3 | 11 58 | 47 58 | 12 12 | 48 52 | 12 27 | 49 47 | 12 42 | 50 42 | 12 57 | 51 36 | 13 11 | 52 31 | 13 26 | 53 26 | 13 41 |
| 28 | 47 3 | 11 59 | 47 57 | 12 13 | 48 52 | 12 28 | 49 46 | 12 43 | 50 41 | 12 58 | 51 36 | 13 12 | 52 30 | 13 27 | 53 25 | 13 42 |
| 30 | 47 2 | 12 0 | 47 57 | 12 14 | 48 51 | 12 29 | 49 46 | 12 44 | 50 40 | 12 59 | 51 35 | 13 14 | 52 30 | 13 28 | 53 24 | 13 43 |
| 32 | 47 1 | 12 1 | 47 56 | 12 15 | 48 51 | 12 30 | 49 45 | 12 45 | 50 40 | 13 0 | 51 34 | 13 15 | 52 29 | 13 29 | 53 24 | 13 44 |
| 34 | 47 1 | 12 2 | 47 55 | 12 16 | 48 50 | 12 31 | 49 44 | 12 46 | 50 39 | 13 1 | 51 34 | 13 16 | 52 28 | 13 31 | 53 23 | 13 45 |
| 36 | 47 0 | 12 3 | 47 55 | 12 17 | 48 49 | 12 32 | 49 44 | 12 47 | 50 38 | 13 2 | 51 33 | 13 17 | 52 28 | 13 32 | 53 22 | 13 46 |
| 38 | 47 0 | 12 4 | 47 54 | 12 18 | 48 49 | 12 33 | 49 43 | 12 48 | 50 38 | 13 3 | 51 32 | 13 18 | 52 27 | 13 33 | 53 21 | 13 48 |
| 40 | 46 59 | 12 4 | 47 53 | 12 19 | 48 48 | 12 34 | 49 43 | 12 49 | 50 37 | 13 4 | 51 32 | 13 19 | 52 26 | 13 34 | 53 21 | 13 49 |
| 42 | 46 58 | 12 5 | 47 53 | 12 20 | 48 47 | 12 35 | 49 42 | 12 50 | 50 37 | 13 5 | 51 31 | 13 20 | 52 26 | 13 35 | 53 20 | 13 50 |
| 44 | 46 58 | 12 6 | 47 52 | 12 21 | 48 47 | 12 36 | 49 41 | 12 51 | 50 36 | 13 6 | 51 31 | 13 21 | 52 25 | 13 36 | 53 19 | 13 51 |
| 46 | 46 57 | 12 7 | 47 52 | 12 22 | 48 46 | 12 37 | 49 41 | 12 52 | 50 35 | 13 7 | 51 30 | 13 22 | 52 24 | 13 37 | 53 19 | 13 52 |
| 48 | 46 57 | 12 8 | 47 51 | 12 23 | 48 46 | 12 38 | 49 40 | 12 53 | 50 35 | 13 8 | 51 29 | 13 23 | 52 24 | 13 38 | 53 18 | 13 53 |
| 50 | 46 56 | 12 9 | 47 50 | 12 24 | 48 45 | 12 39 | 49 39 | 12 54 | 50 34 | 13 9 | 51 28 | 13 24 | 52 23 | 13 39 | 53 17 | 13 54 |
| 52 | 46 55 | 12 10 | 47 50 | 12 25 | 48 44 | 12 40 | 49 39 | 12 55 | 50 33 | 13 10 | 51 28 | 13 25 | 52 22 | 13 40 | 53 17 | 13 55 |
| 54 | 46 55 | 12 11 | 47 49 | 12 26 | 48 44 | 12 41 | 49 38 | 12 56 | 50 33 | 13 11 | 51 27 | 13 26 | 52 22 | 13 41 | 53 16 | 13 56 |
| 56 | 46 54 | 12 12 | 47 49 | 12 27 | 48 43 | 12 42 | 49 38 | 12 57 | 50 32 | 13 12 | 51 26 | 13 28 | 52 21 | 13 43 | 53 15 | 13 58 |
| 58 | 46 54 | 12 13 | 47 48 | 12 28 | 48 43 | 12 43 | 49 37 | 12 58 | 50 31 | 13 14 | 51 26 | 13 29 | 52 20 | 13 44 | 53 15 | 13 59 |
| 25° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 46 53 | 12 14 | 47 47 | 12 29 | 48 42 | 12 44 | 49 36 | 12 59 | 50 31 | 13 15 | 51 25 | 13 30 | 52 19 | 13 45 | 53 14 | 14 0 |
| 2 | 46 52 | 12 15 | 47 47 | 12 30 | 48 41 | 12 45 | 49 36 | 13 1 | 50 30 | 13 16 | 51 24 | 13 31 | 52 19 | 13 46 | 53 13 | 14 1 |
| 4 | 46 52 | 12 16 | 47 46 | 12 31 | 48 41 | 12 46 | 49 35 | 13 2 | 50 29 | 13 17 | 51 24 | 13 32 | 52 18 | 13 47 | 53 12 | 14 2 |
| 6 | 46 51 | 12 17 | 47 46 | 12 32 | 48 40 | 12 47 | 49 34 | 13 3 | 50 29 | 13 18 | 51 23 | 13 33 | 52 17 | 13 48 | 53 12 | 14 3 |
| 8 | 46 51 | 12 18 | 47 45 | 12 33 | 48 39 | 12 48 | 49 34 | 13 4 | 50 28 | 13 19 | 51 22 | 13 34 | 52 17 | 13 49 | 53 11 | 14 4 |
| 10 | 46 50 | 12 19 | 47 44 | 12 34 | 48 39 | 12 49 | 49 33 | 13 5 | 50 27 | 13 20 | 51 22 | 13 35 | 52 16 | 13 50 | 53 10 | 14 5 |
| 12 | 46 49 | 12 20 | 47 44 | 12 35 | 48 38 | 12 51 | 49 32 | 13 6 | 50 27 | 13 21 | 51 21 | 13 36 | 52 15 | 13 51 | 53 10 | 14 6 |
| 14 | 46 49 | 12 21 | 47 43 | 12 36 | 48 37 | 12 52 | 49 32 | 13 7 | 50 26 | 13 22 | 51 20 | 13 37 | 52 14 | 13 52 | 53 9 | 14 7 |
| 16 | 46 48 | 12 22 | 47 42 | 12 37 | 48 37 | 12 53 | 49 31 | 13 8 | 50 25 | 13 23 | 51 19 | 13 38 | 52 14 | 13 53 | 53 8 | 14 9 |
| 18 | 46 47 | 12 23 | 47 42 | 12 38 | 48 36 | 12 54 | 49 30 | 13 9 | 50 24 | 13 24 | 51 19 | 13 39 | 52 13 | 13 55 | 53 7 | 14 10 |
| 20 | 46 47 | 12 24 | 47 41 | 12 39 | 48 35 | 12 55 | 49 30 | 13 10 | 50 24 | 13 25 | 51 18 | 13 40 | 52 12 | 13 56 | 53 7 | 14 11 |
| 22 | 46 46 | 12 25 | 47 40 | 12 40 | 48 35 | 12 56 | 49 29 | 13 11 | 50 23 | 13 26 | 51 17 | 13 41 | 52 12 | 13 57 | 53 6 | 14 12 |
| 24 | 46 46 | 12 26 | 47 40 | 12 41 | 48 34 | 12 57 | 49 28 | 13 12 | 50 22 | 13 27 | 51 17 | 13 42 | 52 11 | 13 58 | 53 5 | 14 13 |
| 26 | 46 45 | 12 27 | 47 39 | 12 42 | 48 33 | 12 58 | 49 28 | 13 13 | 50 22 | 13 28 | 51 16 | 13 43 | 52 10 | 13 59 | 53 4 | 14 14 |
| 28 | 46 44 | 12 28 | 47 38 | 12 43 | 48 33 | 12 59 | 49 27 | 13 14 | 50 21 | 13 29 | 51 15 | 13 45 | 52 9 | 14 0 | 53 4 | 14 15 |
| 30 | 46 44 | 12 29 | 47 38 | 12 44 | 48 32 | 13 0 | 49 26 | 13 15 | 50 20 | 13 30 | 51 15 | 13 46 | 52 9 | 14 1 | 53 3 | 14 16 |
| 32 | 46 43 | 12 30 | 47 37 | 12 45 | 48 31 | 13 1 | 49 26 | 13 16 | 50 20 | 13 31 | 51 14 | 13 47 | 52 8 | 14 2 | 53 2 | 14 17 |
| 34 | 46 42 | 12 31 | 47 37 | 12 46 | 48 31 | 13 2 | 49 25 | 13 17 | 50 19 | 13 32 | 51 13 | 13 48 | 52 7 | 14 3 | 53 1 | 14 18 |
| 36 | 46 42 | 12 32 | 47 36 | 12 47 | 48 30 | 13 3 | 49 24 | 13 18 | 50 18 | 13 33 | 51 12 | 13 49 | 52 7 | 14 4 | 53 1 | 14 20 |
| 38 | 46 41 | 12 33 | 47 35 | 12 48 | 48 30 | 13 4 | 49 23 | 13 19 | 50 18 | 13 34 | 51 12 | 13 50 | 52 6 | 14 5 | 53 0 | 14 21 |
| 40 | 46 40 | 12 34 | 47 35 | 12 49 | 48 29 | 13 5 | 49 23 | 13 20 | 50 17 | 13 35 | 51 11 | 13 51 | 52 5 | 14 6 | 52 59 | 14 22 |
| 42 | 46 40 | 12 35 | 47 34 | 12 50 | 48 28 | 13 6 | 49 22 | 13 21 | 50 16 | 13 36 | 51 10 | 13 52 | 52 5 | 14 7 | 52 58 | 14 23 |
| 44 | 46 39 | 12 36 | 47 33 | 12 51 | 48 27 | 13 7 | 49 21 | 13 22 | 50 16 | 13 37 | 51 10 | 13 53 | 52 4 | 14 8 | 52 58 | 14 24 |
| 46 | 46 39 | 12 37 | 47 33 | 12 52 | 48 27 | 13 8 | 49 21 | 13 23 | 50 15 | 13 38 | 51 9 | 13 54 | 52 4 | 14 9 | 52 57 | 14 25 |
| 48 | 46 38 | 12 38 | 47 32 | 12 53 | 48 26 | 13 9 | 49 20 | 13 24 | 50 14 | 13 39 | 51 8 | 13 55 | 52 3 | 14 10 | 52 56 | 14 26 |
| 50 | 46 37 | 12 39 | 47 31 | 12 54 | 48 25 | 13 10 | 49 19 | 13 25 | 50 13 | 13 40 | 51 7 | 13 56 | 52 2 | 14 11 | 52 55 | 14 27 |
| 52 | 46 37 | 12 40 | 47 31 | 12 55 | 48 25 | 13 11 | 49 19 | 13 26 | 50 13 | 13 41 | 51 7 | 13 57 | 52 1 | 14 12 | 52 55 | 14 28 |
| 54 | 46 36 | 12 41 | 47 30 | 12 56 | 48 24 | 13 12 | 49 18 | 13 27 | 50 12 | 13 42 | 51 6 | 13 58 | 52 0 | 14 13 | 52 54 | 14 29 |
| 56 | 46 35 | 12 42 | 47 29 | 12 57 | 48 23 | 13 13 | 49 17 | 13 28 | 50 11 | 13 43 | 51 5 | 13 59 | 51 59 | 14 14 | 52 53 | 14 31 |
| 58 | 46 35 | 12 43 | 47 29 | 12 58 | 48 23 | 13 14 | 49 17 | 13 29 | 50 11 | 13 44 | 51 5 | 14 0 | 51 58 | 14 15 | 52 52 | 14 32 |

Seconds of H. P.

| ″ | Corr. | A |
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| 1 | 1 | 0 |
| 2 | 2 | 1 |
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| 4 | 4 | 1 |
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| 6 | 5 | 2 |
| 7 | 6 | 2 |
| 8 | 7 | 2 |
| 9 | 8 | 2 |
| 10 | 9 | 3 |
| 11 | 10 | 3 |
| 12 | 11 | 3 |
| 13 | 12 | 3 |
| 14 | 13 | 4 |
| 15 | 14 | 4 |
| 16 | 14 | 4 |
| 17 | 15 | 4 |
| 18 | 16 | 5 |
| 19 | 17 | 5 |
| 20 | 18 | 5 |
| 21 | 19 | 5 |
| 22 | 20 | 6 |
| 23 | 21 | 6 |
| 24 | 22 | 6 |
| 25 | 23 | 6 |
| 26 | 23 | 7 |
| 27 | 24 | 7 |
| 28 | 25 | 7 |
| 29 | 26 | 7 |
| 30 | 27 | 8 |
| 31 | 28 | 8 |
| 32 | 29 | 8 |
| 33 | 30 | 8 |
| 34 | 31 | 9 |
| 35 | 32 | 9 |
| 36 | 32 | 9 |
| 37 | 33 | 9 |
| 38 | 34 | 10 |
| 39 | 35 | 10 |
| 40 | 36 | 10 |
| 41 | 37 | 10 |
| 42 | 38 | 11 |
| 43 | 39 | 11 |
| 44 | 40 | 11 |
| 45 | 41 | 11 |
| 46 | 41 | 12 |
| 47 | 42 | 12 |
| 48 | 43 | 12 |
| 49 | 44 | 12 |
| 50 | 45 | 13 |
| 51 | 46 | 13 |
| 52 | 47 | 13 |
| 53 | 48 | 13 |
| 54 | 49 | 14 |
| 55 | 50 | 14 |
| 56 | 50 | 14 |
| 57 | 51 | 14 |
| 58 | 52 | 15 |
| 59 | 53 | 15 |
| ″ | Corr. | A |
| | ′ | ° |
| 0 | 0 | 0 |
| 1 | 0 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 1 |
| 4 | 1 | 1 |
| 5 | 1 | 1 |
| 6 | 2 | 2 |
| 7 | 2 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 2 |
| 10 | 3 | 3 |
| 11 | 3 | 3 |
| 12 | 3 | 3 |
| 13 | 4 | 4 |
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| 15 | 4 | 4 |
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| 17 | 5 | 5 |
| 18 | 5 | 5 |
| 19 | 6 | 6 |
| 20 | 6 | 6 |
| 21 | 6 | 6 |
| 22 | 7 | 7 |
| 23 | 7 | 7 |
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| 25 | 8 | 8 |
| 26 | 8 | 8 |
| 27 | 8 | 8 |
| 28 | 9 | 9 |
| 29 | 9 | 9 |
| 30 | 9 | 9 |
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| 32 | 10 | 10 |
| 33 | 10 | 10 |
| 34 | 11 | 11 |
| 35 | 11 | 11 |
| 36 | 11 | 11 |
| 37 | 12 | 12 |
| 38 | 12 | 12 |
| 39 | 12 | 12 |
| 40 | 13 | 13 |
| 41 | 13 | 13 |
| 42 | 13 | 13 |
| 43 | 14 | 14 |
| 44 | 14 | 14 |
| 45 | 14 | 14 |
| 46 | 15 | 15 |
| 47 | 15 | 15 |
| 48 | 15 | 15 |
| 49 | 16 | 16 |
| 50 | 16 | 16 |
| 51 | 16 | 16 |
| 52 | 17 | 17 |
| 53 | 17 | 17 |
| 54 | 17 | 17 |
| 55 | 18 | 18 |
| 56 | 18 | 18 |
| 57 | 18 | 18 |
| 58 | 19 | 19 |
| 59 | 19 | 19 |
| 60 | 20 | 20 |

(26° and 27°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 46 34 | 12 44 | 47 28 | 12 59 | 48 22 | 13 15 | 49 16 | 13 30 | 50 10 | 13 46 | 51 4 | 14 2 | 51 58 | 14 17 | 52 52 | 14 33 |
| 2 | 46 33 | 12 45 | 47 27 | 13 0 | 48 21 | 13 16 | 49 15 | 13 31 | 50 9 | 13 47 | 51 3 | 14 3 | 51 57 | 14 18 | 52 51 | 14 34 |
| 4 | 46 33 | 12 46 | 47 27 | 13 1 | 48 21 | 13 17 | 49 14 | 13 32 | 50 8 | 13 48 | 51 2 | 14 4 | 51 56 | 14 19 | 52 50 | 14 35 |
| 6 | 46 32 | 12 47 | 47 26 | 13 2 | 48 20 | 13 18 | 49 14 | 13 33 | 50 8 | 13 49 | 51 2 | 14 5 | 51 56 | 14 20 | 52 49 | 14 36 |
| 8 | 46 31 | 12 47 | 47 25 | 13 3 | 48 19 | 13 19 | 49 13 | 13 35 | 50 7 | 13 50 | 51 1 | 14 6 | 51 55 | 14 22 | 52 49 | 14 37 |
| 10 | 46 31 | 12 48 | 47 25 | 13 4 | 48 19 | 13 20 | 49 12 | 13 36 | 50 6 | 13 51 | 51 0 | 14 7 | 51 54 | 14 23 | 52 48 | 14 38 |
| 12 | 46 30 | 12 49 | 47 24 | 13 5 | 48 18 | 13 21 | 49 12 | 13 37 | 50 6 | 13 52 | 50 59 | 14 8 | 51 53 | 14 24 | 52 47 | 14 39 |
| 14 | 46 29 | 12 50 | 47 23 | 13 6 | 48 17 | 13 22 | 49 11 | 13 38 | 50 5 | 13 53 | 50 59 | 14 9 | 51 53 | 14 25 | 52 46 | 14 40 |
| 16 | 46 29 | 12 51 | 47 23 | 13 7 | 48 16 | 13 23 | 49 10 | 13 39 | 50 4 | 13 54 | 50 58 | 14 10 | 51 52 | 14 26 | 52 46 | 14 42 |
| 18 | 46 28 | 12 52 | 47 22 | 13 8 | 48 16 | 13 24 | 49 10 | 13 40 | 50 3 | 13 55 | 50 57 | 14 11 | 51 51 | 14 27 | 52 45 | 14 43 |
| 20 | 46 27 | 12 53 | 47 21 | 13 9 | 48 15 | 13 25 | 49 9 | 13 41 | 50 3 | 13 56 | 50 56 | 14 12 | 51 50 | 14 28 | 52 44 | 14 44 |
| 22 | 46 27 | 12 54 | 47 21 | 13 10 | 48 14 | 13 26 | 49 8 | 13 42 | 50 2 | 13 57 | 50 56 | 14 13 | 51 50 | 14 29 | 52 43 | 14 45 |
| 24 | 46 26 | 12 55 | 47 20 | 13 11 | 48 14 | 13 27 | 49 7 | 13 43 | 50 1 | 13 58 | 50 55 | 14 14 | 51 49 | 14 30 | 52 42 | 14 46 |
| 26 | 46 25 | 12 56 | 47 19 | 13 12 | 48 13 | 13 28 | 49 7 | 13 44 | 50 0 | 13 59 | 50 54 | 14 15 | 51 48 | 14 31 | 52 42 | 14 47 |
| 28 | 46 25 | 12 57 | 47 18 | 13 13 | 48 12 | 13 29 | 49 6 | 13 45 | 50 0 | 14 0 | 50 53 | 14 16 | 51 47 | 14 32 | 52 41 | 14 48 |
| 30 | 46 24 | 12 58 | 47 18 | 13 14 | 48 12 | 13 30 | 49 5 | 13 46 | 49 59 | 14 2 | 50 53 | 14 17 | 51 46 | 14 33 | 52 40 | 14 49 |
| 32 | 46 23 | 12 59 | 47 17 | 13 15 | 48 11 | 13 31 | 49 5 | 13 47 | 49 58 | 14 3 | 50 52 | 14 18 | 51 46 | 14 34 | 52 39 | 14 50 |
| 34 | 46 23 | 13 0 | 47 16 | 13 16 | 48 10 | 13 32 | 49 4 | 13 48 | 49 57 | 14 4 | 50 51 | 14 20 | 51 45 | 14 35 | 52 38 | 14 51 |
| 36 | 46 22 | 13 1 | 47 16 | 13 17 | 48 9 | 13 33 | 49 3 | 13 49 | 49 57 | 14 5 | 50 50 | 14 21 | 51 44 | 14 36 | 52 38 | 14 52 |
| 38 | 46 21 | 13 2 | 47 15 | 13 18 | 48 9 | 13 34 | 49 2 | 13 50 | 49 56 | 14 6 | 50 50 | 14 22 | 51 43 | 14 38 | 52 37 | 14 54 |
| 40 | 46 21 | 13 3 | 47 14 | 13 19 | 48 8 | 13 35 | 49 2 | 13 51 | 49 55 | 14 7 | 50 49 | 14 23 | 51 43 | 14 39 | 52 36 | 14 55 |
| 42 | 46 20 | 13 4 | 47 14 | 13 20 | 48 7 | 13 36 | 49 1 | 13 52 | 49 54 | 14 8 | 50 48 | 14 24 | 51 42 | 14 40 | 52 35 | 14 56 |
| 44 | 46 19 | 13 5 | 47 13 | 13 21 | 48 7 | 13 37 | 49 0 | 13 53 | 49 54 | 14 9 | 50 47 | 14 25 | 51 41 | 14 41 | 52 35 | 14 57 |
| 46 | 46 19 | 13 6 | 47 12 | 13 22 | 48 6 | 13 38 | 48 59 | 13 54 | 49 53 | 14 10 | 50 47 | 14 26 | 51 40 | 14 42 | 52 34 | 14 58 |
| 48 | 46 18 | 13 7 | 47 12 | 13 23 | 48 5 | 13 39 | 48 59 | 13 55 | 49 52 | 14 11 | 50 46 | 14 27 | 51 39 | 14 43 | 52 33 | 14 59 |
| 50 | 46 17 | 13 8 | 47 11 | 13 24 | 48 4 | 13 40 | 48 58 | 13 56 | 49 51 | 14 12 | 50 45 | 14 28 | 51 39 | 14 44 | 52 32 | 15 0 |
| 52 | 46 17 | 13 9 | 47 10 | 13 25 | 48 4 | 13 41 | 48 57 | 13 57 | 49 51 | 14 13 | 50 44 | 14 29 | 51 38 | 14 45 | 52 31 | 15 1 |
| 54 | 46 16 | 13 10 | 47 9 | 13 26 | 48 3 | 13 42 | 48 56 | 13 58 | 49 50 | 14 14 | 50 44 | 14 30 | 51 37 | 14 46 | 52 31 | 15 2 |
| 56 | 46 15 | 13 11 | 47 9 | 13 27 | 48 2 | 13 43 | 48 56 | 13 59 | 49 49 | 14 15 | 50 43 | 14 31 | 51 36 | 14 47 | 52 30 | 15 3 |
| 58 | 46 15 | 13 12 | 47 8 | 13 28 | 48 2 | 13 44 | 48 55 | 14 0 | 49 49 | 14 16 | 50 42 | 14 32 | 51 35 | 14 48 | 52 29 | 15 4 |

| 27° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 46 14 | 13 13 | 47 7 | 13 29 | 48 1 | 13 45 | 48 54 | 14 1 | 49 48 | 14 17 | 50 41 | 14 33 | 51 35 | 14 49 | 52 28 | 15 5 |
| 2 | 46 13 | 13 14 | 47 7 | 13 30 | 48 0 | 13 46 | 48 54 | 14 2 | 49 47 | 14 18 | 50 41 | 14 34 | 51 34 | 14 50 | 52 27 | 15 7 |
| 4 | 46 12 | 13 14 | 47 6 | 13 31 | 47 59 | 13 47 | 48 53 | 14 3 | 49 46 | 14 19 | 50 40 | 14 35 | 51 33 | 14 52 | 52 27 | 15 8 |
| 6 | 46 12 | 13 15 | 47 5 | 13 32 | 47 59 | 13 48 | 48 52 | 14 4 | 49 46 | 14 20 | 50 39 | 14 36 | 51 32 | 14 53 | 52 26 | 15 9 |
| 8 | 46 11 | 13 16 | 47 5 | 13 33 | 47 58 | 13 49 | 48 51 | 14 5 | 49 45 | 14 21 | 50 38 | 14 37 | 51 32 | 14 54 | 52 25 | 15 10 |
| 10 | 46 10 | 13 17 | 47 4 | 13 34 | 47 57 | 13 50 | 48 51 | 14 6 | 49 44 | 14 22 | 50 37 | 14 38 | 51 31 | 14 55 | 52 24 | 15 11 |
| 12 | 46 10 | 13 18 | 47 3 | 13 35 | 47 56 | 13 51 | 48 50 | 14 7 | 49 43 | 14 23 | 50 37 | 14 39 | 51 30 | 14 56 | 52 23 | 15 12 |
| 14 | 46 9 | 13 19 | 47 2 | 13 35 | 47 56 | 13 52 | 48 49 | 14 8 | 49 42 | 14 24 | 50 36 | 14 41 | 51 29 | 14 57 | 52 23 | 15 13 |
| 16 | 46 8 | 13 20 | 47 2 | 13 36 | 47 55 | 13 53 | 48 48 | 14 9 | 49 42 | 14 25 | 50 35 | 14 42 | 51 28 | 14 58 | 52 22 | 15 14 |
| 18 | 46 8 | 13 21 | 47 1 | 13 37 | 47 54 | 13 54 | 48 48 | 14 10 | 49 41 | 14 26 | 50 34 | 14 43 | 51 28 | 14 59 | 52 21 | 15 15 |
| 20 | 46 7 | 13 22 | 47 0 | 13 38 | 47 53 | 13 55 | 48 47 | 14 11 | 49 40 | 14 27 | 50 33 | 14 44 | 51 27 | 15 0 | 52 20 | 15 16 |
| 22 | 46 6 | 13 23 | 46 59 | 13 39 | 47 53 | 13 56 | 48 46 | 14 12 | 49 39 | 14 28 | 50 33 | 14 45 | 51 26 | 15 1 | 52 19 | 15 17 |
| 24 | 46 5 | 13 24 | 46 59 | 13 40 | 47 52 | 13 57 | 48 45 | 14 13 | 49 39 | 14 29 | 50 32 | 14 46 | 51 25 | 15 2 | 52 18 | 15 19 |
| 26 | 46 5 | 13 25 | 46 58 | 13 41 | 47 51 | 13 58 | 48 44 | 14 14 | 49 38 | 14 30 | 50 31 | 14 47 | 51 24 | 15 3 | 52 18 | 15 20 |
| 28 | 46 4 | 13 26 | 46 57 | 13 42 | 47 50 | 13 59 | 48 44 | 14 15 | 49 37 | 14 32 | 50 30 | 14 48 | 51 24 | 15 4 | 52 17 | 15 21 |
| 30 | 46 3 | 13 27 | 46 56 | 13 43 | 47 50 | 14 0 | 48 43 | 14 16 | 49 36 | 14 33 | 50 29 | 14 49 | 51 23 | 15 5 | 52 16 | 15 22 |
| 32 | 46 3 | 13 28 | 46 56 | 13 44 | 47 49 | 14 1 | 48 42 | 14 17 | 49 35 | 14 34 | 50 29 | 14 50 | 51 22 | 15 6 | 52 15 | 15 23 |
| 34 | 46 2 | 13 29 | 46 55 | 13 45 | 47 48 | 14 2 | 48 41 | 14 18 | 49 35 | 14 35 | 50 28 | 14 51 | 51 21 | 15 8 | 52 14 | 15 24 |
| 36 | 46 1 | 13 30 | 46 54 | 13 46 | 47 47 | 14 3 | 48 41 | 14 19 | 49 34 | 14 36 | 50 27 | 14 52 | 51 20 | 15 9 | 52 13 | 15 25 |
| 38 | 46 0 | 13 31 | 46 54 | 13 47 | 47 47 | 14 4 | 48 40 | 14 20 | 49 33 | 14 37 | 50 26 | 14 53 | 51 19 | 15 10 | 52 13 | 15 26 |
| 40 | 46 0 | 13 32 | 46 53 | 13 48 | 47 46 | 14 5 | 48 39 | 14 21 | 49 32 | 14 38 | 50 25 | 14 54 | 51 19 | 15 11 | 52 12 | 15 27 |
| 42 | 45 59 | 13 33 | 46 52 | 13 49 | 47 45 | 14 6 | 48 38 | 14 22 | 49 32 | 14 30 | 50 25 | 14 55 | 51 18 | 15 12 | 52 11 | 15 28 |
| 44 | 45 58 | 13 34 | 46 51 | 13 50 | 47 44 | 14 7 | 48 38 | 14 23 | 49 31 | 14 40 | 50 24 | 14 56 | 51 17 | 15 13 | 52 10 | 15 29 |
| 46 | 45 57 | 13 35 | 46 51 | 13 51 | 47 44 | 14 8 | 48 37 | 14 24 | 49 30 | 14 41 | 50 23 | 14 57 | 51 16 | 15 14 | 52 9 | 15 30 |
| 48 | 45 57 | 13 36 | 46 50 | 13 52 | 47 43 | 14 9 | 48 36 | 14 25 | 49 29 | 14 42 | 50 22 | 14 58 | 51 15 | 15 15 | 52 8 | 15 31 |
| 50 | 45 56 | 13 36 | 46 49 | 13 53 | 47 42 | 14 10 | 48 35 | 14 26 | 49 28 | 14 43 | 50 21 | 14 59 | 51 14 | 15 16 | 52 8 | 15 33 |
| 52 | 45 55 | 13 37 | 46 48 | 13 54 | 47 41 | 14 11 | 48 35 | 14 27 | 49 28 | 14 44 | 50 21 | 15 0 | 51 14 | 15 17 | 52 7 | 15 34 |
| 54 | 45 55 | 13 38 | 46 48 | 13 55 | 47 41 | 14 12 | 48 34 | 14 28 | 49 27 | 14 45 | 50 20 | 15 1 | 51 13 | 15 18 | 52 6 | 15 35 |
| 56 | 45 54 | 13 39 | 46 47 | 13 56 | 47 40 | 14 13 | 48 33 | 14 29 | 49 26 | 14 46 | 50 19 | 15 3 | 51 12 | 15 19 | 52 5 | 15 36 |
| 58 | 45 53 | 13 40 | 46 46 | 13 57 | 47 39 | 14 14 | 48 32 | 14 30 | 49 25 | 14 47 | 50 18 | 15 4 | 51 11 | 15 20 | 52 4 | 15 37 |

Seconds of H. P.

| ″ | Corr. ″ | A ″ |
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| 1 | 1 | 0 |
| 2 | 2 | 1 |
| 3 | 3 | 1 |
| 4 | 4 | 1 |
| 5 | 4 | 1 |
| 6 | 5 | 2 |
| 7 | 6 | 2 |
| 8 | 7 | 2 |
| 9 | 8 | 2 |
| 10 | 9 | 3 |
| 11 | 10 | 3 |
| 12 | 11 | 3 |
| 13 | 12 | 3 |
| 14 | 12 | 4 |
| 15 | 13 | 4 |
| 16 | 14 | 4 |
| 17 | 15 | 5 |
| 18 | 16 | 5 |
| 19 | 17 | 5 |
| 20 | 18 | 5 |
| 21 | 19 | 6 |
| 22 | 20 | 6 |
| 23 | 20 | 6 |
| 24 | 21 | 6 |
| 25 | 22 | 7 |
| 26 | 23 | 7 |
| 27 | 24 | 7 |
| 28 | 25 | 7 |
| 29 | 26 | 8 |
| 30 | 27 | 8 |
| 31 | 28 | 8 |
| 32 | 29 | 9 |
| 33 | 29 | 9 |
| 34 | 30 | 9 |
| 35 | 31 | 9 |
| 36 | 32 | 10 |
| 37 | 33 | 10 |
| 38 | 34 | 10 |
| 39 | 35 | 10 |
| 40 | 36 | 11 |
| 41 | 37 | 11 |
| 42 | 37 | 11 |
| 43 | 38 | 11 |
| 44 | 39 | 12 |
| 45 | 40 | 12 |
| 46 | 41 | 12 |
| 47 | 42 | 13 |
| 48 | 43 | 13 |
| 49 | 44 | 13 |
| 50 | 45 | 13 |
| 51 | 45 | 14 |
| 52 | 46 | 14 |
| 53 | 47 | 14 |
| 54 | 48 | 14 |
| 55 | 49 | 15 |
| 56 | 50 | 15 |
| 57 | 51 | 15 |
| 58 | 52 | 16 |
| 59 | 53 | 16 |

| Alt. | A ⊙ | A ☾ |
|---|---|---|
| ° | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (28° and 29°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | Seconds of H. P. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. | A |
| 28° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ″ | ′ |
| 0′ | 45 52 | 13 41 | 46 45 | 13 58 | 47 38 | 14 15 | 48 31 | 14 31 | 49 24 | 14 48 | 50 17 | 15 5 | 51 10 | 15 21 | 52 3 | 15 38 | 1 | 0 |
| 2 | 45 52 | 13 42 | 46 45 | 13 59 | 47 38 | 14 16 | 48 31 | 14 32 | 49 24 | 14 49 | 50 17 | 15 6 | 51 10 | 15 22 | 52 3 | 15 39 | 2 | 1 |
| 4 | 45 51 | 13 43 | 46 44 | 14 0 | 47 37 | 14 17 | 48 30 | 14 33 | 49 23 | 14 50 | 50 16 | 15 7 | 51 9 | 15 23 | 52 2 | 15 40 | 3 | 1 |
| 6 | 45 50 | 13 44 | 46 43 | 14 1 | 47 36 | 14 18 | 48 29 | 14 34 | 49 22 | 14 51 | 50 15 | 15 8 | 51 8 | 15 24 | 52 1 | 15 41 | 4 | 1 |
| 8 | 45 49 | 13 45 | 46 42 | 14 2 | 47 35 | 14 19 | 48 28 | 14 35 | 49 21 | 14 52 | 50 14 | 15 9 | 51 7 | 15 25 | 52 0 | 15 42 | 5 | 2 |
| 10 | 45 49 | 13 46 | 46 42 | 14 3 | 47 35 | 14 20 | 48 27 | 14 36 | 49 20 | 14 53 | 50 13 | 15 10 | 51 6 | 15 27 | 51 59 | 15 43 | 6 | 2 |
| 12 | 45 48 | 13 47 | 46 41 | 14 4 | 47 34 | 14 21 | 48 27 | 14 37 | 49 20 | 14 54 | 50 12 | 15 11 | 51 5 | 15 28 | 51 58 | 15 44 | 7 | 2 |
| 14 | 45 47 | 13 48 | 46 40 | 14 5 | 47 33 | 14 22 | 48 26 | 14 38 | 49 19 | 14 55 | 50 12 | 15 12 | 51 5 | 15 29 | 51 57 | 15 45 | 8 | 3 |
| 16 | 45 46 | 13 49 | 46 39 | 14 6 | 47 33 | 14 23 | 48 25 | 14 39 | 49 18 | 14 56 | 50 11 | 15 13 | 51 4 | 15 30 | 51 57 | 15 47 | 9 | 3 |
| 18 | 45 46 | 13 50 | 46 38 | 14 7 | 47 31 | 14 24 | 48 24 | 14 40 | 49 17 | 14 57 | 50 10 | 15 14 | 51 3 | 15 31 | 51 56 | 15 48 | 10 | 4 |
| 20 | 45 45 | 13 51 | 46 38 | 14 8 | 47 31 | 14 24 | 48 23 | 14 41 | 49 16 | 14 58 | 50 9 | 15 15 | 51 2 | 15 32 | 51 55 | 15 49 | 11 | 4 |
| 22 | 45 44 | 13 52 | 46 37 | 14 9 | 47 30 | 14 25 | 48 23 | 14 42 | 49 16 | 14 59 | 50 8 | 15 16 | 51 1 | 15 33 | 51 54 | 15 50 | 12 | 5 |
| 24 | 45 43 | 13 53 | 46 36 | 14 10 | 47 29 | 14 26 | 48 22 | 14 43 | 49 15 | 15 0 | 50 8 | 15 17 | 51 0 | 15 34 | 51 53 | 15 51 | 13 | 5 |
| 26 | 45 43 | 13 54 | 46 36 | 14 11 | 47 28 | 14 27 | 48 21 | 14 44 | 49 14 | 15 1 | 50 7 | 15 18 | 51 0 | 15 35 | 51 52 | 15 52 | 14 | 6 |
| 28 | 45 42 | 13 55 | 46 35 | 14 11 | 47 28 | 14 28 | 48 20 | 14 45 | 49 13 | 15 2 | 50 6 | 15 19 | 50 59 | 15 36 | 51 51 | 15 53 | 15 | 6 |
| 30 | 45 41 | 13 56 | 46 34 | 14 12 | 47 27 | 14 29 | 48 20 | 14 46 | 49 12 | 15 3 | 50 5 | 15 20 | 50 58 | 15 37 | 51 50 | 15 54 | 16 | 7 |
| 32 | 45 40 | 13 56 | 46 33 | 14 13 | 47 26 | 14 30 | 48 19 | 14 47 | 49 11 | 15 4 | 50 4 | 15 21 | 50 57 | 15 38 | 51 50 | 15 55 | 17 | 7 |
| 34 | 45 40 | 13 57 | 46 32 | 14 14 | 47 25 | 14 31 | 48 18 | 14 48 | 49 11 | 15 5 | 50 3 | 15 22 | 50 56 | 15 39 | 51 49 | 15 56 | 18 | 8 |
| 36 | 45 39 | 13 58 | 46 32 | 14 15 | 47 24 | 14 32 | 48 17 | 14 49 | 49 10 | 15 6 | 50 2 | 15 23 | 50 55 | 15 40 | 51 48 | 15 57 | 19 | 8 |
| 38 | 45 38 | 13 59 | 46 31 | 14 16 | 47 24 | 14 33 | 48 16 | 14 50 | 49 9 | 15 7 | 50 2 | 15 24 | 50 54 | 15 41 | 51 47 | 15 58 | 20 | 9 |
| 40 | 45 37 | 14 0 | 46 30 | 14 17 | 47 23 | 14 34 | 48 15 | 14 51 | 49 8 | 15 8 | 50 1 | 15 25 | 50 53 | 15 42 | 51 46 | 15 59 | 21 | 9 |
| 42 | 45 37 | 14 1 | 46 29 | 14 18 | 47 22 | 14 35 | 48 15 | 14 52 | 49 7 | 15 9 | 50 0 | 15 26 | 50 53 | 15 43 | 51 45 | 16 0 | 22 | 10 |
| 44 | 45 36 | 14 2 | 46 29 | 14 19 | 47 21 | 14 36 | 48 14 | 14 53 | 49 6 | 15 10 | 49 59 | 15 28 | 50 52 | 15 45 | 51 44 | 16 2 | 23 | 10 |
| 46 | 45 35 | 14 3 | 46 28 | 14 20 | 47 20 | 14 37 | 48 13 | 14 54 | 49 6 | 15 12 | 49 58 | 15 29 | 50 51 | 15 46 | 51 43 | 16 3 | 24 | 11 |
| 48 | 45 34 | 14 4 | 46 27 | 14 21 | 47 20 | 14 38 | 48 12 | 14 55 | 49 5 | 15 13 | 49 57 | 15 30 | 50 50 | 15 47 | 51 43 | 16 4 | 25 | 11 |
| 50 | 45 34 | 14 5 | 46 26 | 14 22 | 47 19 | 14 39 | 48 11 | 14 56 | 49 4 | 15 14 | 49 57 | 15 31 | 50 49 | 15 48 | 51 42 | 16 5 | 26 | 12 |
| 52 | 45 33 | 14 6 | 46 25 | 14 23 | 47 18 | 14 40 | 48 11 | 14 57 | 49 3 | 15 15 | 49 56 | 15 32 | 50 48 | 15 49 | 51 41 | 16 6 | 27 | 12 |
| 54 | 45 32 | 14 7 | 46 25 | 14 24 | 47 17 | 14 41 | 48 10 | 14 58 | 49 2 | 15 16 | 49 55 | 15 33 | 50 47 | 15 50 | 51 40 | 16 7 | 28 | 13 |
| 56 | 45 31 | 14 8 | 46 24 | 14 25 | 47 16 | 14 42 | 48 9 | 14 59 | 49 1 | 15 17 | 49 54 | 15 34 | 50 46 | 15 51 | 51 39 | 16 8 | 29 | 13 |
| 58 | 45 31 | 14 9 | 46 23 | 14 26 | 47 16 | 14 43 | 48 8 | 15 0 | 49 1 | 15 18 | 49 53 | 15 35 | 50 46 | 15 52 | 51 38 | 16 9 | 30 | 14 |
| 29° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | | |
| 0′ | 45 30 | 14 10 | 46 22 | 14 27 | 47 15 | 14 44 | 48 7 | 15 2 | 49 0 | 15 19 | 49 52 | 15 36 | 50 45 | 15 53 | 51 37 | 16 10 | 31 | 14 |
| 2 | 45 29 | 14 11 | 46 22 | 14 28 | 47 14 | 14 45 | 48 6 | 15 3 | 48 59 | 15 20 | 49 51 | 15 37 | 50 44 | 15 54 | 51 36 | 16 11 | 32 | 15 |
| 4 | 45 28 | 14 12 | 46 21 | 14 29 | 47 13 | 14 46 | 48 6 | 15 4 | 48 58 | 15 21 | 49 51 | 15 38 | 50 43 | 15 55 | 51 36 | 16 12 | 33 | 15 |
| 6 | 45 27 | 14 13 | 46 20 | 14 30 | 47 12 | 14 47 | 48 5 | 15 5 | 48 57 | 15 22 | 49 50 | 15 39 | 50 42 | 15 56 | 51 35 | 16 13 | 34 | 16 |
| 8 | 45 27 | 14 13 | 46 19 | 14 31 | 47 12 | 14 48 | 48 4 | 15 5 | 48 56 | 15 23 | 49 49 | 15 40 | 50 41 | 15 57 | 51 34 | 16 14 | 35 | 16 |
| 10 | 45 26 | 14 14 | 46 18 | 14 32 | 47 11 | 14 49 | 48 3 | 15 6 | 48 56 | 15 24 | 49 48 | 15 41 | 50 40 | 15 58 | 51 33 | 16 15 | 36 | 17 |
| 12 | 45 25 | 14 15 | 46 18 | 14 33 | 47 10 | 14 50 | 48 2 | 15 7 | 48 55 | 15 25 | 49 47 | 15 42 | 50 40 | 15 59 | 51 32 | 16 16 | 37 | 17 |
| 14 | 45 24 | 14 16 | 46 17 | 14 34 | 47 9 | 14 51 | 48 2 | 15 8 | 48 54 | 15 26 | 49 46 | 15 43 | 50 39 | 16 0 | 51 31 | 16 18 | 38 | 18 |
| 16 | 45 24 | 14 17 | 46 16 | 14 35 | 47 8 | 14 52 | 48 1 | 15 9 | 48 53 | 15 27 | 49 45 | 15 44 | 50 38 | 16 1 | 51 30 | 16 19 | 39 | 18 |
| 18 | 45 23 | 14 18 | 46 15 | 14 36 | 47 8 | 14 53 | 48 0 | 15 10 | 48 52 | 15 28 | 49 45 | 15 45 | 50 37 | 16 2 | 51 29 | 16 20 | 40 | 19 |
| 20 | 45 22 | 14 19 | 46 14 | 14 37 | 47 7 | 14 54 | 47 59 | 15 11 | 48 51 | 15 29 | 49 44 | 15 46 | 50 36 | 16 3 | 51 28 | 16 21 | 41 | 19 |
| 22 | 45 21 | 14 20 | 46 14 | 14 38 | 47 6 | 14 55 | 47 58 | 15 12 | 48 51 | 15 30 | 49 43 | 15 47 | 50 35 | 16 4 | 51 27 | 16 22 | 42 | 20 |
| 24 | 45 21 | 14 21 | 46 13 | 14 38 | 47 5 | 14 56 | 47 57 | 15 13 | 48 50 | 15 31 | 49 42 | 15 48 | 50 34 | 16 5 | 51 27 | 16 23 | 43 | 20 |
| 26 | 45 20 | 14 22 | 46 12 | 14 39 | 47 4 | 14 57 | 47 57 | 15 14 | 48 49 | 15 32 | 49 41 | 15 49 | 50 33 | 16 6 | 51 26 | 16 24 | 44 | 21 |
| 28 | 45 19 | 14 23 | 46 11 | 14 40 | 47 3 | 14 58 | 47 56 | 15 15 | 48 48 | 15 33 | 49 40 | 15 50 | 50 32 | 16 7 | 51 25 | 16 25 | 45 | 21 |
| 30 | 45 18 | 14 24 | 46 10 | 14 41 | 47 3 | 14 59 | 47 55 | 15 16 | 48 47 | 15 34 | 49 39 | 15 51 | 50 32 | 16 8 | 51 24 | 16 26 | 46 | 22 |
| 32 | 45 17 | 14 25 | 46 10 | 14 42 | 47 2 | 15 0 | 47 54 | 15 17 | 48 46 | 15 35 | 49 38 | 15 52 | 50 31 | 16 10 | 51 23 | 16 27 | 47 | 22 |
| 34 | 45 17 | 14 26 | 46 9 | 14 43 | 47 1 | 15 1 | 47 53 | 15 18 | 48 45 | 15 36 | 49 38 | 15 53 | 50 30 | 16 11 | 51 22 | 16 28 | 48 | 23 |
| 36 | 45 16 | 14 27 | 46 8 | 14 44 | 47 0 | 15 2 | 47 52 | 15 19 | 48 45 | 15 37 | 49 37 | 15 54 | 50 29 | 16 12 | 51 21 | 16 29 | 49 | 23 |
| 38 | 45 15 | 14 28 | 46 7 | 14 45 | 46 59 | 15 3 | 47 51 | 15 20 | 48 44 | 15 38 | 49 36 | 15 55 | 50 28 | 16 13 | 51 20 | 16 30 | 50 | 24 |
| 40 | 45 14 | 14 29 | 46 6 | 14 46 | 46 58 | 15 4 | 47 51 | 15 21 | 48 43 | 15 39 | 49 35 | 15 56 | 50 27 | 16 14 | 51 19 | 16 31 | 51 | 24 |
| 42 | 45 13 | 14 30 | 46 5 | 14 47 | 46 58 | 15 5 | 47 50 | 15 22 | 48 42 | 15 40 | 49 34 | 15 57 | 50 26 | 16 15 | 51 18 | 16 32 | 52 | 25 |
| 44 | 45 13 | 14 30 | 46 5 | 14 48 | 46 57 | 15 6 | 47 49 | 15 23 | 48 41 | 15 41 | 49 33 | 15 58 | 50 25 | 16 16 | 51 17 | 16 33 | 53 | 25 |
| 46 | 45 12 | 14 31 | 46 4 | 14 49 | 46 56 | 15 7 | 47 48 | 15 24 | 48 40 | 15 42 | 49 32 | 15 59 | 50 24 | 16 17 | 51 16 | 16 34 | 54 | 26 |
| 48 | 45 11 | 14 32 | 46 3 | 14 50 | 46 55 | 15 7 | 47 47 | 15 25 | 48 39 | 15 43 | 49 31 | 16 0 | 50 23 | 16 18 | 51 16 | 16 35 | 55 | 26 |
| 50 | 45 10 | 14 33 | 46 2 | 14 51 | 46 54 | 15 8 | 47 46 | 15 26 | 48 38 | 15 44 | 49 30 | 16 1 | 50 23 | 16 19 | 51 15 | 16 36 | 56 | 27 |
| 52 | 45 9 | 14 34 | 46 1 | 14 52 | 46 53 | 15 9 | 47 45 | 15 27 | 48 38 | 15 45 | 49 30 | 16 2 | 50 22 | 16 20 | 51 14 | 16 38 | 57 | 27 |
| 54 | 45 9 | 14 35 | 46 1 | 14 53 | 46 53 | 15 10 | 47 45 | 15 28 | 48 37 | 15 46 | 49 29 | 16 3 | 50 21 | 16 21 | 51 13 | 16 39 | 58 | 28 |
| 56 | 45 8 | 14 36 | 46 0 | 14 54 | 46 52 | 15 11 | 47 44 | 15 29 | 48 36 | 15 47 | 49 28 | 16 4 | 50 20 | 16 22 | 51 12 | 16 40 | 59 | 28 |
| 58 | 45 7 | 14 37 | 45 59 | 14 55 | 46 51 | 15 12 | 47 43 | 15 30 | 48 35 | 15 48 | 49 27 | 16 5 | 50 19 | 16 23 | 51 11 | 16 41 | 60 | 29 |

## (30° and 31°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59 | | 60′ | | 61′ | | Seconds of H. P. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. − | A 60° | Corr. − | A 60° | " | Corr. | A |
| 30° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | ″ | ″ |
| | | | | | | | | | | | | | | | | | 1 | 1 | 0 |
| | | | | | | | | | | | | | | | | | 2 | 2 | 1 |
| 0′ | 45 6 | 14 38 | 45 58 | 14 56 | 46 50 | 15 13 | 47 42 | 15 31 | 48 34 | 15 49 | 49 26 | 16 6 | 50 18 | 16 24 | 51 10 | 16 42 | 3 | 3 | 1 |
| 2 | 45 5 | 14 39 | 45 57 | 14 57 | 46 49 | 15 14 | 47 41 | 15 32 | 48 33 | 15 50 | 49 25 | 16 7 | 50 17 | 16 25 | 51 9 | 16 43 | 4 | 3 | 1 |
| 4 | 45 4 | 14 40 | 45 56 | 14 58 | 46 48 | 15 15 | 47 40 | 15 33 | 48 32 | 15 51 | 49 24 | 16 8 | 50 16 | 16 26 | 51 8 | 16 44 | 5 | 4 | 2 |
| 6 | 45 4 | 14 41 | 45 56 | 14 58 | 46 48 | 15 16 | 47 40 | 15 34 | 48 31 | 15 52 | 49 23 | 16 9 | 50 15 | 16 27 | 51 7 | 16 45 | 6 | 5 | 2 |
| 8 | 45 3 | 14 42 | 45 55 | 14 59 | 46 47 | 15 17 | 47 39 | 15 35 | 48 31 | 15 53 | 49 22 | 16 11 | 50 14 | 16 28 | 51 6 | 16 46 | 7 | 6 | 2 |
| 10 | 45 2 | 14 43 | 45 54 | 15 0 | 46 46 | 15 18 | 47 38 | 15 36 | 48 30 | 15 54 | 49 22 | 16 12 | 50 13 | 16 29 | 51 5 | 16 47 | 8 | 7 | 2 |
| 12 | 45 1 | 14 44 | 45 53 | 15 1 | 46 45 | 15 19 | 47 37 | 15 37 | 48 29 | 15 55 | 49 21 | 16 13 | 50 13 | 16 30 | 51 5 | 16 48 | 9 | 8 | 3 |
| 14 | 45 0 | 14 44 | 45 52 | 15 2 | 46 44 | 15 20 | 47 36 | 15 38 | 48 28 | 15 56 | 49 20 | 16 14 | 50 12 | 16 31 | 51 4 | 16 49 | 10 | 9 | 3 |
| 16 | 45 0 | 14 45 | 45 51 | 15 3 | 46 43 | 15 21 | 47 35 | 15 39 | 48 27 | 15 57 | 49 19 | 16 15 | 50 11 | 16 32 | 51 3 | 16 50 | 11 | 9 | 3 |
| | | | | | | | | | | | | | | | | | 12 | 10 | 4 |
| 18 | 44 59 | 14 46 | 45 50 | 15 4 | 46 43 | 15 22 | 47 34 | 15 40 | 48 26 | 15 58 | 49 18 | 16 16 | 50 10 | 16 34 | 51 2 | 16 51 | 13 | 11 | 4 |
| 20 | 44 58 | 14 47 | 45 50 | 15 5 | 46 42 | 15 23 | 47 33 | 15 41 | 48 25 | 15 59 | 49 17 | 16 17 | 50 9 | 16 35 | 51 1 | 16 52 | 14 | 12 | 4 |
| 22 | 44 57 | 14 48 | 45 49 | 15 6 | 46 41 | 15 24 | 47 33 | 15 42 | 48 24 | 16 0 | 49 16 | 16 18 | 50 8 | 16 36 | 51 0 | 16 54 | 15 | 13 | 5 |
| | | | | | | | | | | | | | | | | | 16 | 14 | 5 |
| 24 | 44 56 | 14 49 | 45 48 | 15 7 | 46 40 | 15 25 | 47 32 | 15 43 | 48 23 | 16 1 | 49 15 | 16 19 | 50 7 | 16 37 | 50 59 | 16 55 | 17 | 15 | 5 |
| 26 | 44 56 | 14 50 | 45 47 | 15 8 | 46 39 | 15 26 | 47 31 | 15 44 | 48 23 | 16 2 | 49 14 | 16 20 | 50 6 | 16 38 | 50 58 | 16 56 | 18 | 15 | 5 |
| 28 | 44 55 | 14 51 | 45 46 | 15 9 | 46 38 | 15 27 | 47 30 | 15 45 | 48 22 | 16 3 | 49 14 | 16 21 | 50 5 | 16 39 | 50 57 | 16 57 | 19 | 16 | 6 |
| | | | | | | | | | | | | | | | | | 20 | 17 | 6 |
| 30 | 44 54 | 14 52 | 45 45 | 15 10 | 46 37 | 15 28 | 47 29 | 15 46 | 48 21 | 16 4 | 49 13 | 16 22 | 50 4 | 16 40 | 50 56 | 16 58 | 21 | 18 | 6 |
| 32 | 44 53 | 14 53 | 45 45 | 15 11 | 46 37 | 15 29 | 47 28 | 15 47 | 48 20 | 16 5 | 49 12 | 16 23 | 50 3 | 16 41 | 50 55 | 16 59 | 22 | 19 | 7 |
| 34 | 44 52 | 14 54 | 45 44 | 15 12 | 46 36 | 15 30 | 47 27 | 15 48 | 48 19 | 16 6 | 49 11 | 16 24 | 50 2 | 16 42 | 50 54 | 17 0 | 23 | 20 | 7 |
| | | | | | | | | | | | | | | | | | 24 | 20 | 7 |
| 36 | 44 51 | 14 55 | 45 43 | 15 13 | 46 35 | 15 31 | 47 26 | 15 49 | 48 18 | 16 7 | 49 10 | 16 25 | 50 1 | 16 43 | 50 53 | 17 1 | 25 | 21 | 8 |
| 38 | 44 51 | 14 56 | 45 42 | 15 14 | 46 34 | 15 32 | 47 26 | 15 50 | 48 17 | 16 8 | 49 9 | 16 26 | 50 1 | 16 44 | 50 52 | 17 2 | 26 | 22 | 8 |
| 40 | 44 50 | 14 56 | 45 41 | 15 15 | 46 33 | 15 33 | 47 25 | 15 51 | 48 16 | 16 9 | 49 8 | 16 27 | 50 0 | 16 45 | 50 51 | 17 3 | 27 | 23 | 8 |
| | | | | | | | | | | | | | | | | | 28 | 24 | 8 |
| 42 | 44 49 | 14 57 | 45 40 | 15 16 | 46 32 | 15 34 | 47 24 | 15 52 | 48 15 | 16 10 | 49 7 | 16 28 | 49 59 | 16 46 | 50 50 | 17 4 | 29 | 25 | 9 |
| 44 | 44 48 | 14 58 | 45 40 | 15 16 | 46 31 | 15 35 | 47 23 | 15 53 | 48 14 | 16 11 | 49 6 | 16 29 | 49 58 | 16 47 | 50 49 | 17 5 | 30 | 26 | 9 |
| 46 | 44 47 | 14 59 | 45 39 | 15 17 | 46 30 | 15 35 | 47 22 | 15 54 | 48 14 | 16 12 | 49 5 | 16 30 | 49 57 | 16 48 | 50 48 | 17 6 | 31 | 26 | 9 |
| | | | | | | | | | | | | | | | | | 32 | 27 | 10 |
| 48 | 44 46 | 15 0 | 45 38 | 15 18 | 46 30 | 15 36 | 47 21 | 15 55 | 48 13 | 16 13 | 49 4 | 16 31 | 49 56 | 16 49 | 50 47 | 17 7 | 33 | 28 | 10 |
| 50 | 44 46 | 15 1 | 45 37 | 15 19 | 46 29 | 15 37 | 47 20 | 15 56 | 48 12 | 16 14 | 49 3 | 16 32 | 49 55 | 16 50 | 50 46 | 17 8 | 34 | 29 | 10 |
| 52 | 44 45 | 15 2 | 45 36 | 15 20 | 46 28 | 15 38 | 47 19 | 15 57 | 48 11 | 16 15 | 49 2 | 16 33 | 49 54 | 16 51 | 50 45 | 17 9 | 35 | 30 | 11 |
| | | | | | | | | | | | | | | | | | 36 | 31 | 11 |
| 54 | 44 44 | 15 3 | 45 35 | 15 21 | 46 27 | 15 39 | 47 18 | 15 57 | 48 10 | 16 16 | 49 1 | 16 34 | 49 53 | 16 52 | 50 44 | 17 10 | 37 | 32 | 11 |
| 56 | 44 43 | 15 4 | 45 34 | 15 22 | 46 26 | 15 40 | 47 17 | 15 58 | 48 9 | 16 17 | 49 1 | 16 35 | 49 52 | 16 53 | 50 43 | 17 11 | 38 | 32 | 11 |
| 58 | 44 42 | 15 5 | 45 34 | 15 23 | 46 25 | 15 41 | 47 17 | 15 59 | 48 8 | 16 18 | 49 0 | 16 36 | 49 51 | 16 54 | 50 42 | 17 12 | 39 | 33 | 12 |
| | | | | | | | | | | | | | | | | | 40 | 34 | 12 |

| 31° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 44 41 | 15 6 | 45 33 | 15 24 | 46 24 | 15 42 | 47 16 | 16 0 | 48 7 | 16 19 | 48 59 | 16 37 | 49 50 | 16 55 | 50 41 | 17 13 | 41 | 35 | 12 |
| 2 | 44 41 | 15 7 | 45 32 | 15 25 | 46 23 | 15 43 | 47 15 | 16 1 | 48 6 | 16 20 | 48 58 | 16 38 | 49 49 | 16 56 | 50 41 | 17 14 | 42 | 36 | 13 |
| 4 | 44 40 | 15 8 | 45 31 | 15 26 | 46 23 | 15 44 | 47 14 | 16 2 | 48 5 | 16 21 | 48 57 | 16 39 | 49 48 | 16 57 | 50 40 | 17 15 | 43 | 37 | 13 |
| | | | | | | | | | | | | | | | | | 44 | 37 | 13 |
| 6 | 44 39 | 15 9 | 45 30 | 15 27 | 46 22 | 15 45 | 47 13 | 16 3 | 48 4 | 16 22 | 48 56 | 16 40 | 49 47 | 16 58 | 50 39 | 17 16 | 45 | 38 | 14 |
| 8 | 44 38 | 15 9 | 45 29 | 15 28 | 46 21 | 15 46 | 47 12 | 16 4 | 48 3 | 16 23 | 48 55 | 16 41 | 49 46 | 16 59 | 50 38 | 17 17 | 46 | 39 | 14 |
| 10 | 44 37 | 15 10 | 45 28 | 15 29 | 46 20 | 15 47 | 47 11 | 16 5 | 48 3 | 16 24 | 48 54 | 16 42 | 49 45 | 17 0 | 50 37 | 17 18 | 47 | 40 | 14 |
| | | | | | | | | | | | | | | | | | 48 | 41 | 14 |
| 12 | 44 36 | 15 11 | 45 28 | 15 30 | 46 19 | 15 48 | 47 10 | 16 6 | 48 2 | 16 25 | 48 53 | 16 43 | 49 44 | 17 1 | 50 36 | 17 20 | 49 | 42 | 15 |
| 14 | 44 35 | 15 12 | 45 27 | 15 31 | 46 18 | 15 49 | 47 9 | 16 7 | 48 1 | 16 26 | 48 52 | 16 44 | 49 43 | 17 2 | 50 35 | 17 21 | 50 | 43 | 15 |
| 16 | 44 35 | 15 13 | 45 26 | 15 32 | 46 17 | 15 50 | 47 8 | 16 8 | 48 0 | 16 27 | 48 51 | 16 45 | 49 42 | 17 3 | 50 34 | 17 22 | 51 | 43 | 15 |
| | | | | | | | | | | | | | | | | | 52 | 44 | 16 |
| 18 | 44 34 | 15 14 | 45 25 | 15 32 | 46 16 | 15 51 | 47 8 | 16 9 | 47 59 | 16 28 | 48 50 | 16 46 | 49 41 | 17 4 | 50 33 | 17 23 | 53 | 45 | 16 |
| 20 | 44 33 | 15 15 | 45 24 | 15 33 | 46 15 | 15 52 | 47 7 | 16 10 | 47 58 | 16 28 | 48 49 | 16 47 | 49 40 | 17 5 | 50 32 | 17 24 | 54 | 46 | 16 |
| 22 | 44 32 | 15 16 | 45 23 | 15 34 | 46 14 | 15 53 | 47 6 | 16 11 | 47 57 | 16 29 | 48 48 | 16 48 | 49 39 | 17 6 | 50 31 | 17 25 | 55 | 47 | 17 |
| | | | | | | | | | | | | | | | | | 56 | 48 | 17 |
| 24 | 44 31 | 15 17 | 45 22 | 15 35 | 46 14 | 15 54 | 47 5 | 16 12 | 47 56 | 16 30 | 48 47 | 16 49 | 49 38 | 17 7 | 50 30 | 17 26 | 57 | 49 | 17 |
| 26 | 44 30 | 15 18 | 45 21 | 15 36 | 46 13 | 15 55 | 47 4 | 16 13 | 47 55 | 16 31 | 48 46 | 16 50 | 49 37 | 17 8 | 50 29 | 17 27 | 58 | 49 | 17 |
| 28 | 44 30 | 15 19 | 45 20 | 15 37 | 46 12 | 15 56 | 47 3 | 16 14 | 47 54 | 16 32 | 48 45 | 16 51 | 49 37 | 17 9 | 50 28 | 17 28 | 59 | 50 | 18 |
| 30 | 44 29 | 15 20 | 45 20 | 15 38 | 46 11 | 15 57 | 47 2 | 16 15 | 47 53 | 16 33 | 48 44 | 16 52 | 49 36 | 17 10 | 50 27 | 17 29 | ′ Alt. | ☉ A | ✱ A |
| 32 | 44 28 | 15 21 | 45 19 | 15 39 | 46 10 | 15 57 | 47 1 | 16 16 | 47 52 | 16 34 | 48 43 | 16 53 | 49 35 | 17 11 | 50 26 | 17 30 | | | |
| 34 | 44 27 | 15 21 | 45 18 | 15 40 | 46 9 | 15 58 | 47 0 | 16 17 | 47 51 | 16 35 | 48 42 | 16 54 | 49 34 | 17 12 | 50 25 | 17 31 | | | |
| | | | | | | | | | | | | | | | | | 3 | 8 | 8 |
| 36 | 44 26 | 15 22 | 45 17 | 15 41 | 46 8 | 15 59 | 46 59 | 16 18 | 47 50 | 16 36 | 48 42 | 16 55 | 49 33 | 17 13 | 50 24 | 17 32 | 4 | 6 | 5 |
| 38 | 44 25 | 15 23 | 45 16 | 15 42 | 46 7 | 16 0 | 46 58 | 16 19 | 47 49 | 16 37 | 48 41 | 16 56 | 49 32 | 17 14 | 50 23 | 17 33 | 5 | 4 | 4 |
| 40 | 44 24 | 15 24 | 45 15 | 15 43 | 46 6 | 16 1 | 46 57 | 16 20 | 47 48 | 16 38 | 48 40 | 16 57 | 49 31 | 17 15 | 50 22 | 17 34 | 6 | 3 | 3 |
| | | | | | | | | | | | | | | | | | 7 | 3 | 2 |
| 42 | 44 23 | 15 25 | 45 14 | 15 44 | 46 5 | 16 2 | 46 57 | 16 21 | 47 48 | 16 39 | 48 39 | 16 58 | 49 30 | 17 17 | 50 21 | 17 35 | 8 | 2 | 2 |
| 44 | 44 22 | 15 26 | 45 13 | 15 45 | 46 5 | 16 3 | 46 56 | 16 22 | 47 47 | 16 40 | 48 38 | 16 59 | 49 29 | 17 18 | 50 20 | 17 36 | 9 | 2 | 1 |
| 46 | 44 22 | 15 27 | 45 12 | 15 46 | 46 4 | 16 4 | 46 55 | 16 23 | 47 46 | 16 41 | 48 37 | 17 0 | 49 28 | 17 19 | 50 19 | 17 37 | 10 | 2 | 1 |
| | | | | | | | | | | | | | | | | | 20 | 2 | 0 |
| 48 | 44 21 | 15 28 | 45 12 | 15 46 | 46 3 | 16 5 | 46 54 | 16 24 | 47 45 | 16 42 | 48 36 | 17 1 | 49 27 | 17 20 | 50 18 | 17 38 | 30 | 2 | 0 |
| 50 | 44 20 | 15 29 | 45 11 | 15 47 | 46 2 | 16 6 | 46 53 | 16 25 | 47 44 | 16 43 | 48 35 | 17 2 | 49 26 | 17 21 | 50 17 | 17 39 | 40 | 2 | 0 |
| 52 | 44 19 | 15 30 | 45 10 | 15 48 | 46 1 | 16 7 | 46 52 | 16 26 | 47 43 | 16 44 | 48 34 | 17 3 | 49 25 | 17 22 | 50 16 | 17 40 | 50 | 3 | 0 |
| | | | | | | | | | | | | | | | | | 60 | 4 | 0 |
| 54 | 44 18 | 15 31 | 45 9 | 15 49 | 46 0 | 16 8 | 46 51 | 16 27 | 47 42 | 16 45 | 48 33 | 17 4 | 49 24 | 17 23 | 50 15 | 17 41 | 70 | 5 | 0 |
| 56 | 44 17 | 15 31 | 45 8 | 15 50 | 45 59 | 16 9 | 46 50 | 16 28 | 47 41 | 16 46 | 48 32 | 17 5 | 49 23 | 17 24 | 50 14 | 17 42 | 80 | 5 | 0 |
| 58 | 44 16 | 15 32 | 45 7 | 15 51 | 45 58 | 16 10 | 46 49 | 16 29 | 47 40 | 16 47 | 48 31 | 17 6 | 49 22 | 17 25 | 50 13 | 17 43 | 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (32° and 33°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 44 15 | 15 33 | 45 6 | 15 52 | 45 57 | 16 11 | 46 48 | 16 29 | 47 39 | 16 48 | 48 30 | 17 7 | 49 21 | 17 26 | 50 12 | 17 44 |
| 2 | 44 14 | 15 34 | 45 5 | 15 53 | 45 56 | 16 12 | 46 47 | 16 30 | 47 38 | 16 49 | 48 29 | 17 8 | 49 20 | 17 27 | 50 11 | 17 45 |
| 4 | 44 14 | 15 35 | 45 4 | 15 54 | 45 55 | 16 13 | 46 46 | 16 31 | 47 37 | 16 50 | 48 28 | 17 9 | 49 19 | 17 28 | 50 10 | 17 46 |
| 6 | 44 13 | 15 36 | 45 4 | 15 55 | 45 54 | 16 14 | 46 45 | 16 32 | 47 36 | 16 51 | 48 27 | 17 10 | 49 18 | 17 29 | 50 9 | 17 47 |
| 8 | 44 12 | 15 37 | 45 3 | 15 56 | 45 53 | 16 15 | 46 44 | 16 33 | 47 35 | 16 52 | 48 26 | 17 11 | 49 17 | 17 30 | 50 8 | 17 49 |
| 10 | 44 11 | 15 38 | 45 2 | 15 57 | 45 52 | 16 15 | 46 43 | 16 34 | 47 34 | 16 53 | 48 25 | 17 12 | 49 16 | 17 31 | 50 7 | 17 50 |
| 12 | 44 10 | 15 39 | 45 1 | 15 58 | 45 52 | 16 16 | 46 42 | 16 35 | 47 33 | 16 54 | 48 24 | 17 13 | 49 15 | 17 32 | 50 6 | 17 51 |
| 14 | 44 9 | 15 40 | 45 0 | 15 59 | 45 51 | 16 17 | 46 41 | 16 36 | 47 32 | 16 55 | 48 23 | 17 14 | 49 14 | 17 33 | 50 4 | 17 52 |
| 16 | 44 8 | 15 41 | 44 59 | 15 59 | 45 50 | 16 18 | 46 40 | 16 37 | 47 31 | 16 56 | 48 22 | 17 15 | 49 13 | 17 34 | 50 3 | 17 53 |
| 18 | 44 7 | 15 41 | 44 58 | 16 0 | 45 49 | 16 19 | 46 39 | 16 38 | 47 30 | 16 57 | 48 21 | 17 16 | 49 12 | 17 35 | 50 2 | 17 54 |
| 20 | 44 6 | 15 42 | 44 57 | 16 1 | 45 48 | 16 20 | 46 38 | 16 39 | 47 29 | 16 58 | 48 20 | 17 17 | 49 11 | 17 36 | 50 1 | 17 55 |
| 22 | 44 6 | 15 43 | 44 56 | 16 2 | 45 47 | 16 21 | 46 38 | 16 40 | 47 28 | 16 59 | 48 19 | 17 18 | 49 10 | 17 37 | 50 0 | 17 56 |
| 24 | 44 5 | 15 44 | 44 55 | 16 3 | 45 46 | 16 22 | 46 37 | 16 41 | 47 27 | 17 0 | 48 18 | 17 19 | 49 9 | 17 38 | 49 59 | 17 57 |
| 26 | 44 4 | 15 45 | 44 54 | 16 4 | 45 45 | 16 23 | 46 36 | 16 42 | 47 26 | 17 1 | 48 17 | 17 20 | 49 8 | 17 39 | 49 58 | 17 58 |
| 28 | 44 3 | 15 46 | 44 53 | 16 5 | 45 44 | 16 24 | 46 35 | 16 43 | 47 25 | 17 2 | 48 16 | 17 21 | 49 7 | 17 40 | 49 57 | 17 59 |
| 30 | 44 2 | 15 47 | 44 53 | 16 6 | 45 43 | 16 25 | 46 34 | 16 44 | 47 24 | 17 3 | 48 15 | 17 22 | 49 6 | 17 41 | 49 56 | 18 0 |
| 32 | 44 1 | 15 48 | 44 52 | 16 7 | 45 42 | 16 26 | 46 33 | 16 45 | 47 24 | 17 4 | 48 14 | 17 23 | 49 5 | 17 42 | 49 55 | 18 1 |
| 34 | 44 0 | 15 49 | 44 51 | 16 8 | 45 41 | 16 27 | 46 32 | 16 46 | 47 23 | 17 5 | 48 13 | 17 24 | 49 4 | 17 43 | 49 54 | 18 2 |
| 36 | 43 59 | 15 50 | 44 50 | 16 9 | 45 40 | 16 28 | 46 31 | 16 47 | 47 22 | 17 6 | 48 12 | 17 25 | 49 3 | 17 44 | 49 53 | 18 3 |
| 38 | 43 58 | 15 51 | 44 49 | 16 10 | 45 40 | 16 29 | 46 30 | 16 48 | 47 21 | 17 7 | 48 11 | 17 26 | 49 2 | 17 45 | 49 52 | 18 4 |
| 40 | 43 57 | 15 51 | 44 48 | 16 11 | 45 39 | 16 30 | 46 29 | 16 49 | 47 20 | 17 8 | 48 10 | 17 27 | 49 1 | 17 46 | 49 51 | 18 5 |
| 42 | 43 57 | 15 52 | 44 47 | 16 12 | 45 38 | 16 31 | 46 28 | 16 50 | 47 19 | 17 9 | 48 9 | 17 28 | 49 0 | 17 47 | 49 50 | 18 6 |
| 44 | 43 56 | 15 53 | 44 46 | 16 12 | 45 37 | 16 31 | 46 27 | 16 51 | 47 18 | 17 10 | 48 8 | 17 29 | 48 59 | 17 48 | 49 49 | 18 7 |
| 46 | 43 55 | 15 54 | 44 45 | 16 13 | 45 36 | 16 32 | 46 26 | 16 52 | 47 17 | 17 11 | 48 7 | 17 30 | 48 58 | 17 49 | 49 48 | 18 8 |
| 48 | 43 54 | 15 55 | 44 44 | 16 14 | 45 35 | 16 33 | 46 25 | 16 53 | 47 16 | 17 12 | 48 6 | 17 31 | 48 57 | 17 50 | 49 47 | 18 9 |
| 50 | 43 53 | 15 56 | 44 43 | 16 15 | 45 34 | 16 34 | 46 24 | 16 53 | 47 15 | 17 13 | 48 5 | 17 32 | 48 56 | 17 51 | 49 46 | 18 10 |
| 52 | 43 52 | 15 57 | 44 43 | 16 16 | 45 33 | 16 35 | 46 23 | 16 54 | 47 14 | 17 14 | 48 4 | 17 33 | 48 55 | 17 52 | 49 45 | 18 11 |
| 54 | 43 51 | 15 58 | 44 42 | 16 17 | 45 32 | 16 36 | 46 22 | 16 55 | 47 13 | 17 15 | 48 3 | 17 34 | 48 54 | 17 53 | 49 44 | 18 12 |
| 56 | 43 50 | 15 59 | 44 41 | 16 18 | 45 31 | 16 37 | 46 21 | 16 56 | 47 12 | 17 16 | 48 2 | 17 35 | 48 53 | 17 54 | 49 43 | 18 13 |
| 58 | 43 49 | 16 0 | 44 40 | 16 19 | 45 30 | 16 38 | 46 20 | 16 57 | 47 11 | 17 17 | 48 1 | 17 36 | 48 52 | 17 55 | 49 42 | 18 14 |
| 33° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 43 48 | 16 1 | 44 39 | 16 20 | 45 29 | 16 39 | 46 19 | 16 58 | 47 10 | 17 17 | 48 0 | 17 37 | 48 51 | 17 56 | 49 41 | 18 15 |
| 2 | 43 48 | 16 1 | 44 38 | 16 21 | 45 28 | 16 40 | 46 19 | 16 59 | 47 9 | 17 18 | 47 59 | 17 38 | 48 50 | 17 57 | 49 40 | 18 16 |
| 4 | 43 47 | 16 2 | 44 37 | 16 22 | 45 27 | 16 41 | 46 18 | 17 0 | 47 8 | 17 19 | 47 58 | 17 39 | 48 49 | 17 58 | 49 39 | 18 17 |
| 6 | 43 46 | 16 3 | 44 36 | 16 23 | 45 26 | 16 42 | 46 17 | 17 1 | 47 7 | 17 20 | 47 57 | 17 40 | 48 47 | 17 59 | 49 38 | 18 18 |
| 8 | 43 45 | 16 4 | 44 35 | 16 23 | 45 25 | 16 43 | 46 16 | 17 2 | 47 6 | 17 21 | 47 56 | 17 41 | 48 46 | 18 0 | 49 37 | 18 19 |
| 10 | 43 44 | 16 5 | 44 34 | 16 24 | 45 24 | 16 44 | 46 15 | 17 3 | 47 5 | 17 22 | 47 55 | 17 42 | 48 45 | 18 1 | 49 36 | 18 20 |
| 12 | 43 43 | 16 6 | 44 33 | 16 25 | 45 23 | 16 45 | 46 14 | 17 4 | 47 4 | 17 23 | 47 54 | 17 43 | 48 44 | 18 2 | 49 35 | 18 21 |
| 14 | 43 42 | 16 7 | 44 32 | 16 26 | 45 22 | 16 46 | 46 13 | 17 5 | 47 3 | 17 24 | 47 53 | 17 44 | 48 43 | 18 3 | 49 33 | 18 22 |
| 16 | 43 41 | 16 8 | 44 31 | 16 27 | 45 22 | 16 47 | 46 12 | 17 6 | 47 2 | 17 25 | 47 52 | 17 45 | 48 42 | 18 4 | 49 32 | 18 23 |
| 18 | 43 40 | 16 9 | 44 30 | 16 28 | 45 21 | 16 48 | 46 11 | 17 7 | 47 1 | 17 26 | 47 51 | 17 46 | 48 41 | 18 5 | 49 31 | 18 24 |
| 20 | 43 39 | 16 10 | 44 29 | 16 29 | 45 20 | 16 48 | 46 10 | 17 8 | 47 0 | 17 27 | 47 50 | 17 46 | 48 40 | 18 6 | 49 30 | 18 25 |
| 22 | 43 38 | 16 10 | 44 29 | 16 30 | 45 19 | 16 49 | 46 9 | 17 9 | 46 59 | 17 28 | 47 49 | 17 47 | 48 39 | 18 7 | 49 29 | 18 26 |
| 24 | 43 37 | 16 11 | 44 28 | 16 31 | 45 18 | 16 50 | 46 8 | 17 10 | 46 58 | 17 29 | 47 48 | 17 48 | 48 38 | 18 8 | 49 28 | 18 27 |
| 26 | 43 37 | 16 12 | 44 27 | 16 32 | 45 17 | 16 51 | 46 7 | 17 11 | 46 57 | 17 30 | 47 47 | 17 49 | 48 37 | 18 9 | 49 27 | 18 28 |
| 28 | 43 36 | 16 13 | 44 26 | 16 33 | 45 16 | 16 52 | 46 6 | 17 12 | 46 56 | 17 31 | 47 46 | 17 50 | 48 36 | 18 10 | 49 26 | 18 29 |
| 30 | 43 35 | 16 14 | 44 25 | 16 34 | 45 15 | 16 53 | 46 5 | 17 13 | 46 55 | 17 32 | 47 45 | 17 51 | 48 35 | 18 11 | 49 25 | 18 30 |
| 32 | 43 34 | 16 15 | 44 24 | 16 34 | 45 14 | 16 54 | 46 4 | 17 13 | 46 54 | 17 33 | 47 44 | 17 52 | 48 34 | 18 12 | 49 24 | 18 31 |
| 34 | 43 33 | 16 16 | 44 23 | 16 35 | 45 13 | 16 55 | 46 3 | 17 14 | 46 53 | 17 34 | 47 43 | 17 53 | 48 33 | 18 13 | 49 23 | 18 32 |
| 36 | 43 32 | 16 17 | 44 22 | 16 36 | 45 12 | 16 56 | 46 2 | 17 15 | 46 52 | 17 35 | 47 42 | 17 54 | 48 32 | 18 14 | 49 22 | 18 33 |
| 38 | 43 31 | 16 18 | 44 21 | 16 37 | 45 11 | 16 57 | 46 1 | 17 16 | 46 51 | 17 36 | 47 41 | 17 55 | 48 31 | 18 15 | 49 21 | 18 34 |
| 40 | 43 30 | 16 19 | 44 20 | 16 38 | 45 10 | 16 58 | 46 0 | 17 17 | 46 50 | 17 37 | 47 40 | 17 56 | 48 30 | 18 16 | 49 20 | 18 35 |
| 42 | 43 29 | 16 19 | 44 19 | 16 39 | 45 9 | 16 59 | 45 59 | 17 18 | 46 49 | 17 38 | 47 39 | 17 57 | 48 29 | 18 17 | 49 19 | 18 36 |
| 44 | 43 28 | 16 20 | 44 18 | 16 40 | 45 8 | 17 0 | 45 58 | 17 19 | 46 48 | 17 39 | 47 38 | 17 58 | 48 28 | 18 18 | 49 18 | 18 37 |
| 46 | 43 27 | 16 21 | 44 17 | 16 41 | 45 7 | 17 0 | 45 57 | 17 20 | 46 47 | 17 40 | 47 37 | 17 59 | 48 27 | 18 19 | 49 17 | 18 38 |
| 48 | 43 26 | 16 22 | 44 16 | 16 42 | 45 6 | 17 1 | 45 56 | 17 21 | 46 46 | 17 41 | 47 36 | 18 0 | 48 26 | 18 20 | 49 15 | 18 39 |
| 50 | 43 25 | 16 23 | 44 15 | 16 43 | 45 5 | 17 2 | 45 55 | 17 22 | 46 45 | 17 42 | 47 35 | 18 1 | 48 24 | 18 21 | 49 14 | 18 40 |
| 52 | 43 24 | 16 24 | 44 14 | 16 44 | 45 4 | 17 3 | 45 54 | 17 23 | 46 44 | 17 43 | 47 34 | 18 2 | 48 23 | 18 22 | 49 13 | 18 42 |
| 54 | 43 24 | 16 25 | 44 13 | 16 45 | 45 3 | 17 4 | 45 53 | 17 24 | 46 43 | 17 44 | 47 33 | 18 3 | 48 22 | 18 23 | 49 12 | 18 43 |
| 56 | 43 23 | 16 26 | 44 12 | 16 45 | 45 2 | 17 5 | 45 52 | 17 25 | 46 42 | 17 45 | 47 32 | 18 4 | 48 21 | 18 24 | 49 11 | 18 44 |
| 58 | 43 22 | 16 27 | 44 12 | 16 46 | 45 1 | 17 6 | 45 51 | 17 26 | 46 41 | 17 46 | 47 31 | 18 5 | 48 20 | 18 25 | 49 10 | 18 45 |

| Seconds of H. P. | ″ | Sec. A |
|---|---|---|
| | | ″ |
| 1 | 1 | 0 |
| 2 | 2 | 1 |
| 3 | 3 | 1 |
| 4 | 3 | 1 |
| 5 | 4 | 2 |
| 6 | 5 | 2 |
| 7 | 6 | 2 |
| 8 | 7 | 3 |
| 9 | 8 | 3 |
| 10 | 8 | 3 |
| 11 | 9 | 4 |
| 12 | 10 | 4 |
| 13 | 11 | 4 |
| 14 | 12 | 4 |
| 15 | 13 | 5 |
| 16 | 13 | 5 |
| 17 | 14 | 5 |
| 18 | 15 | 6 |
| 19 | 16 | 6 |
| 20 | 17 | 6 |
| 21 | 18 | 7 |
| 22 | 18 | 7 |
| 23 | 19 | 7 |
| 24 | 20 | 8 |
| 25 | 21 | 8 |
| 26 | 22 | 8 |
| 27 | 23 | 9 |
| 28 | 23 | 9 |
| 29 | 24 | 9 |
| 30 | 25 | 10 |
| 31 | 26 | 10 |
| 32 | 27 | 10 |
| 33 | 28 | 11 |
| 34 | 28 | 11 |
| 35 | 29 | 11 |
| 36 | 30 | 11 |
| 37 | 31 | 12 |
| 38 | 32 | 12 |
| 39 | 33 | 12 |
| 40 | 33 | 13 |
| 41 | 34 | 13 |
| 42 | 35 | 13 |
| 43 | 36 | 14 |
| 44 | 37 | 14 |
| 45 | 38 | 14 |
| 46 | 38 | 15 |
| 47 | 39 | 15 |
| 48 | 40 | 15 |
| 49 | 41 | 16 |
| 50 | 42 | 16 |
| 51 | 43 | 16 |
| 52 | 43 | 17 |
| 53 | 44 | 17 |
| 54 | 45 | 17 |
| 55 | 46 | 17 |
| 56 | 47 | 18 |
| 57 | 48 | 18 |
| 58 | 48 | 18 |
| 59 | 49 | 19 |
| = | = | = |
| Alt. | A | A |
| ⊙ | ☾ | |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 80 | 5 | 0 |

(34° and 35°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 43 21 | 16 28 | 44 11 | 16 47 | 45 0 | 17 7 | 45 50 | 17 27 | 46 40 | 17 46 | 47 30 | 18 6 | 48 19 | 18 26 | 49 9 | 18 46 |
| 2 | 43 20 | 16 28 | 44 10 | 16 48 | 44 59 | 17 8 | 45 49 | 17 28 | 46 39 | 17 47 | 47 29 | 18 7 | 48 18 | 18 27 | 49 8 | 18 47 |
| 4 | 43 19 | 16 29 | 44 9 | 16 49 | 44 58 | 17 9 | 45 48 | 17 29 | 46 38 | 17 48 | 47 27 | 18 8 | 48 17 | 18 28 | 49 7 | 18 48 |
| 6 | 43 18 | 16 30 | 44 8 | 16 50 | 44 57 | 17 10 | 45 47 | 17 30 | 46 37 | 17 49 | 47 26 | 18 9 | 48 16 | 18 29 | 49 6 | 18 49 |
| 8 | 43 17 | 16 31 | 44 7 | 16 51 | 44 56 | 17 11 | 45 46 | 17 30 | 46 36 | 17 50 | 47 25 | 18 10 | 48 15 | 18 30 | 49 5 | 18 50 |
| 10 | 43 16 | 16 32 | 44 6 | 16 52 | 44 55 | 17 12 | 45 45 | 17 31 | 46 35 | 17 51 | 47 24 | 18 11 | 48 14 | 18 31 | 49 4 | 18 51 |
| 12 | 43 15 | 16 33 | 44 5 | 16 53 | 44 54 | 17 13 | 45 44 | 17 32 | 46 34 | 17 52 | 47 23 | 18 12 | 48 13 | 18 32 | 49 2 | 18 52 |
| 14 | 43 14 | 16 34 | 44 4 | 16 54 | 44 53 | 17 13 | 45 43 | 17 33 | 46 33 | 17 53 | 47 22 | 18 13 | 48 12 | 18 33 | 49 1 | 18 53 |
| 16 | 43 13 | 16 35 | 44 3 | 16 55 | 44 52 | 17 14 | 45 42 | 17 34 | 46 31 | 17 54 | 47 21 | 18 14 | 48 11 | 18 34 | 49 0 | 18 54 |
| 18 | 43 12 | 16 36 | 44 2 | 16 55 | 44 51 | 17 15 | 45 41 | 17 35 | 46 30 | 17 55 | 47 20 | 18 15 | 48 10 | 18 35 | 48 59 | 18 55 |
| 20 | 43 11 | 16 36 | 44 1 | 16 56 | 44 50 | 17 16 | 45 40 | 17 36 | 46 29 | 17 56 | 47 19 | 18 16 | 48 9 | 18 36 | 48 58 | 18 56 |
| 22 | 43 10 | 16 37 | 44 0 | 16 57 | 44 49 | 17 17 | 45 39 | 17 37 | 46 28 | 17 57 | 47 18 | 18 17 | 48 7 | 18 37 | 48 57 | 18 57 |
| 24 | 43 9 | 16 38 | 43 59 | 16 58 | 44 48 | 17 18 | 45 38 | 17 38 | 46 27 | 17 58 | 47 17 | 18 18 | 48 6 | 18 38 | 48 56 | 18 58 |
| 26 | 43 8 | 16 39 | 43 58 | 17 0 | 44 47 | 17 19 | 45 37 | 17 39 | 46 26 | 17 59 | 47 16 | 18 19 | 48 5 | 18 39 | 48 55 | 18 59 |
| 28 | 43 7 | 16 40 | 43 57 | 17 1 | 44 46 | 17 20 | 45 36 | 17 40 | 46 25 | 18 0 | 47 15 | 18 20 | 48 4 | 18 40 | 48 54 | 19 0 |
| 30 | 43 6 | 16 41 | 43 56 | 17 2 | 44 45 | 17 21 | 45 35 | 17 41 | 46 24 | 18 1 | 47 14 | 18 21 | 48 3 | 18 41 | 48 53 | 19 1 |
| 32 | 43 5 | 16 42 | 43 55 | 17 3 | 44 44 | 17 22 | 45 34 | 17 42 | 46 23 | 18 2 | 47 13 | 18 22 | 48 2 | 18 42 | 48 51 | 19 2 |
| 34 | 43 4 | 16 43 | 43 54 | 17 4 | 44 43 | 17 23 | 45 33 | 17 43 | 46 22 | 18 3 | 47 12 | 18 23 | 48 1 | 18 43 | 48 50 | 19 3 |
| 36 | 43 3 | 16 44 | 43 53 | 17 4 | 44 42 | 17 24 | 45 32 | 17 44 | 46 21 | 18 4 | 47 10 | 18 24 | 48 0 | 18 44 | 48 49 | 19 4 |
| 38 | 43 2 | 16 44 | 43 52 | 17 5 | 44 41 | 17 24 | 45 31 | 17 44 | 46 20 | 18 5 | 47 9 | 18 25 | 47 59 | 18 45 | 48 48 | 19 5 |
| 40 | 43 1 | 16 45 | 43 51 | 17 5 | 44 40 | 17 25 | 45 29 | 17 45 | 46 19 | 18 5 | 47 8 | 18 25 | 47 58 | 18 45 | 48 47 | 19 6 |
| 42 | 43 0 | 16 46 | 43 50 | 17 6 | 44 39 | 17 26 | 45 28 | 17 46 | 46 18 | 18 6 | 47 7 | 18 26 | 47 57 | 18 46 | 48 46 | 19 7 |
| 44 | 42 59 | 16 47 | 43 49 | 17 7 | 44 38 | 17 27 | 45 27 | 17 47 | 46 17 | 18 7 | 47 6 | 18 27 | 47 55 | 18 47 | 48 45 | 19 8 |
| 46 | 42 59 | 16 48 | 43 48 | 17 8 | 44 37 | 17 28 | 45 26 | 17 48 | 46 16 | 18 8 | 47 5 | 18 28 | 47 54 | 18 48 | 48 44 | 19 9 |
| 48 | 42 58 | 16 49 | 43 47 | 17 9 | 44 36 | 17 29 | 45 25 | 17 49 | 46 15 | 18 9 | 47 4 | 18 29 | 47 53 | 18 49 | 48 43 | 19 10 |
| 50 | 42 57 | 16 50 | 43 46 | 17 10 | 44 35 | 17 30 | 45 24 | 17 50 | 46 14 | 18 10 | 47 3 | 18 30 | 47 52 | 18 50 | 48 41 | 19 11 |
| 52 | 42 56 | 16 51 | 43 45 | 17 11 | 44 34 | 17 31 | 45 23 | 17 51 | 46 13 | 18 11 | 47 2 | 18 31 | 47 51 | 18 51 | 48 40 | 19 12 |
| 54 | 42 55 | 16 52 | 43 44 | 17 12 | 44 33 | 17 32 | 45 22 | 17 52 | 46 12 | 18 12 | 47 1 | 18 32 | 47 50 | 18 52 | 48 39 | 19 13 |
| 56 | 42 54 | 16 52 | 43 43 | 17 13 | 44 32 | 17 33 | 45 21 | 17 53 | 46 11 | 18 13 | 47 0 | 18 33 | 47 49 | 18 53 | 48 38 | 19 14 |
| 58 | 42 53 | 16 53 | 43 42 | 17 13 | 44 31 | 17 34 | 45 20 | 17 54 | 46 10 | 18 14 | 46 59 | 18 34 | 47 48 | 18 54 | 48 37 | 19 15 |
| 35° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 42 52 | 16 54 | 43 41 | 17 14 | 44 30 | 17 35 | 45 19 | 17 55 | 46 8 | 18 15 | 46 58 | 18 35 | 47 47 | 18 55 | 48 36 | 19 16 |
| 2 | 42 51 | 16 55 | 43 40 | 17 15 | 44 29 | 17 36 | 45 18 | 17 56 | 46 7 | 18 16 | 46 57 | 18 36 | 47 46 | 18 56 | 48 35 | 19 17 |
| 4 | 42 50 | 16 56 | 43 39 | 17 16 | 44 28 | 17 36 | 45 17 | 17 57 | 46 6 | 18 17 | 46 55 | 18 37 | 47 45 | 18 57 | 48 34 | 19 18 |
| 6 | 42 49 | 16 57 | 43 38 | 17 17 | 44 27 | 17 37 | 45 16 | 17 58 | 46 5 | 18 18 | 46 54 | 18 38 | 47 43 | 18 58 | 48 33 | 19 19 |
| 8 | 42 48 | 16 58 | 43 37 | 17 18 | 44 26 | 17 38 | 45 15 | 17 59 | 46 4 | 18 19 | 46 53 | 18 39 | 47 42 | 18 59 | 48 31 | 19 20 |
| 10 | 42 47 | 16 59 | 43 36 | 17 19 | 44 25 | 17 39 | 45 14 | 17 59 | 46 3 | 18 20 | 46 52 | 18 40 | 47 41 | 19 0 | 48 30 | 19 21 |
| 12 | 42 46 | 16 59 | 43 35 | 17 20 | 44 24 | 17 40 | 45 13 | 18 0 | 46 2 | 18 21 | 46 51 | 18 41 | 47 40 | 19 1 | 48 29 | 19 22 |
| 14 | 42 45 | 17 0 | 43 34 | 17 21 | 44 23 | 17 41 | 45 12 | 18 1 | 46 1 | 18 22 | 46 50 | 18 42 | 47 39 | 19 2 | 48 28 | 19 23 |
| 16 | 42 44 | 17 1 | 43 33 | 17 22 | 44 22 | 17 42 | 45 11 | 18 2 | 46 0 | 18 23 | 46 49 | 18 43 | 47 38 | 19 3 | 48 27 | 19 24 |
| 18 | 42 43 | 17 2 | 43 32 | 17 22 | 44 21 | 17 43 | 45 10 | 18 3 | 45 59 | 18 23 | 46 48 | 18 44 | 47 37 | 19 4 | 48 26 | 19 25 |
| 20 | 42 42 | 17 3 | 43 31 | 17 23 | 44 20 | 17 44 | 45 9 | 18 4 | 45 58 | 18 24 | 46 47 | 18 45 | 47 36 | 19 5 | 48 25 | 19 25 |
| 22 | 42 41 | 17 4 | 43 30 | 17 24 | 44 19 | 17 45 | 45 8 | 18 5 | 45 57 | 18 25 | 46 46 | 18 46 | 47 34 | 19 6 | 48 23 | 19 26 |
| 24 | 42 40 | 17 5 | 43 29 | 17 25 | 44 18 | 17 46 | 45 7 | 18 6 | 45 56 | 18 26 | 46 44 | 18 47 | 47 33 | 19 7 | 48 22 | 19 27 |
| 26 | 42 39 | 17 6 | 43 28 | 17 26 | 44 17 | 17 46 | 45 6 | 18 7 | 45 54 | 18 27 | 46 43 | 18 48 | 47 32 | 19 8 | 48 21 | 19 28 |
| 28 | 42 38 | 17 6 | 43 27 | 17 27 | 44 16 | 17 47 | 45 4 | 18 8 | 45 53 | 18 28 | 46 42 | 18 49 | 47 31 | 19 9 | 48 20 | 19 29 |
| 30 | 42 37 | 17 7 | 43 26 | 17 28 | 44 15 | 17 48 | 45 3 | 18 9 | 45 52 | 18 29 | 46 41 | 18 50 | 47 30 | 19 10 | 48 19 | 19 30 |
| 32 | 42 36 | 17 8 | 43 25 | 17 29 | 44 14 | 17 49 | 45 2 | 18 10 | 45 51 | 18 30 | 46 40 | 18 50 | 47 29 | 19 11 | 48 18 | 19 31 |
| 34 | 42 35 | 17 9 | 43 24 | 17 30 | 44 12 | 17 50 | 45 1 | 18 11 | 45 50 | 18 31 | 46 39 | 18 51 | 47 28 | 19 12 | 48 17 | 19 32 |
| 36 | 42 34 | 17 10 | 43 23 | 17 30 | 44 11 | 17 51 | 45 0 | 18 11 | 45 49 | 18 32 | 46 38 | 18 52 | 47 27 | 19 13 | 48 16 | 19 33 |
| 38 | 42 33 | 17 11 | 43 22 | 17 31 | 44 10 | 17 52 | 44 59 | 18 12 | 45 48 | 18 33 | 46 37 | 18 53 | 47 26 | 19 14 | 48 14 | 19 34 |
| 40 | 42 32 | 17 12 | 43 21 | 17 32 | 44 9 | 17 53 | 44 58 | 18 13 | 45 47 | 18 34 | 46 36 | 18 54 | 47 24 | 19 15 | 48 13 | 19 35 |
| 42 | 42 31 | 17 13 | 43 20 | 17 33 | 44 8 | 17 54 | 44 57 | 18 14 | 45 46 | 18 35 | 46 35 | 18 55 | 47 23 | 19 16 | 48 12 | 19 36 |
| 44 | 42 30 | 17 13 | 43 19 | 17 34 | 44 7 | 17 55 | 44 56 | 18 15 | 45 45 | 18 36 | 46 34 | 18 56 | 47 22 | 19 17 | 48 11 | 19 37 |
| 46 | 42 29 | 17 14 | 43 18 | 17 35 | 44 6 | 17 56 | 44 55 | 18 16 | 45 44 | 18 37 | 46 32 | 18 57 | 47 21 | 19 18 | 48 0 | 19 38 |
| 48 | 42 28 | 17 15 | 43 17 | 17 36 | 44 5 | 17 56 | 44 54 | 18 17 | 45 43 | 18 38 | 46 31 | 18 58 | 47 20 | 19 19 | 48 9 | 19 39 |
| 50 | 42 27 | 17 16 | 43 16 | 17 37 | 44 4 | 17 57 | 44 53 | 18 18 | 45 42 | 18 38 | 46 30 | 18 59 | 47 19 | 19 20 | 48 8 | 19 40 |
| 52 | 42 26 | 17 17 | 43 15 | 17 38 | 44 3 | 17 58 | 44 52 | 18 19 | 45 41 | 18 39 | 46 29 | 19 0 | 47 18 | 19 21 | 48 6 | 19 41 |
| 54 | 42 25 | 17 18 | 43 14 | 17 38 | 44 2 | 17 59 | 44 51 | 18 20 | 45 39 | 18 40 | 46 28 | 19 1 | 47 17 | 19 22 | 48 5 | 19 42 |
| 56 | 42 24 | 17 19 | 43 13 | 17 39 | 44 1 | 18 0 | 44 50 | 18 21 | 45 38 | 18 41 | 46 27 | 19 2 | 47 16 | 19 23 | 48 4 | 19 43 |
| 58 | 42 23 | 17 20 | 43 12 | 17 40 | 44 0 | 18 1 | 44 49 | 18 22 | 45 37 | 18 42 | 46 26 | 19 3 | 47 14 | 19 24 | 48 3 | 19 44 |

| Seconds of H. P. | | |
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| ″ | Corr. | A |
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| 1 | 1 | 0 |
| 2 | 2 | 1 |
| 3 | 2 | 1 |
| 4 | 3 | 1 |
| 5 | 4 | 2 |
| 6 | 5 | 2 |
| 7 | 6 | 2 |
| 8 | 7 | 3 |
| 9 | 7 | 3 |
| 10 | 8 | 3 |
| 11 | 9 | 4 |
| 12 | 10 | 4 |
| 13 | 11 | 4 |
| 14 | 11 | 5 |
| 15 | 12 | 5 |
| 16 | 13 | 5 |
| 17 | 14 | 6 |
| 18 | 15 | 6 |
| 19 | 15 | 6 |
| 20 | 16 | 7 |
| 21 | 17 | 7 |
| 22 | 18 | 7 |
| 23 | 19 | 8 |
| 24 | 20 | 8 |
| 25 | 20 | 8 |
| 26 | 21 | 9 |
| 27 | 22 | 9 |
| 28 | 23 | 9 |
| 29 | 24 | 10 |
| 30 | 24 | 10 |
| 31 | 25 | 10 |
| 32 | 26 | 11 |
| 33 | 27 | 11 |
| 34 | 28 | 11 |
| 35 | 29 | 12 |
| 36 | 29 | 12 |
| 37 | 30 | 12 |
| 38 | 31 | 13 |
| 39 | 32 | 13 |
| 40 | 33 | 13 |
| 41 | 33 | 14 |
| 42 | 34 | 14 |
| 43 | 35 | 14 |
| 44 | 36 | 15 |
| 45 | 37 | 15 |
| 46 | 38 | 15 |
| 47 | 38 | 16 |
| 48 | 39 | 16 |
| 49 | 40 | 16 |
| 50 | 41 | 17 |
| 51 | 42 | 17 |
| 52 | 42 | 17 |
| 53 | 43 | 18 |
| 54 | 44 | 18 |
| 55 | 45 | 18 |
| 56 | 46 | 19 |
| 57 | 47 | 19 |
| 58 | 47 | 19 |
| 59 | 48 | 20 |
| App. Alt. | ☉ | ✱ |
| | A | A |
| 3 | 8 | 8 |
| 4 | 6 | 4 |
| 5 | 4 | 5 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 80 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (36° and 37°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 36° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 42 22 | 17 20 | 43 10 | 17 41 | 43 59 | 18 2 | 44 48 | 18 23 | 45 36 | 18 43 | 46 25 | 19 4 | 47 13 | 19 25 | 48 2 | 19 45 |
| 2 | 42 21 | 17 21 | 43 9 | 17 42 | 43 58 | 18 3 | 44 47 | 18 24 | 45 35 | 18 44 | 46 24 | 19 5 | 47 12 | 19 26 | 48 1 | 19 46 |
| 4 | 42 20 | 17 22 | 43 8 | 17 43 | 43 57 | 18 4 | 44 45 | 18 24 | 45 34 | 18 45 | 46 23 | 19 6 | 47 11 | 19 27 | 48 0 | 19 47 |
| 6 | 42 19 | 17 23 | 43 7 | 17 44 | 43 56 | 18 5 | 44 44 | 18 25 | 45 33 | 18 46 | 46 21 | 19 7 | 47 10 | 19 27 | 47 58 | 19 48 |
| 8 | 42 18 | 17 24 | 43 6 | 17 45 | 43 55 | 18 5 | 44 43 | 18 26 | 45 32 | 18 47 | 46 20 | 19 8 | 47 9 | 19 28 | 47 57 | 19 49 |
| 10 | 42 17 | 17 25 | 43 5 | 17 46 | 43 54 | 18 6 | 44 42 | 18 27 | 45 31 | 18 48 | 46 19 | 19 9 | 47 8 | 19 29 | 47 56 | 19 50 |
| 12 | 42 16 | 17 26 | 43 4 | 17 46 | 43 53 | 18 7 | 44 41 | 18 28 | 45 30 | 18 49 | 46 18 | 19 10 | 47 6 | 19 30 | 47 55 | 19 51 |
| 14 | 42 15 | 17 27 | 43 3 | 17 47 | 43 52 | 18 8 | 44 40 | 18 29 | 45 28 | 18 50 | 46 17 | 19 10 | 47 5 | 19 31 | 47 54 | 19 52 |
| 16 | 42 14 | 17 27 | 43 2 | 17 48 | 43 51 | 18 9 | 44 39 | 18 30 | 45 27 | 18 51 | 46 16 | 19 11 | 47 4 | 19 32 | 47 53 | 19 53 |
| 18 | 42 13 | 17 28 | 43 1 | 17 49 | 43 49 | 18 10 | 44 38 | 18 31 | 45 26 | 18 52 | 46 15 | 19 12 | 47 3 | 19 33 | 47 51 | 19 54 |
| 20 | 42 12 | 17 29 | 43 0 | 17 50 | 43 48 | 18 11 | 44 37 | 18 32 | 45 25 | 18 52 | 46 13 | 19 13 | 47 2 | 19 34 | 47 50 | 19 55 |
| 22 | 42 11 | 17 30 | 42 59 | 17 51 | 43 47 | 18 12 | 44 36 | 18 33 | 45 24 | 18 53 | 46 12 | 19 14 | 47 1 | 19 35 | 47 49 | 19 56 |
| 24 | 42 10 | 17 31 | 42 58 | 17 52 | 43 46 | 18 13 | 44 35 | 18 34 | 45 23 | 18 54 | 46 11 | 19 15 | 46 59 | 19 36 | 47 48 | 19 57 |
| 26 | 42 9 | 17 32 | 42 57 | 17 53 | 43 45 | 18 14 | 44 34 | 18 34 | 45 22 | 18 55 | 46 10 | 19 16 | 46 58 | 19 37 | 47 47 | 19 58 |
| 28 | 42 8 | 17 33 | 42 56 | 17 54 | 43 44 | 18 14 | 44 32 | 18 35 | 45 21 | 18 56 | 46 9 | 19 17 | 46 57 | 19 38 | 47 46 | 19 59 |
| 30 | 42 7 | 17 33 | 42 55 | 17 54 | 43 43 | 18 15 | 44 31 | 18 36 | 45 20 | 18 57 | 46 8 | 19 18 | 46 56 | 19 39 | 47 44 | 20 0 |
| 32 | 42 6 | 17 34 | 42 54 | 17 55 | 43 42 | 18 16 | 44 30 | 18 37 | 45 18 | 18 58 | 46 7 | 19 19 | 46 55 | 19 40 | 47 43 | 20 1 |
| 34 | 42 4 | 17 35 | 42 53 | 17 56 | 43 41 | 18 17 | 44 29 | 18 38 | 45 17 | 18 59 | 46 6 | 19 20 | 46 54 | 19 41 | 47 42 | 20 2 |
| 36 | 42 3 | 17 36 | 42 52 | 17 57 | 43 40 | 18 18 | 44 28 | 18 39 | 45 16 | 19 0 | 46 4 | 19 21 | 46 53 | 19 42 | 47 41 | 20 3 |
| 38 | 42 2 | 17 37 | 42 51 | 17 58 | 43 39 | 18 19 | 44 27 | 18 40 | 45 15 | 19 1 | 46 3 | 19 22 | 46 51 | 19 43 | 47 40 | 20 4 |
| 40 | 42 1 | 17 38 | 42 50 | 17 59 | 43 38 | 18 20 | 44 26 | 18 41 | 45 14 | 19 2 | 46 2 | 19 23 | 46 50 | 19 45 | 47 38 | 20 5 |
| 42 | 42 0 | 17 39 | 42 49 | 18 0 | 43 37 | 18 21 | 44 25 | 18 42 | 45 13 | 19 3 | 46 1 | 19 24 | 46 49 | 19 46 | 47 37 | 20 6 |
| 44 | 41 59 | 17 40 | 42 47 | 18 1 | 43 36 | 18 22 | 44 24 | 18 43 | 45 12 | 19 4 | 46 0 | 19 25 | 46 48 | 19 47 | 47 36 | 20 7 |
| 46 | 41 58 | 17 40 | 42 46 | 18 2 | 43 35 | 18 23 | 44 23 | 18 44 | 45 11 | 19 5 | 45 59 | 19 26 | 46 47 | 19 47 | 47 35 | 20 8 |
| 48 | 41 57 | 17 41 | 42 45 | 18 2 | 43 33 | 18 23 | 44 22 | 18 44 | 45 10 | 19 6 | 45 58 | 19 27 | 46 46 | 19 48 | 47 34 | 20 9 |
| 50 | 41 56 | 17 42 | 42 44 | 18 3 | 43 32 | 18 24 | 44 20 | 18 45 | 45 8 | 19 6 | 45 57 | 19 28 | 46 45 | 19 49 | 47 33 | 20 10 |
| 52 | 41 55 | 17 43 | 42 43 | 18 4 | 43 31 | 18 25 | 44 19 | 18 46 | 45 7 | 19 7 | 45 55 | 19 28 | 46 43 | 19 50 | 47 31 | 20 11 |
| 54 | 41 54 | 17 44 | 42 42 | 18 5 | 43 30 | 18 26 | 44 18 | 18 47 | 45 6 | 19 8 | 45 54 | 19 29 | 46 42 | 19 51 | 47 30 | 20 12 |
| 56 | 41 53 | 17 45 | 42 41 | 18 6 | 43 29 | 18 27 | 44 17 | 18 48 | 45 5 | 19 9 | 45 53 | 19 30 | 46 41 | 19 52 | 47 29 | 20 13 |
| 58 | 41 52 | 17 46 | 42 40 | 18 7 | 43 28 | 18 28 | 44 16 | 18 49 | 45 4 | 19 10 | 45 52 | 19 31 | 46 40 | 19 53 | 47 28 | 20 14 |
| 37° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 41 51 | 17 46 | 42 39 | 18 8 | 43 27 | 18 29 | 44 15 | 18 50 | 45 3 | 19 11 | 45 51 | 19 32 | 46 39 | 19 53 | 47 27 | 20 15 |
| 2 | 41 50 | 17 47 | 42 38 | 18 9 | 43 26 | 18 30 | 44 14 | 18 51 | 45 2 | 19 12 | 45 50 | 19 33 | 46 38 | 19 54 | 47 26 | 20 16 |
| 4 | 41 49 | 17 48 | 42 37 | 18 9 | 43 25 | 18 31 | 44 13 | 18 52 | 45 1 | 19 13 | 45 49 | 19 34 | 46 37 | 19 55 | 47 24 | 20 17 |
| 6 | 41 48 | 17 49 | 42 36 | 18 10 | 43 24 | 18 31 | 44 12 | 18 53 | 45 0 | 19 14 | 45 47 | 19 35 | 46 35 | 19 56 | 47 23 | 20 17 |
| 8 | 41 47 | 17 50 | 42 35 | 18 11 | 43 23 | 18 32 | 44 11 | 18 54 | 44 58 | 19 15 | 45 46 | 19 36 | 46 34 | 19 57 | 47 22 | 20 18 |
| 10 | 41 46 | 17 51 | 42 34 | 18 12 | 43 22 | 18 33 | 44 9 | 18 54 | 44 57 | 19 16 | 45 45 | 19 37 | 46 33 | 19 58 | 47 21 | 20 19 |
| 12 | 41 45 | 17 52 | 42 33 | 18 13 | 43 20 | 18 34 | 44 8 | 18 55 | 44 56 | 19 17 | 45 44 | 19 38 | 46 32 | 19 59 | 47 20 | 20 20 |
| 14 | 41 44 | 17 53 | 42 32 | 18 14 | 43 19 | 18 35 | 44 7 | 18 56 | 44 55 | 19 17 | 45 43 | 19 39 | 46 31 | 20 0 | 47 18 | 20 21 |
| 16 | 41 43 | 17 53 | 42 30 | 18 15 | 43 18 | 18 36 | 44 6 | 18 57 | 44 54 | 19 18 | 45 42 | 19 40 | 46 29 | 20 1 | 47 17 | 20 22 |
| 18 | 41 42 | 17 54 | 42 29 | 18 15 | 43 17 | 18 37 | 44 5 | 18 58 | 44 53 | 19 19 | 45 40 | 19 41 | 46 28 | 20 2 | 47 16 | 20 23 |
| 20 | 41 41 | 17 55 | 42 28 | 18 16 | 43 16 | 18 38 | 44 4 | 18 59 | 44 51 | 19 20 | 45 39 | 19 41 | 46 27 | 20 3 | 47 15 | 20 24 |
| 22 | 41 40 | 17 56 | 42 27 | 18 17 | 43 15 | 18 38 | 44 3 | 19 0 | 44 50 | 19 21 | 45 38 | 19 42 | 46 26 | 20 4 | 47 13 | 20 25 |
| 24 | 41 38 | 17 57 | 42 26 | 18 18 | 43 14 | 18 39 | 44 2 | 19 1 | 44 49 | 19 22 | 45 37 | 19 43 | 46 25 | 20 5 | 47 12 | 20 26 |
| 26 | 41 37 | 17 58 | 42 25 | 18 19 | 43 13 | 18 40 | 44 0 | 19 2 | 44 48 | 19 23 | 45 36 | 19 44 | 46 23 | 20 6 | 47 11 | 20 27 |
| 28 | 41 36 | 17 58 | 42 24 | 18 20 | 43 12 | 18 41 | 43 59 | 19 3 | 44 47 | 19 24 | 45 35 | 19 45 | 46 22 | 20 7 | 47 10 | 20 28 |
| 30 | 41 35 | 17 59 | 42 28 | 18 21 | 43 11 | 18 42 | 43 58 | 19 3 | 44 46 | 19 25 | 45 33 | 19 46 | 46 21 | 20 8 | 47 9 | 20 29 |
| 32 | 41 34 | 18 0 | 42 22 | 18 22 | 43 9 | 18 43 | 43 57 | 19 4 | 44 45 | 19 26 | 45 32 | 19 47 | 46 20 | 20 8 | 47 7 | 20 30 |
| 34 | 41 33 | 18 1 | 42 21 | 18 22 | 43 8 | 18 44 | 43 56 | 19 5 | 44 44 | 19 27 | 45 31 | 19 48 | 46 19 | 20 9 | 47 6 | 20 31 |
| 36 | 41 32 | 18 2 | 42 20 | 18 23 | 43 7 | 18 45 | 43 55 | 19 6 | 44 42 | 19 28 | 45 30 | 19 49 | 46 18 | 20 10 | 47 5 | 20 32 |
| 38 | 41 31 | 18 3 | 42 19 | 18 24 | 43 6 | 18 46 | 43 54 | 19 7 | 44 41 | 19 28 | 45 29 | 19 50 | 46 16 | 20 11 | 47 4 | 20 33 |
| 40 | 41 30 | 18 3 | 42 18 | 18 25 | 43 5 | 18 46 | 43 53 | 19 8 | 44 40 | 19 29 | 45 28 | 19 51 | 46 15 | 20 12 | 47 3 | 20 34 |
| 42 | 41 29 | 18 4 | 42 17 | 18 26 | 43 4 | 18 47 | 43 51 | 19 9 | 44 39 | 19 30 | 45 27 | 19 52 | 46 14 | 20 13 | 47 1 | 20 35 |
| 44 | 41 28 | 18 5 | 42 15 | 18 28 | 43 3 | 18 48 | 43 50 | 19 10 | 44 38 | 19 31 | 45 25 | 19 53 | 46 13 | 20 14 | 47 0 | 20 36 |
| 46 | 41 27 | 18 6 | 42 14 | 18 29 | 43 2 | 18 49 | 43 49 | 19 11 | 44 37 | 19 32 | 45 24 | 19 54 | 46 12 | 20 15 | 46 59 | 20 37 |
| 48 | 41 26 | 18 7 | 42 13 | 18 30 | 43 1 | 18 50 | 43 48 | 19 12 | 44 36 | 19 38 | 45 23 | 19 55 | 46 10 | 20 16 | 46 58 | 20 38 |
| 50 | 41 25 | 18 8 | 42 12 | 18 31 | 43 0 | 18 51 | 43 47 | 19 12 | 44 34 | 19 34 | 45 22 | 19 55 | 46 9 | 20 17 | 46 57 | 20 39 |
| 52 | 41 24 | 18 9 | 42 11 | 18 33 | 42 58 | 18 52 | 43 46 | 19 13 | 44 33 | 19 35 | 45 21 | 19 56 | 46 8 | 20 18 | 46 55 | 20 40 |
| 54 | 41 23 | 18 10 | 42 10 | 18 34 | 42 57 | 18 53 | 43 45 | 19 14 | 44 32 | 19 36 | 45 20 | 19 57 | 46 7 | 20 19 | 46 54 | 20 41 |
| 56 | 41 22 | 18 10 | 42 9 | 18 35 | 42 56 | 18 54 | 43 44 | 19 15 | 44 31 | 19 37 | 45 18 | 19 58 | 46 6 | 20 20 | 46 53 | 20 42 |
| 58 | 41 21 | 18 11 | 42 8 | 18 36 | 42 55 | 18 54 | 43 43 | 19 16 | 44 30 | 19 38 | 45 17 | 19 59 | 46 4 | 20 21 | 46 52 | 20 43 |

Seconds of H. P.

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| 1 | 1 | 0 |
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| 9 | 7 | 3 |
| 10 | 8 | 3 |
| 11 | 9 | 4 |
| 12 | 10 | 4 |
| 13 | 10 | 5 |
| 14 | 11 | 5 |
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| 25 | 20 | 9 |
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| 31 | 25 | 11 |
| 32 | 26 | 11 |
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| 35 | 28 | 12 |
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| 37 | 30 | 13 |
| 38 | 30 | 13 |
| 39 | 31 | 14 |
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| 41 | 33 | 14 |
| 42 | 34 | 15 |
| 43 | 34 | 15 |
| 44 | 35 | 15 |
| 45 | 36 | 16 |
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| 48 | 38 | 17 |
| 49 | 39 | 17 |
| 50 | 40 | 18 |
| 51 | 41 | 18 |
| 52 | 42 | 18 |
| 53 | 42 | 19 |
| 54 | 43 | 19 |
| 55 | 44 | 19 |
| 56 | 45 | 20 |
| 57 | 46 | 20 |
| 58 | 46 | 20 |
| 59 | 47 | 21 |

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| 1 | 0 | 0 |
| 2 | 1 | 1 |
| 3 | 1 | 1 |
| 4 | 2 | 2 |
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| 6 | 3 | 3 |
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| 8 | 4 | 4 |
| 9 | 4 | 4 |
| 10 | 5 | 5 |
| 11 | 5 | 5 |
| 12 | 6 | 6 |
| 13 | 6 | 6 |
| 14 | 7 | 7 |
| 15 | 7 | 7 |
| 16 | 8 | 8 |
| 17 | 8 | 8 |
| 18 | 9 | 9 |
| 19 | 9 | 9 |
| 20 | 10 | 10 |
| 21 | 10 | 10 |
| 22 | 11 | 11 |
| 23 | 11 | 11 |
| 24 | 12 | 12 |
| 25 | 12 | 12 |
| 26 | 13 | 13 |
| 27 | 13 | 13 |
| 28 | 14 | 14 |
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| 30 | 15 | 15 |
| 31 | 15 | 15 |
| 32 | 16 | 16 |
| 33 | 16 | 16 |
| 34 | 17 | 17 |
| 35 | 17 | 17 |
| 36 | 18 | 18 |
| 37 | 18 | 18 |
| 38 | 19 | 19 |
| 39 | 19 | 19 |
| 40 | 20 | 20 |
| 41 | 20 | 20 |
| 42 | 21 | 21 |
| 43 | 21 | 21 |
| 44 | 22 | 22 |
| 45 | 22 | 22 |
| 46 | 23 | 23 |
| 47 | 23 | 23 |
| 48 | 24 | 24 |
| 49 | 24 | 24 |
| 50 | 25 | 25 |
| 51 | 25 | 25 |
| 52 | 26 | 26 |
| 53 | 26 | 26 |
| 54 | 27 | 27 |
| 55 | 27 | 27 |
| 56 | 28 | 28 |
| 57 | 28 | 28 |
| 58 | 29 | 29 |
| 59 | 29 | 29 |

(38° and 39°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| 38° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 41 19 | 18 12 | 42 7 | 18 34 | 42 54 | 18 55 | 43 41 | 19 17 | 44 29 | 19 39 | 45 16 | 20 0 | 46 3 | 20 22 | 46 51 | 20 43 |
| 2 | 41 18 | 18 13 | 42 6 | 18 35 | 42 53 | 18 56 | 43 40 | 19 18 | 44 28 | 19 39 | 45 15 | 20 1 | 46 2 | 20 23 | 46 49 | 20 44 |
| 4 | 41 17 | 18 14 | 42 5 | 18 35 | 42 52 | 18 57 | 43 39 | 19 19 | 44 26 | 19 40 | 45 14 | 20 2 | 46 1 | 20 24 | 46 48 | 20 45 |
| 6 | 41 16 | 18 15 | 42 3 | 18 36 | 42 51 | 18 58 | 43 38 | 19 20 | 44 25 | 19 41 | 45 12 | 20 3 | 46 0 | 20 25 | 46 47 | 20 46 |
| 8 | 41 15 | 18 15 | 42 2 | 18 37 | 42 50 | 18 59 | 43 37 | 19 21 | 44 24 | 19 42 | 45 11 | 20 4 | 45 58 | 20 26 | 46 46 | 20 47 |
| 10 | 41 14 | 18 16 | 42 1 | 18 38 | 42 48 | 19 0 | 43 36 | 19 21 | 44 23 | 19 43 | 45 10 | 20 5 | 45 57 | 20 27 | 46 44 | 20 48 |
| 12 | 41 13 | 18 17 | 42 0 | 18 39 | 42 47 | 19 1 | 43 34 | 19 22 | 44 22 | 19 44 | 45 9 | 20 6 | 45 56 | 20 27 | 46 43 | 20 49 |
| 14 | 41 12 | 18 18 | 41 59 | 18 40 | 42 46 | 19 1 | 43 33 | 19 23 | 44 20 | 19 45 | 45 8 | 20 7 | 45 55 | 20 28 | 46 42 | 20 50 |
| 16 | 41 11 | 18 19 | 41 58 | 18 41 | 42 45 | 19 2 | 43 32 | 19 24 | 44 19 | 19 46 | 45 6 | 20 8 | 45 54 | 20 29 | 46 41 | 20 51 |
| 18 | 41 10 | 18 20 | 41 57 | 18 41 | 42 44 | 19 3 | 43 31 | 19 25 | 44 18 | 19 47 | 45 5 | 20 8 | 45 52 | 20 30 | 46 39 | 20 52 |
| 20 | 41 9 | 18 20 | 41 56 | 18 42 | 42 43 | 19 4 | 43 30 | 19 26 | 44 17 | 19 48 | 45 4 | 20 9 | 45 51 | 20 31 | 46 38 | 20 53 |
| 22 | 41 8 | 18 21 | 41 55 | 18 43 | 42 42 | 19 5 | 43 29 | 19 27 | 44 16 | 19 48 | 45 3 | 20 10 | 45 50 | 20 32 | 46 37 | 20 54 |
| 24 | 41 6 | 18 22 | 41 53 | 18 44 | 42 41 | 19 6 | 43 28 | 19 28 | 44 15 | 19 49 | 45 2 | 20 11 | 45 49 | 20 33 | 46 36 | 20 55 |
| 26 | 41 5 | 18 23 | 41 52 | 18 45 | 42 39 | 19 7 | 43 26 | 19 29 | 44 13 | 19 50 | 45 0 | 20 12 | 45 47 | 20 34 | 46 34 | 20 56 |
| 28 | 41 4 | 18 24 | 41 51 | 18 46 | 42 38 | 19 8 | 43 25 | 19 29 | 44 12 | 19 51 | 44 59 | 20 13 | 45 46 | 20 35 | 46 33 | 20 57 |
| 30 | 41 3 | 18 25 | 41 50 | 18 47 | 42 37 | 19 8 | 43 24 | 19 30 | 44 11 | 19 52 | 44 58 | 20 14 | 45 45 | 20 36 | 46 32 | 20 58 |
| 32 | 41 2 | 18 26 | 41 49 | 18 47 | 42 36 | 19 9 | 43 23 | 19 31 | 44 10 | 19 53 | 44 57 | 20 15 | 45 44 | 20 37 | 46 31 | 20 59 |
| 34 | 41 1 | 18 26 | 41 48 | 18 48 | 42 35 | 19 10 | 43 22 | 19 32 | 44 9 | 19 54 | 44 56 | 20 16 | 45 43 | 20 38 | 46 30 | 21 0 |
| 36 | 41 0 | 18 27 | 41 47 | 18 49 | 42 34 | 19 11 | 43 21 | 19 33 | 44 8 | 19 55 | 44 54 | 20 17 | 45 41 | 20 39 | 46 28 | 21 1 |
| 38 | 40 59 | 18 28 | 41 46 | 18 50 | 42 33 | 19 12 | 43 20 | 19 34 | 44 6 | 19 56 | 44 53 | 20 18 | 45 40 | 20 40 | 46 27 | 21 1 |
| 40 | 40 58 | 18 29 | 41 45 | 18 51 | 42 31 | 19 13 | 43 18 | 19 35 | 44 5 | 19 57 | 44 52 | 20 18 | 45 39 | 20 40 | 46 26 | 21 2 |
| 42 | 40 57 | 18 30 | 41 44 | 18 52 | 42 30 | 19 14 | 43 17 | 19 36 | 44 4 | 19 58 | 44 51 | 20 19 | 45 38 | 20 41 | 46 25 | 21 3 |
| 44 | 40 56 | 18 31 | 41 42 | 18 53 | 42 29 | 19 15 | 43 16 | 19 36 | 44 3 | 19 58 | 44 50 | 20 20 | 45 36 | 20 42 | 46 23 | 21 4 |
| 46 | 40 55 | 18 31 | 41 41 | 18 53 | 42 28 | 19 15 | 43 15 | 19 37 | 44 2 | 19 59 | 44 48 | 20 21 | 45 35 | 20 43 | 46 22 | 21 5 |
| 48 | 40 53 | 18 32 | 41 40 | 18 54 | 42 27 | 19 16 | 43 14 | 19 38 | 44 0 | 20 0 | 44 47 | 20 22 | 45 34 | 20 44 | 46 21 | 21 6 |
| 50 | 40 52 | 18 33 | 41 39 | 18 55 | 42 26 | 19 17 | 43 13 | 19 39 | 43 59 | 20 1 | 44 46 | 20 23 | 45 33 | 20 45 | 46 20 | 21 7 |
| 52 | 40 51 | 18 34 | 41 38 | 18 56 | 42 25 | 19 18 | 43 11 | 19 40 | 43 58 | 20 2 | 44 45 | 20 24 | 45 32 | 20 46 | 46 18 | 21 8 |
| 54 | 40 50 | 18 35 | 41 37 | 18 57 | 42 24 | 19 19 | 43 10 | 19 41 | 43 57 | 20 3 | 44 44 | 20 25 | 45 30 | 20 47 | 46 17 | 21 9 |
| 56 | 40 49 | 18 36 | 41 36 | 18 58 | 42 22 | 19 20 | 43 9 | 19 42 | 43 56 | 20 4 | 44 42 | 20 26 | 45 29 | 20 48 | 46 16 | 21 10 |
| 58 | 40 48 | 18 37 | 41 35 | 18 59 | 42 21 | 19 21 | 43 8 | 19 43 | 43 55 | 20 5 | 44 41 | 20 27 | 45 28 | 20 49 | 46 15 | 21 11 |
| 39° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 40 47 | 18 37 | 41 33 | 18 59 | 42 20 | 19 21 | 43 7 | 19 44 | 43 53 | 20 6 | 44 40 | 20 28 | 45 27 | 20 50 | 46 13 | 21 12 |
| 2 | 40 46 | 18 38 | 41 32 | 19 0 | 42 19 | 19 22 | 43 6 | 19 44 | 43 52 | 20 7 | 44 39 | 20 29 | 45 26 | 20 51 | 46 12 | 21 13 |
| 4 | 40 45 | 18 39 | 41 31 | 19 1 | 42 18 | 19 23 | 43 4 | 19 45 | 43 51 | 20 7 | 44 38 | 20 30 | 45 24 | 20 52 | 46 11 | 21 14 |
| 6 | 40 44 | 18 40 | 41 30 | 19 2 | 42 17 | 19 24 | 43 3 | 19 46 | 43 50 | 20 8 | 44 36 | 20 30 | 45 23 | 20 53 | 46 10 | 21 15 |
| 8 | 40 42 | 18 41 | 41 29 | 19 3 | 42 16 | 19 25 | 43 2 | 19 47 | 43 49 | 20 9 | 44 35 | 20 31 | 45 22 | 20 53 | 46 8 | 21 16 |
| 10 | 40 41 | 18 42 | 41 28 | 19 4 | 42 14 | 19 26 | 43 1 | 19 48 | 43 47 | 20 10 | 44 34 | 20 32 | 45 21 | 20 54 | 46 7 | 21 17 |
| 12 | 40 40 | 18 42 | 41 27 | 19 5 | 42 13 | 19 27 | 43 0 | 19 49 | 43 46 | 20 11 | 44 33 | 20 33 | 45 19 | 20 55 | 46 6 | 21 18 |
| 14 | 40 39 | 18 43 | 41 26 | 19 5 | 42 12 | 19 28 | 42 58 | 19 50 | 43 45 | 20 12 | 44 31 | 20 34 | 45 18 | 20 56 | 46 5 | 21 18 |
| 16 | 40 38 | 18 44 | 41 24 | 19 6 | 42 11 | 19 28 | 42 57 | 19 51 | 43 44 | 20 13 | 44 30 | 20 35 | 45 17 | 20 57 | 46 3 | 21 19 |
| 18 | 40 37 | 18 45 | 41 23 | 19 7 | 42 10 | 19 29 | 42 56 | 19 51 | 43 43 | 20 14 | 44 29 | 20 36 | 45 16 | 20 58 | 46 2 | 21 20 |
| 20 | 40 36 | 18 46 | 41 22 | 19 8 | 42 9 | 19 30 | 42 55 | 19 52 | 43 41 | 20 15 | 44 28 | 20 37 | 45 14 | 20 59 | 46 1 | 21 21 |
| 22 | 40 35 | 18 47 | 41 21 | 19 9 | 42 7 | 19 31 | 42 54 | 19 53 | 43 40 | 20 15 | 44 27 | 20 38 | 45 13 | 21 0 | 45 59 | 21 22 |
| 24 | 40 33 | 18 47 | 41 20 | 19 10 | 42 6 | 19 32 | 42 53 | 19 54 | 43 39 | 20 16 | 44 25 | 20 39 | 45 12 | 21 1 | 45 58 | 21 23 |
| 26 | 40 32 | 18 48 | 41 19 | 19 10 | 42 5 | 19 33 | 42 51 | 19 55 | 43 38 | 20 17 | 44 24 | 20 40 | 45 10 | 21 2 | 45 57 | 21 24 |
| 28 | 40 31 | 18 49 | 41 18 | 19 11 | 42 4 | 19 34 | 42 50 | 19 56 | 43 37 | 20 18 | 44 23 | 20 40 | 45 9 | 21 3 | 45 56 | 21 25 |
| 30 | 40 30 | 18 50 | 41 16 | 19 12 | 42 3 | 19 34 | 42 49 | 19 57 | 43 35 | 20 19 | 44 22 | 20 41 | 45 8 | 21 4 | 45 54 | 21 26 |
| 32 | 40 29 | 18 51 | 41 15 | 19 13 | 42 2 | 19 35 | 42 48 | 19 58 | 43 34 | 20 20 | 44 20 | 20 42 | 45 7 | 21 5 | 45 53 | 21 27 |
| 34 | 40 28 | 18 52 | 41 14 | 19 14 | 42 0 | 19 36 | 42 47 | 19 58 | 43 33 | 20 21 | 44 19 | 20 43 | 45 6 | 21 5 | 45 52 | 21 28 |
| 36 | 40 27 | 18 53 | 41 13 | 19 15 | 41 59 | 19 37 | 42 46 | 19 59 | 43 32 | 20 22 | 44 18 | 20 44 | 45 4 | 21 6 | 45 51 | 21 29 |
| 38 | 40 26 | 18 53 | 41 12 | 19 16 | 41 58 | 19 38 | 42 44 | 20 0 | 43 31 | 20 23 | 44 17 | 20 45 | 45 3 | 21 7 | 45 49 | 21 30 |
| 40 | 40 25 | 18 54 | 41 11 | 19 16 | 41 57 | 19 39 | 42 43 | 20 1 | 43 29 | 20 23 | 44 16 | 20 46 | 45 2 | 21 8 | 45 48 | 21 31 |
| 42 | 40 23 | 18 55 | 41 10 | 19 17 | 41 56 | 19 40 | 42 42 | 20 2 | 43 28 | 20 24 | 44 14 | 20 47 | 45 0 | 21 9 | 45 47 | 21 32 |
| 44 | 40 22 | 18 56 | 41 9 | 19 18 | 41 54 | 19 40 | 42 41 | 20 3 | 43 27 | 20 25 | 44 13 | 20 48 | 44 59 | 21 10 | 45 45 | 21 32 |
| 46 | 40 21 | 18 56 | 41 7 | 19 19 | 41 53 | 19 41 | 42 40 | 20 4 | 43 26 | 20 26 | 44 12 | 20 49 | 44 58 | 21 11 | 45 44 | 21 33 |
| 48 | 40 20 | 18 57 | 41 6 | 19 20 | 41 52 | 19 42 | 42 38 | 20 5 | 43 25 | 20 27 | 44 11 | 20 49 | 44 57 | 21 12 | 45 43 | 21 34 |
| 50 | 40 19 | 18 58 | 41 5 | 19 21 | 41 51 | 19 43 | 42 37 | 20 5 | 43 23 | 20 28 | 44 9 | 20 50 | 44 56 | 21 13 | 45 42 | 21 35 |
| 52 | 40 18 | 18 59 | 41 4 | 19 21 | 41 50 | 19 44 | 42 36 | 20 6 | 43 22 | 20 29 | 44 8 | 20 51 | 44 54 | 21 14 | 45 40 | 21 36 |
| 54 | 40 17 | 19 0 | 41 3 | 19 22 | 41 49 | 19 45 | 42 35 | 20 7 | 43 21 | 20 30 | 44 7 | 20 52 | 44 53 | 21 15 | 45 39 | 21 37 |
| 56 | 40 16 | 19 1 | 41 2 | 19 23 | 41 48 | 19 46 | 42 34 | 20 8 | 43 20 | 20 31 | 44 6 | 20 53 | 44 52 | 21 16 | 45 38 | 21 38 |
| 58 | 40 15 | 19 2 | 41 1 | 19 24 | 41 47 | 19 47 | 42 33 | 20 9 | 43 19 | 20 32 | 44 5 | 20 54 | 44 51 | 21 17 | 45 37 | 21 39 |

Seconds of H. P.

| | ☽ | A |
|---|---|---|
| | ″ | ″ |
| 1 | 1 | 0 |
| 2 | 2 | 1 |
| 3 | 2 | 1 |
| 4 | 3 | 1 |
| 5 | 4 | 2 |
| 6 | 5 | 2 |
| 7 | 5 | 3 |
| 8 | 6 | 3 |
| 9 | 7 | 3 |
| 10 | 8 | 4 |
| 11 | 9 | 4 |
| 12 | 9 | 4 |
| 13 | 10 | 5 |
| 14 | 11 | 5 |
| 15 | 12 | 6 |
| 16 | 12 | 6 |
| 17 | 13 | 6 |
| 18 | 14 | 7 |
| 19 | 15 | 7 |
| 20 | 16 | 7 |
| 21 | 16 | 8 |
| 22 | 17 | 8 |
| 23 | 18 | 9 |
| 24 | 19 | 9 |
| 25 | 20 | 9 |
| 26 | 20 | 10 |
| 27 | 21 | 10 |
| 28 | 22 | 10 |
| 29 | 23 | 11 |
| 30 | 23 | 11 |
| 31 | 24 | 12 |
| 32 | 25 | 12 |
| 33 | 26 | 12 |
| 34 | 27 | 13 |
| 35 | 27 | 13 |
| 36 | 28 | 13 |
| 37 | 29 | 14 |
| 38 | 30 | 14 |
| 39 | 31 | 14 |
| 40 | 31 | 15 |
| 41 | 32 | 15 |
| 42 | 33 | 15 |
| 43 | 34 | 16 |
| 44 | 34 | 16 |
| 45 | 35 | 17 |
| 46 | 36 | 17 |
| 47 | 37 | 17 |
| 48 | 38 | 18 |
| 49 | 38 | 18 |
| 50 | 39 | 18 |
| 51 | 40 | 19 |
| 52 | 41 | 19 |
| 53 | 41 | 19 |
| 54 | 42 | 20 |
| 55 | 43 | 20 |
| 56 | 44 | 21 |
| 57 | 45 | 21 |
| 58 | 45 | 22 |
| 59 | 46 | 22 |

| App. Alt. | ☉ | A |
|---|---|---|
| | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w) The Correction of the Moon's Altitude, and the Aux. Angle A. (40° and 41°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | Seconds of H. P. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. − | A 60° | | Corr. | A |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | ″ | ″ |
| 0′ | 40 13 | 19 2 | 40 59 | 19 25 | 41 45 | 19 47 | 42 31 | 20 10 | 43 17 | 20 32 | 44 3 | 20 55 | 44 49 | 21 17 | 45 35 | 21 40 | 1 | 1 | 0 |
| 2 | 40 12 | 19 3 | 40 58 | 19 26 | 41 44 | 19 48 | 42 30 | 20 11 | 43 16 | 20 33 | 44 2 | 20 56 | 44 48 | 21 18 | 45 34 | 21 41 | 2 | 1 | 1 |
| 4 | 40 11 | 19 4 | 40 57 | 19 26 | 41 43 | 19 49 | 42 29 | 20 12 | 43 15 | 20 34 | 44 1 | 20 57 | 44 47 | 21 19 | 45 33 | 21 42 | 3 | 2 | 1 |
| 6 | 40 10 | 19 5 | 40 56 | 19 27 | 41 42 | 19 50 | 42 28 | 20 13 | 43 14 | 20 35 | 43 59 | 20 58 | 44 45 | 21 20 | 45 31 | 21 43 | 4 | 2 | 2 |
| 8 | 40 9 | 19 6 | 40 55 | 19 28 | 41 41 | 19 51 | 42 27 | 20 13 | 43 12 | 20 36 | 43 58 | 20 58 | 44 44 | 21 21 | 45 30 | 21 44 | 5 | 3 | 2 |
| 10 | 40 8 | 19 6 | 40 54 | 19 29 | 41 39 | 19 52 | 42 25 | 20 14 | 43 11 | 20 37 | 43 57 | 20 59 | 44 43 | 21 22 | 45 29 | 21 45 | 6 | 3 | 3 |
| 12 | 40 6 | 19 7 | 40 52 | 19 30 | 41 38 | 19 52 | 42 24 | 20 15 | 43 10 | 20 38 | 43 56 | 21 0 | 44 42 | 21 23 | 45 27 | 21 46 | 7 | 4 | 3 |
| 14 | 40 5 | 19 8 | 40 51 | 19 31 | 41 37 | 19 53 | 42 23 | 20 16 | 43 9 | 20 39 | 43 54 | 21 1 | 44 40 | 21 24 | 45 26 | 21 46 | 8 | 4 | 4 |
| 16 | 40 4 | 19 9 | 40 50 | 19 32 | 41 36 | 19 54 | 42 22 | 20 17 | 43 7 | 20 39 | 43 53 | 21 2 | 44 39 | 21 25 | 45 25 | 21 47 | 9 | 5 | 4 |
| 18 | 40 3 | 19 10 | 40 49 | 19 32 | 41 35 | 19 55 | 42 20 | 20 18 | 43 6 | 20 40 | 43 52 | 21 3 | 44 38 | 21 26 | 45 23 | 21 48 | 10 | 5 | 5 |
| 20 | 40 2 | 19 10 | 40 48 | 19 33 | 41 33 | 19 56 | 42 19 | 20 18 | 43 5 | 20 41 | 43 51 | 21 4 | 44 36 | 21 26 | 45 22 | 21 49 | 11 | 6 | 5 |
| 22 | 40 1 | 19 11 | 40 47 | 19 34 | 41 32 | 19 57 | 42 18 | 20 19 | 43 4 | 20 42 | 43 49 | 21 5 | 44 35 | 21 27 | 45 21 | 21 50 | 12 | 6 | 6 |
| 24 | 40 0 | 19 12 | 40 45 | 19 35 | 41 31 | 19 57 | 42 17 | 20 20 | 43 2 | 20 43 | 43 48 | 21 6 | 44 34 | 21 28 | 45 20 | 21 51 | 13 | 7 | 6 |
| 26 | 39 58 | 19 13 | 40 44 | 19 36 | 41 30 | 19 58 | 42 16 | 20 21 | 43 1 | 20 44 | 43 47 | 21 7 | 44 33 | 21 29 | 45 18 | 21 52 | 14 | 7 | 7 |
| 28 | 39 57 | 19 14 | 40 43 | 19 36 | 41 29 | 19 59 | 42 14 | 20 22 | 43 0 | 20 45 | 43 46 | 21 8 | 44 31 | 21 30 | 45 17 | 21 53 | 15 | 8 | 7 |
| 30 | 39 56 | 19 15 | 40 42 | 19 37 | 41 27 | 20 0 | 42 13 | 20 23 | 42 59 | 20 46 | 43 44 | 21 8 | 44 30 | 21 31 | 45 16 | 21 54 | 16 | 8 | 8 |
| 32 | 39 55 | 19 15 | 40 41 | 19 38 | 41 26 | 20 1 | 42 12 | 20 24 | 42 58 | 20 46 | 43 43 | 21 9 | 44 29 | 21 32 | 45 14 | 21 55 | 17 | 9 | 8 |
| 34 | 39 54 | 19 16 | 40 40 | 19 39 | 41 25 | 20 2 | 42 11 | 20 25 | 42 56 | 20 47 | 43 42 | 21 10 | 44 28 | 21 33 | 45 13 | 21 56 | 18 | 9 | 9 |
| 36 | 39 53 | 19 17 | 40 38 | 19 40 | 41 24 | 20 3 | 42 10 | 20 25 | 42 55 | 20 48 | 43 41 | 21 11 | 44 26 | 21 34 | 45 12 | 21 57 | 19 | 10 | 9 |
| 38 | 39 52 | 19 18 | 40 37 | 19 41 | 41 23 | 20 3 | 42 8 | 20 26 | 42 54 | 20 49 | 43 39 | 21 12 | 44 25 | 21 35 | 45 10 | 21 57 | 20 | 10 | 10 |
| 40 | 39 50 | 19 19 | 40 36 | 19 41 | 41 22 | 20 4 | 42 7 | 20 27 | 42 53 | 20 50 | 43 38 | 21 13 | 44 24 | 21 36 | 45 9 | 21 58 | 21 | 11 | 10 |
| 42 | 39 49 | 19 19 | 40 35 | 19 42 | 41 20 | 20 5 | 42 6 | 20 28 | 42 51 | 20 51 | 43 37 | 21 14 | 44 22 | 21 37 | 45 8 | 21 59 | 22 | 11 | 11 |
| 44 | 39 48 | 19 20 | 40 34 | 19 43 | 41 19 | 20 6 | 42 5 | 20 29 | 42 50 | 20 52 | 43 36 | 21 14 | 44 21 | 21 37 | 45 7 | 22 0 | 23 | 12 | 11 |
| 46 | 39 47 | 19 21 | 40 33 | 19 44 | 41 18 | 20 7 | 42 3 | 20 30 | 42 49 | 20 53 | 43 34 | 21 15 | 44 20 | 21 38 | 45 5 | 22 1 | 24 | 12 | 12 |
| 48 | 39 46 | 19 22 | 40 31 | 19 45 | 41 17 | 20 8 | 42 2 | 20 31 | 42 48 | 20 53 | 43 33 | 21 16 | 44 19 | 21 39 | 45 4 | 22 2 | 25 | 13 | 13 |
| 50 | 39 45 | 19 23 | 40 30 | 19 46 | 41 16 | 20 9 | 42 1 | 20 31 | 42 46 | 20 54 | 43 32 | 21 17 | 44 17 | 21 40 | 45 3 | 22 3 | 26 | 13 | 13 |
| 52 | 39 44 | 19 24 | 40 29 | 19 46 | 41 14 | 20 9 | 42 0 | 20 32 | 42 45 | 20 55 | 43 31 | 21 18 | 44 16 | 21 41 | 45 1 | 22 4 | 27 | 14 | 14 |
| 54 | 39 43 | 19 24 | 40 28 | 19 47 | 41 13 | 20 10 | 41 59 | 20 33 | 42 44 | 20 56 | 43 29 | 21 19 | 44 15 | 21 42 | 45 0 | 22 5 | 28 | 15 | 14 |
| 56 | 39 41 | 19 25 | 40 27 | 19 48 | 41 12 | 20 11 | 41 57 | 20 34 | 42 43 | 20 57 | 43 28 | 21 20 | 44 13 | 21 43 | 44 59 | 22 6 | 29 | 15 | 15 |
| 58 | 39 40 | 19 26 | 40 26 | 19 49 | 41 11 | 20 12 | 41 56 | 20 35 | 42 41 | 20 58 | 43 27 | 21 21 | 44 12 | 21 44 | 44 57 | 22 7 | 30 | 15 | 15 |

| 41° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | | Alt. | ☉ | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 39 39 | 19 27 | 40 24 | 19 50 | 41 10 | 20 13 | 41 55 | 20 36 | 42 40 | 20 59 | 43 25 | 21 22 | 44 11 | 21 45 | 44 56 | 22 8 | 31 | ° | ′ | ° |
| 2 | 39 38 | 19 28 | 40 23 | 19 51 | 41 8 | 20 14 | 41 54 | 20 37 | 42 39 | 21 0 | 43 24 | 21 23 | 44 9 | 21 46 | 44 55 | 22 9 | 32 | 0 | 8 | 8 |
| 4 | 39 37 | 19 28 | 40 22 | 19 51 | 41 7 | 20 14 | 41 52 | 20 37 | 42 38 | 21 0 | 43 23 | 21 23 | 44 8 | 21 46 | 44 53 | 22 10 | 33 | 1 | 8 | 8 |
| 6 | 39 36 | 19 29 | 40 21 | 19 52 | 41 6 | 20 15 | 41 51 | 20 38 | 42 36 | 21 1 | 43 22 | 21 24 | 44 7 | 21 47 | 44 52 | 22 10 | 34 | 2 | 8 | 8 |
| 8 | 39 34 | 19 30 | 40 20 | 19 53 | 41 5 | 20 16 | 41 50 | 20 39 | 42 35 | 21 2 | 43 20 | 21 25 | 44 6 | 21 48 | 44 51 | 22 11 | 35 | 3 | 8 | 8 |
| 10 | 39 33 | 19 31 | 40 18 | 19 54 | 41 4 | 20 17 | 41 49 | 20 40 | 42 34 | 21 3 | 43 19 | 21 26 | 44 4 | 21 49 | 44 49 | 22 12 | 36 | 4 | 8 | 8 |
| 12 | 39 32 | 19 32 | 40 17 | 19 55 | 41 2 | 20 18 | 41 47 | 20 41 | 42 33 | 21 4 | 43 18 | 21 27 | 44 3 | 21 50 | 44 48 | 22 13 | 37 | 5 | 8 | 8 |
| 14 | 39 31 | 19 32 | 40 16 | 19 56 | 41 1 | 20 19 | 41 46 | 20 42 | 42 31 | 21 5 | 43 16 | 21 28 | 44 2 | 21 51 | 44 47 | 22 14 | 38 | 6 | 8 | 8 |
| 16 | 39 30 | 19 33 | 40 15 | 19 56 | 41 0 | 20 20 | 41 45 | 20 43 | 42 30 | 21 6 | 43 15 | 21 29 | 44 0 | 21 52 | 44 45 | 22 15 | 39 | 7 | 8 | 8 |
| 18 | 39 28 | 19 34 | 40 14 | 19 57 | 40 59 | 20 20 | 41 44 | 20 43 | 42 29 | 21 7 | 43 14 | 21 30 | 43 59 | 21 53 | 44 44 | 22 16 | 40 | 8 | 8 | 8 |
| 20 | 39 27 | 19 35 | 40 12 | 19 58 | 40 57 | 20 21 | 41 42 | 20 44 | 42 27 | 21 7 | 43 13 | 21 30 | 43 58 | 21 54 | 44 43 | 22 17 | 41 | 9 | 8 | 8 |
| 22 | 39 26 | 19 36 | 40 11 | 19 59 | 40 56 | 20 22 | 41 41 | 20 45 | 42 26 | 21 8 | 43 11 | 21 31 | 43 56 | 21 55 | 44 41 | 22 18 | 42 | 10 | 8 | 8 |
| 24 | 39 25 | 19 37 | 40 10 | 20 0 | 40 55 | 20 23 | 41 40 | 20 46 | 42 25 | 21 9 | 43 10 | 21 32 | 43 55 | 21 55 | 44 40 | 22 19 | 43 | 11 | 8 | 8 |
| 26 | 39 24 | 19 37 | 40 9 | 20 0 | 40 54 | 20 24 | 41 39 | 20 47 | 42 24 | 21 10 | 43 9 | 21 33 | 43 54 | 21 56 | 44 39 | 22 20 | 44 | 12 | 8 | 8 |
| 28 | 39 23 | 19 38 | 40 8 | 20 1 | 40 52 | 20 25 | 41 38 | 20 48 | 42 22 | 21 11 | 43 7 | 21 34 | 43 52 | 21 57 | 44 37 | 22 20 | 45 | 13 | 8 | 8 |
| 30 | 39 21 | 19 39 | 40 6 | 20 2 | 40 51 | 20 25 | 41 36 | 20 49 | 42 21 | 21 12 | 43 6 | 21 35 | 43 51 | 21 58 | 44 36 | 22 21 | 46 | 14 | 8 | 8 |
| 32 | 39 20 | 19 40 | 40 5 | 20 3 | 40 50 | 20 26 | 41 35 | 20 49 | 42 20 | 21 13 | 43 5 | 21 36 | 43 50 | 21 59 | 44 35 | 22 22 | 47 | 15 | 8 | 8 |
| 34 | 39 19 | 19 41 | 40 4 | 20 4 | 40 49 | 20 27 | 41 34 | 20 50 | 42 19 | 21 13 | 43 4 | 21 37 | 43 48 | 22 0 | 44 33 | 22 23 | 48 | 16 | 8 | 8 |
| 36 | 39 18 | 19 41 | 40 3 | 20 5 | 40 48 | 20 28 | 41 33 | 20 51 | 42 17 | 21 14 | 43 2 | 21 38 | 43 47 | 22 1 | 44 32 | 22 24 | 49 | 17 | 8 | 8 |
| 38 | 39 17 | 19 42 | 40 2 | 20 5 | 40 47 | 20 29 | 41 31 | 20 52 | 42 16 | 21 15 | 43 1 | 21 38 | 43 46 | 22 2 | 44 31 | 22 25 | 50 | 18 | 8 | 8 |
| 40 | 39 16 | 19 43 | 40 0 | 20 6 | 40 45 | 20 29 | 41 30 | 20 53 | 42 15 | 21 16 | 43 0 | 21 39 | 43 45 | 22 2 | 44 29 | 22 26 | 51 | 19 | 8 | 8 |
| 42 | 39 14 | 19 44 | 39 59 | 20 7 | 40 44 | 20 30 | 41 29 | 20 54 | 42 14 | 21 17 | 42 58 | 21 40 | 43 43 | 22 3 | 44 28 | 22 27 | 52 | 20 | 8 | 8 |
| 44 | 39 13 | 19 45 | 39 58 | 20 8 | 40 43 | 20 31 | 41 28 | 20 54 | 42 12 | 21 18 | 42 57 | 21 41 | 43 42 | 22 4 | 44 27 | 22 28 | 53 | 21 | 8 | 8 |
| 46 | 39 12 | 19 45 | 39 57 | 20 9 | 40 42 | 20 32 | 41 26 | 20 55 | 42 11 | 21 19 | 42 56 | 21 42 | 43 41 | 22 5 | 44 25 | 22 29 | 54 | 22 | 8 | 8 |
| 48 | 39 11 | 19 46 | 39 56 | 20 9 | 40 40 | 20 33 | 41 25 | 20 56 | 42 10 | 21 19 | 42 55 | 21 43 | 43 39 | 22 6 | 44 24 | 22 30 | 55 | 23 | 8 | 8 |
| 50 | 39 10 | 19 47 | 39 54 | 20 10 | 40 39 | 20 34 | 41 24 | 20 57 | 42 9 | 21 20 | 42 53 | 21 44 | 43 38 | 22 7 | 44 23 | 22 30 | 56 | 24 | 8 | 8 |
| 52 | 39 9 | 19 48 | 39 53 | 20 11 | 40 38 | 20 34 | 41 23 | 20 58 | 42 7 | 21 21 | 42 52 | 21 45 | 43 37 | 22 8 | 44 21 | 22 31 | 57 | 25 | 8 | 8 |
| 54 | 39 7 | 19 49 | 39 52 | 20 12 | 40 37 | 20 35 | 41 21 | 20 59 | 42 6 | 21 22 | 42 51 | 21 45 | 43 35 | 22 9 | 44 20 | 22 32 | 58 | 26 | 8 | 8 |
| 56 | 39 6 | 19 50 | 39 51 | 20 13 | 40 36 | 20 36 | 41 20 | 21 0 | 42 5 | 21 23 | 42 49 | 21 46 | 43 34 | 22 10 | 44 19 | 22 33 | 59 | 27 | 8 | 8 |
| 58 | 39 5 | 19 50 | 39 50 | 20 13 | 40 34 | 20 37 | 41 19 | 21 0 | 42 4 | 21 24 | 42 48 | 21 47 | 43 33 | 22 11 | 44 17 | 22 34 | 60 | 28 | 8 | 8 |

## (42° and 43°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55 | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 42° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 39 4 | 19 51 | 39 48 | 20 14 | 40 33 | 20 38 | 41 18 | 21 1 | 42 2 | 21 25 | 42 47 | 21 48 | 43 31 | 22 11 | 44 16 | 22 35 |
| 2 | 39 3 | 19 52 | 39 47 | 20 15 | 40 32 | 20 39 | 41 16 | 21 2 | 42 1 | 21 25 | 42 46 | 21 49 | 43 30 | 22 12 | 44 15 | 22 36 |
| 4 | 39 1 | 19 52 | 39 46 | 20 16 | 40 31 | 20 39 | 41 15 | 21 3 | 42 0 | 21 26 | 42 44 | 21 50 | 43 29 | 22 13 | 44 13 | 22 37 |
| 6 | 39 0 | 19 53 | 39 45 | 20 17 | 40 29 | 20 40 | 41 14 | 21 4 | 41 58 | 21 27 | 42 43 | 21 51 | 43 27 | 22 14 | 44 12 | 22 38 |
| 8 | 38 59 | 19 54 | 39 44 | 20 18 | 40 28 | 20 41 | 41 13 | 21 5 | 41 57 | 21 28 | 42 42 | 21 51 | 43 26 | 22 15 | 44 11 | 22 38 |
| 10 | 38 58 | 19 55 | 39 42 | 20 18 | 40 27 | 20 42 | 41 11 | 21 5 | 41 56 | 21 29 | 42 40 | 21 52 | 43 25 | 22 16 | 44 9 | 22 39 |
| 12 | 38 57 | 19 56 | 39 41 | 20 19 | 40 26 | 20 43 | 41 10 | 21 6 | 41 55 | 21 30 | 42 39 | 21 53 | 43 23 | 22 17 | 44 8 | 22 40 |
| 14 | 38 55 | 19 56 | 39 40 | 20 20 | 40 24 | 20 43 | 41 9 | 21 7 | 41 53 | 21 31 | 42 38 | 21 54 | 43 22 | 22 18 | 44 7 | 22 41 |
| 16 | 38 54 | 19 57 | 39 39 | 20 21 | 40 23 | 20 44 | 41 8 | 21 8 | 41 52 | 21 31 | 42 36 | 21 55 | 43 21 | 22 18 | 44 5 | 22 42 |
| 18 | 38 53 | 19 58 | 39 38 | 20 22 | 40 22 | 20 45 | 41 6 | 21 9 | 41 51 | 21 32 | 42 35 | 21 56 | 43 19 | 22 19 | 44 4 | 22 43 |
| 20 | 38 52 | 19 59 | 39 36 | 20 22 | 40 21 | 20 46 | 41 5 | 21 10 | 41 49 | 21 33 | 42 34 | 21 57 | 43 18 | 22 20 | 44 2 | 22 44 |
| 22 | 38 51 | 20 0 | 39 35 | 20 23 | 40 19 | 20 47 | 41 4 | 21 10 | 41 48 | 21 34 | 42 32 | 21 57 | 43 17 | 22 21 | 44 1 | 22 45 |
| 24 | 38 49 | 20 0 | 39 34 | 20 24 | 40 18 | 20 48 | 41 2 | 21 11 | 41 47 | 21 35 | 42 31 | 21 58 | 43 15 | 22 22 | 44 0 | 22 46 |
| 26 | 38 48 | 20 1 | 39 33 | 20 25 | 40 17 | 20 48 | 41 1 | 21 12 | 41 45 | 21 36 | 42 30 | 21 59 | 43 14 | 22 23 | 43 58 | 22 46 |
| 28 | 38 47 | 20 2 | 39 31 | 20 26 | 40 16 | 20 49 | 41 0 | 21 13 | 41 44 | 21 36 | 42 28 | 22 0 | 43 13 | 22 24 | 43 57 | 22 47 |
| 30 | 38 46 | 20 3 | 39 30 | 20 26 | 40 14 | 20 50 | 40 59 | 21 14 | 41 43 | 21 37 | 42 27 | 22 1 | 43 11 | 22 25 | 43 56 | 22 48 |
| 32 | 38 45 | 20 4 | 39 29 | 20 27 | 40 13 | 20 51 | 40 57 | 21 15 | 41 42 | 21 38 | 42 26 | 22 2 | 43 10 | 22 25 | 43 54 | 22 49 |
| 34 | 38 43 | 20 4 | 39 28 | 20 28 | 40 12 | 20 52 | 40 56 | 21 15 | 41 40 | 21 39 | 42 24 | 22 3 | 43 9 | 22 26 | 43 53 | 22 50 |
| 36 | 38 42 | 20 5 | 39 26 | 20 29 | 40 11 | 20 53 | 40 55 | 21 16 | 41 39 | 21 40 | 42 23 | 22 4 | 43 7 | 22 27 | 43 52 | 22 51 |
| 38 | 38 41 | 20 6 | 39 25 | 20 30 | 40 9 | 20 54 | 40 54 | 21 17 | 41 38 | 21 41 | 42 22 | 22 4 | 43 6 | 22 28 | 43 50 | 22 52 |
| 40 | 38 40 | 20 7 | 39 24 | 20 30 | 40 8 | 20 54 | 40 52 | 21 18 | 41 36 | 21 42 | 42 20 | 22 5 | 43 5 | 22 29 | 43 49 | 22 53 |
| 42 | 38 39 | 20 8 | 39 23 | 20 31 | 40 7 | 20 55 | 40 51 | 21 19 | 41 35 | 21 42 | 42 19 | 22 6 | 43 3 | 22 30 | 43 47 | 22 54 |
| 44 | 38 37 | 20 8 | 39 22 | 20 32 | 40 6 | 20 56 | 40 50 | 21 20 | 41 34 | 21 43 | 42 18 | 22 7 | 43 2 | 22 31 | 43 46 | 22 54 |
| 46 | 38 36 | 20 9 | 39 20 | 20 33 | 40 4 | 20 57 | 40 49 | 21 20 | 41 33 | 21 44 | 42 17 | 22 8 | 43 1 | 22 32 | 43 45 | 22 55 |
| 48 | 38 35 | 20 10 | 39 19 | 20 34 | 40 3 | 20 57 | 40 47 | 21 21 | 41 31 | 21 45 | 42 15 | 22 9 | 42 59 | 22 33 | 43 43 | 22 56 |
| 50 | 38 34 | 20 11 | 39 18 | 20 35 | 40 2 | 20 58 | 40 46 | 21 22 | 41 30 | 21 46 | 42 14 | 22 10 | 42 58 | 22 33 | 43 42 | 22 57 |
| 52 | 38 33 | 20 12 | 39 17 | 20 35 | 40 1 | 20 59 | 40 45 | 21 23 | 41 29 | 21 47 | 42 13 | 22 11 | 42 57 | 22 34 | 43 41 | 22 58 |
| 54 | 38 31 | 20 12 | 39 16 | 20 36 | 40 0 | 21 0 | 40 44 | 21 24 | 41 28 | 21 48 | 42 12 | 22 11 | 42 56 | 22 35 | 43 39 | 22 59 |
| 56 | 38 30 | 20 13 | 39 14 | 20 37 | 39 58 | 21 1 | 40 42 | 21 25 | 41 26 | 21 48 | 42 10 | 22 12 | 42 54 | 22 36 | 43 38 | 23 0 |
| 58 | 38 29 | 20 14 | 39 13 | 20 38 | 39 57 | 21 2 | 40 41 | 21 25 | 41 25 | 21 49 | 42 9 | 22 13 | 42 53 | 22 37 | 43 37 | 23 1 |

| 43° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 38 28 | 20 15 | 39 12 | 20 39 | 39 56 | 21 2 | 40 40 | 21 26 | 41 24 | 21 50 | 42 8 | 22 14 | 42 52 | 22 38 | 43 35 | 23 2 |
| 2 | 38 27 | 20 15 | 39 11 | 20 39 | 39 55 | 21 3 | 40 38 | 21 27 | 41 22 | 21 51 | 42 6 | 22 15 | 42 50 | 22 39 | 43 34 | 23 3 |
| 4 | 38 25 | 20 16 | 39 9 | 20 40 | 39 53 | 21 4 | 40 37 | 21 28 | 41 21 | 21 52 | 42 5 | 22 16 | 42 49 | 22 40 | 43 32 | 23 4 |
| 6 | 38 24 | 20 17 | 39 8 | 20 41 | 39 52 | 21 5 | 40 36 | 21 29 | 41 20 | 21 53 | 42 4 | 22 17 | 42 47 | 22 41 | 43 31 | 23 5 |
| 8 | 38 23 | 20 18 | 39 7 | 20 42 | 39 51 | 21 6 | 40 35 | 21 30 | 41 18 | 21 54 | 42 2 | 22 18 | 42 46 | 22 42 | 43 30 | 23 7 |
| 10 | 38 22 | 20 19 | 39 6 | 20 43 | 39 49 | 21 7 | 40 33 | 21 31 | 41 17 | 21 55 | 42 1 | 22 19 | 42 45 | 22 44 | 43 28 | 23 8 |
| 12 | 38 21 | 20 19 | 39 4 | 20 44 | 39 48 | 21 8 | 40 32 | 21 32 | 41 16 | 21 56 | 41 59 | 22 21 | 42 43 | 22 45 | 43 27 | 23 9 |
| 14 | 38 19 | 20 20 | 39 3 | 20 44 | 39 47 | 21 9 | 40 31 | 21 33 | 41 14 | 21 57 | 41 58 | 22 22 | 42 42 | 22 46 | 43 25 | 23 10 |
| 16 | 38 18 | 20 21 | 39 2 | 20 45 | 39 45 | 21 10 | 40 29 | 21 34 | 41 13 | 21 58 | 41 57 | 22 23 | 42 40 | 22 47 | 43 24 | 23 11 |
| 18 | 38 17 | 20 22 | 39 1 | 20 46 | 39 44 | 21 10 | 40 28 | 21 35 | 41 12 | 21 59 | 41 55 | 22 24 | 42 39 | 22 48 | 43 23 | 23 13 |
| 20 | 38 16 | 20 22 | 38 59 | 20 47 | 39 43 | 21 11 | 40 27 | 21 36 | 41 10 | 22 0 | 41 54 | 22 25 | 42 37 | 22 49 | 43 21 | 23 14 |
| 22 | 38 14 | 20 23 | 38 58 | 20 48 | 39 42 | 21 12 | 40 25 | 21 37 | 41 9 | 22 1 | 41 53 | 22 26 | 42 36 | 22 50 | 43 20 | 23 15 |
| 24 | 38 13 | 20 24 | 38 57 | 20 49 | 39 40 | 21 13 | 40 24 | 21 38 | 41 8 | 22 2 | 41 51 | 22 27 | 42 35 | 22 52 | 43 18 | 23 16 |
| 26 | 38 12 | 20 25 | 38 56 | 20 50 | 39 39 | 21 14 | 40 23 | 21 39 | 41 6 | 22 3 | 41 50 | 22 28 | 42 33 | 22 53 | 43 17 | 23 17 |
| 28 | 38 11 | 20 26 | 38 54 | 20 50 | 39 38 | 21 15 | 40 21 | 21 40 | 41 5 | 22 4 | 41 48 | 22 29 | 42 32 | 22 54 | 43 16 | 23 19 |
| 30 | 38 9 | 20 26 | 38 53 | 20 51 | 39 37 | 21 16 | 40 20 | 21 41 | 41 4 | 22 5 | 41 47 | 22 30 | 42 31 | 22 55 | 43 14 | 23 20 |
| 32 | 38 8 | 20 27 | 38 52 | 20 52 | 39 35 | 21 17 | 40 19 | 21 42 | 41 2 | 22 7 | 41 46 | 22 31 | 42 29 | 22 56 | 43 13 | 23 21 |
| 34 | 38 7 | 20 28 | 38 51 | 20 53 | 39 34 | 21 18 | 40 17 | 21 43 | 41 1 | 22 8 | 41 44 | 22 32 | 42 28 | 22 57 | 43 11 | 23 22 |
| 36 | 38 6 | 20 29 | 38 49 | 20 54 | 39 33 | 21 19 | 40 16 | 21 44 | 41 0 | 22 9 | 41 43 | 22 34 | 42 27 | 22 58 | 43 10 | 23 23 |
| 38 | 38 5 | 20 30 | 38 48 | 20 55 | 39 31 | 21 20 | 40 15 | 21 45 | 40 58 | 22 10 | 41 42 | 22 35 | 42 25 | 23 0 | 43 9 | 23 25 |
| 40 | 38 3 | 20 30 | 38 47 | 20 55 | 39 30 | 21 20 | 40 14 | 21 46 | 40 57 | 22 11 | 41 40 | 22 36 | 42 24 | 23 1 | 43 7 | 23 26 |
| 42 | 38 2 | 20 31 | 38 46 | 20 56 | 39 29 | 21 21 | 40 12 | 21 47 | 40 56 | 22 12 | 41 39 | 22 37 | 42 22 | 23 2 | 43 6 | 23 27 |
| 44 | 38 1 | 20 32 | 38 44 | 20 57 | 39 28 | 21 22 | 40 11 | 21 48 | 40 54 | 22 13 | 41 38 | 22 38 | 42 21 | 23 3 | 43 4 | 23 28 |
| 46 | 38 0 | 20 33 | 38 43 | 20 58 | 39 26 | 21 23 | 40 10 | 21 49 | 40 53 | 22 14 | 41 36 | 22 39 | 42 20 | 23 4 | 43 3 | 23 30 |
| 48 | 37 58 | 20 33 | 38 42 | 20 59 | 39 25 | 21 24 | 40 8 | 21 49 | 40 52 | 22 15 | 41 35 | 22 40 | 42 18 | 23 5 | 43 2 | 23 31 |
| 50 | 37 57 | 20 34 | 38 41 | 21 0 | 39 24 | 21 25 | 40 7 | 21 50 | 40 50 | 22 16 | 41 34 | 22 41 | 42 17 | 23 7 | 43 0 | 23 32 |
| 52 | 37 56 | 20 35 | 38 39 | 21 0 | 39 23 | 21 26 | 40 6 | 21 51 | 40 49 | 22 17 | 41 32 | 22 42 | 42 16 | 23 8 | 42 59 | 23 33 |
| 54 | 37 55 | 20 36 | 38 38 | 21 1 | 39 21 | 21 27 | 40 4 | 21 52 | 40 48 | 22 18 | 41 31 | 22 43 | 42 14 | 23 9 | 42 57 | 23 34 |
| 56 | 37 54 | 20 36 | 38 37 | 21 2 | 39 20 | 21 28 | 40 3 | 21 53 | 40 46 | 22 19 | 41 30 | 22 44 | 42 13 | 23 10 | 42 56 | 23 36 |
| 58 | 37 52 | 20 37 | 38 36 | 21 3 | 39 19 | 21 29 | 40 2 | 21 54 | 40 45 | 22 20 | 41 28 | 22 46 | 42 11 | 23 11 | 42 55 | 23 37 |

| Seconds of H. P. | | |
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| ″ | Cor. | A. |
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| 1 | 1 | 0 |
| 2 | 1 | 1 |
| 3 | 2 | 1 |
| 4 | 3 | 2 |
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| 6 | 4 | 2 |
| 7 | 5 | 3 |
| 8 | 6 | 3 |
| 9 | 7 | 4 |
| 10 | 7 | 4 |
| 11 | 8 | 4 |
| 12 | 9 | 5 |
| 13 | 9 | 5 |
| 14 | 10 | 6 |
| 15 | 11 | 6 |
| 16 | 12 | 6 |
| 17 | 12 | 7 |
| 18 | 13 | 7 |
| 19 | 14 | 8 |
| 20 | 15 | 8 |
| 21 | 15 | 8 |
| 22 | 16 | 9 |
| 23 | 17 | 9 |
| 24 | 18 | 10 |
| 25 | 18 | 10 |
| 26 | 19 | 10 |
| 27 | 20 | 11 |
| 28 | 20 | 11 |
| 29 | 21 | 12 |
| 30 | 22 | 12 |
| 31 | 23 | 12 |
| 32 | 23 | 13 |
| 33 | 24 | 13 |
| 34 | 25 | 14 |
| 35 | 26 | 14 |
| 36 | 26 | 14 |
| 37 | 27 | 15 |
| 38 | 28 | 15 |
| 39 | 29 | 16 |
| 40 | 29 | 16 |
| 41 | 30 | 16 |
| 42 | 31 | 17 |
| 43 | 31 | 17 |
| 44 | 32 | 18 |
| 45 | 33 | 18 |
| 46 | 34 | 18 |
| 47 | 34 | 19 |
| 48 | 35 | 19 |
| 49 | 36 | 20 |
| 50 | 37 | 20 |
| 51 | 37 | 20 |
| 52 | 38 | 21 |
| 53 | 39 | 21 |
| 54 | 40 | 22 |
| 55 | 40 | 22 |
| 56 | 41 | 22 |
| 57 | 42 | 23 |
| 58 | 42 | 23 |
| 59 | 43 | 24 |
| Alt. | ☉ | ☽ |
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| 0 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (44° and 45°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 44° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 37 51 | 20 38 | 38 34 | 21 4 | 39 17 | 21 29 | 40 1 | 21 55 | 40 44 | 22 21 | 41 27 | 22 47 | 42 10 | 23 13 | 42 53 | 23 38 |
| 2 | 37 50 | 20 39 | 38 33 | 21 5 | 39 16 | 21 30 | 39 59 | 21 56 | 40 42 | 22 22 | 41 26 | 22 47 | 42 9 | 23 13 | 42 52 | 23 39 |
| 4 | 37 49 | 20 40 | 38 32 | 21 5 | 39 15 | 21 31 | 39 58 | 21 57 | 40 41 | 22 22 | 41 24 | 22 48 | 42 7 | 23 14 | 42 50 | 23 39 |
| 6 | 37 47 | 20 40 | 38 30 | 21 6 | 39 14 | 21 32 | 39 57 | 21 57 | 40 40 | 22 23 | 41 23 | 22 48 | 42 6 | 23 14 | 42 49 | 23 40 |
| 8 | 37 46 | 20 41 | 38 29 | 21 7 | 39 12 | 21 32 | 39 55 | 21 58 | 40 38 | 22 23 | 41 21 | 22 49 | 42 5 | 23 15 | 42 48 | 23 40 |
| 10 | 37 45 | 20 42 | 38 28 | 21 7 | 39 11 | 21 33 | 39 54 | 21 59 | 40 37 | 22 24 | 41 20 | 22 50 | 42 3 | 23 15 | 42 46 | 23 41 |
| 12 | 37 44 | 20 43 | 38 27 | 21 8 | 39 10 | 21 34 | 39 53 | 21 59 | 40 36 | 22 25 | 41 19 | 22 50 | 42 2 | 23 16 | 42 45 | 23 41 |
| 14 | 37 42 | 20 43 | 38 25 | 21 9 | 39 8 | 21 34 | 39 51 | 22 0 | 40 34 | 22 25 | 41 17 | 22 51 | 42 0 | 23 16 | 42 43 | 23 42 |
| 16 | 37 41 | 20 44 | 38 24 | 21 10 | 39 7 | 21 35 | 39 50 | 22 1 | 40 33 | 22 26 | 41 16 | 22 51 | 41 59 | 23 17 | 42 42 | 23 42 |
| 18 | 37 40 | 20 45 | 38 23 | 21 11 | 39 6 | 21 36 | 39 49 | 22 1 | 40 32 | 22 27 | 41 15 | 22 52 | 41 58 | 23 17 | 42 41 | 23 43 |
| 20 | 37 39 | 20 46 | 38 21 | 21 11 | 39 4 | 21 36 | 39 47 | 22 2 | 40 30 | 22 27 | 41 13 | 22 53 | 41 56 | 23 18 | 42 39 | 23 43 |
| 22 | 37 37 | 20 47 | 38 20 | 21 12 | 39 3 | 21 37 | 39 46 | 22 3 | 40 29 | 22 28 | 41 12 | 22 53 | 41 55 | 23 18 | 42 38 | 23 44 |
| 24 | 37 36 | 20 47 | 38 19 | 21 13 | 39 2 | 21 38 | 39 45 | 22 3 | 40 28 | 22 28 | 41 10 | 22 54 | 41 53 | 23 19 | 42 36 | 23 44 |
| 26 | 37 35 | 20 48 | 38 18 | 21 13 | 39 1 | 21 39 | 39 43 | 22 4 | 40 26 | 22 29 | 41 9 | 22 54 | 41 52 | 23 20 | 42 35 | 23 45 |
| 28 | 37 34 | 20 49 | 38 16 | 21 14 | 38 59 | 21 39 | 39 42 | 22 5 | 40 25 | 22 30 | 41 8 | 22 55 | 41 51 | 23 20 | 42 33 | 23 45 |
| 30 | 37 32 | 20 50 | 38 15 | 21 15 | 38 58 | 21 40 | 39 41 | 22 5 | 40 24 | 22 30 | 41 6 | 22 56 | 41 49 | 23 21 | 42 32 | 23 46 |
| 32 | 37 31 | 20 50 | 38 14 | 21 16 | 38 57 | 21 41 | 39 39 | 22 6 | 40 22 | 22 31 | 41 5 | 22 56 | 41 48 | 23 21 | 42 31 | 23 46 |
| 34 | 37 30 | 20 51 | 38 13 | 21 16 | 38 55 | 21 41 | 39 38 | 22 7 | 40 21 | 22 32 | 41 4 | 22 57 | 41 46 | 23 22 | 42 29 | 23 47 |
| 36 | 37 29 | 20 52 | 38 11 | 21 17 | 38 54 | 21 42 | 39 37 | 22 7 | 40 19 | 22 32 | 41 2 | 22 57 | 41 45 | 23 22 | 42 28 | 23 48 |
| 38 | 37 27 | 20 53 | 38 10 | 21 18 | 38 53 | 21 43 | 39 36 | 22 8 | 40 18 | 22 33 | 41 1 | 22 58 | 41 44 | 23 23 | 42 26 | 23 48 |
| 40 | 37 26 | 20 54 | 38 9 | 21 18 | 38 51 | 21 43 | 39 34 | 22 8 | 40 17 | 22 33 | 40 59 | 22 58 | 41 42 | 23 24 | 42 25 | 23 49 |
| 42 | 37 25 | 20 54 | 38 8 | 21 19 | 38 50 | 21 44 | 39 33 | 22 9 | 40 15 | 22 34 | 40 58 | 22 59 | 41 41 | 23 24 | 42 23 | 23 49 |
| 44 | 37 24 | 20 55 | 38 6 | 21 20 | 38 49 | 21 45 | 39 32 | 22 10 | 40 14 | 22 35 | 40 57 | 23 0 | 41 39 | 23 25 | 42 22 | 23 50 |
| 46 | 37 22 | 20 56 | 38 5 | 21 21 | 38 48 | 21 46 | 39 30 | 22 11 | 40 13 | 22 35 | 40 55 | 23 0 | 41 38 | 23 25 | 42 21 | 23 50 |
| 48 | 37 21 | 20 56 | 38 4 | 21 21 | 38 46 | 21 46 | 39 29 | 22 11 | 40 11 | 22 36 | 40 54 | 23 1 | 41 37 | 23 26 | 42 19 | 23 51 |
| 50 | 37 20 | 20 57 | 38 2 | 21 22 | 38 45 | 21 47 | 39 28 | 22 12 | 40 10 | 22 37 | 40 53 | 23 2 | 41 35 | 23 26 | 42 18 | 23 51 |
| 52 | 37 19 | 20 58 | 38 1 | 21 23 | 38 44 | 21 48 | 39 26 | 22 13 | 40 9 | 22 37 | 40 51 | 23 2 | 41 34 | 23 27 | 42 16 | 23 52 |
| 54 | 37 17 | 20 59 | 38 0 | 21 24 | 38 42 | 21 48 | 39 25 | 22 13 | 40 7 | 22 38 | 40 50 | 23 3 | 41 32 | 23 28 | 42 15 | 23 52 |
| 56 | 37 16 | 21 0 | 37 59 | 21 25 | 38 41 | 21 49 | 39 24 | 22 14 | 40 6 | 22 39 | 40 49 | 23 3 | 41 31 | 23 28 | 42 14 | 23 53 |
| 58 | 37 15 | 21 0 | 37 57 | 21 25 | 38 40 | 21 50 | 39 22 | 22 15 | 40 5 | 22 39 | 40 47 | 23 4 | 41 30 | 23 29 | 42 12 | 23 53 |
| 45° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 37 14 | 21 1 | 37 56 | 21 26 | 38 38 | 21 50 | 39 21 | 22 15 | 40 3 | 22 40 | 40 46 | 23 5 | 41 28 | 23 29 | 42 11 | 23 54 |
| 2 | 37 12 | 21 2 | 37 55 | 21 27 | 38 37 | 21 51 | 39 20 | 22 16 | 40 2 | 22 41 | 40 44 | 23 5 | 41 27 | 23 30 | 42 9 | 23 55 |
| 4 | 37 11 | 21 3 | 37 53 | 21 27 | 38 36 | 21 52 | 39 18 | 22 17 | 40 1 | 22 42 | 40 43 | 23 6 | 41 25 | 23 31 | 42 8 | 23 56 |
| 6 | 37 10 | 21 3 | 37 52 | 21 28 | 38 35 | 21 53 | 39 17 | 22 18 | 39 59 | 22 42 | 40 42 | 23 7 | 41 24 | 23 32 | 42 6 | 23 57 |
| 8 | 37 8 | 21 4 | 37 51 | 21 29 | 38 33 | 21 54 | 39 15 | 22 18 | 39 58 | 22 43 | 40 40 | 23 8 | 41 23 | 23 33 | 42 5 | 23 57 |
| 10 | 37 7 | 21 5 | 37 49 | 21 30 | 38 32 | 21 54 | 39 14 | 22 19 | 39 56 | 22 44 | 40 39 | 23 9 | 41 21 | 23 33 | 42 3 | 23 58 |
| 12 | 37 6 | 21 6 | 37 48 | 21 30 | 38 31 | 21 55 | 39 13 | 22 20 | 39 55 | 22 45 | 40 37 | 23 10 | 41 20 | 23 34 | 42 2 | 23 59 |
| 14 | 37 5 | 21 6 | 37 47 | 21 31 | 38 29 | 21 56 | 39 11 | 22 21 | 39 54 | 22 46 | 40 36 | 23 10 | 41 18 | 23 35 | 42 0 | 24 0 |
| 16 | 37 3 | 21 7 | 37 46 | 21 32 | 38 28 | 21 57 | 39 10 | 22 22 | 39 52 | 22 46 | 40 35 | 23 11 | 41 17 | 23 36 | 41 59 | 24 1 |
| 18 | 37 2 | 21 8 | 37 44 | 21 33 | 38 27 | 21 58 | 39 9 | 22 22 | 39 51 | 22 47 | 40 33 | 23 12 | 41 15 | 23 37 | 41 58 | 24 2 |
| 20 | 37 1 | 21 9 | 37 43 | 21 33 | 38 25 | 21 58 | 39 7 | 22 23 | 39 49 | 22 48 | 40 32 | 23 13 | 41 14 | 23 38 | 41 56 | 24 3 |
| 22 | 37 0 | 21 9 | 37 42 | 21 34 | 38 24 | 21 59 | 39 6 | 22 24 | 39 48 | 22 49 | 40 30 | 23 14 | 41 12 | 23 39 | 41 55 | 24 3 |
| 24 | 36 58 | 21 10 | 37 40 | 21 35 | 38 23 | 22 0 | 39 5 | 22 25 | 39 47 | 22 50 | 40 29 | 23 15 | 41 11 | 23 39 | 41 53 | 24 4 |
| 26 | 36 57 | 21 11 | 37 39 | 21 36 | 38 21 | 22 1 | 39 3 | 22 26 | 39 45 | 22 50 | 40 27 | 23 15 | 41 10 | 23 40 | 41 52 | 24 5 |
| 28 | 36 56 | 21 12 | 37 38 | 21 37 | 38 20 | 22 1 | 39 2 | 22 26 | 39 44 | 22 51 | 40 26 | 23 16 | 41 8 | 23 41 | 41 50 | 24 6 |
| 30 | 36 54 | 21 12 | 37 36 | 21 37 | 38 19 | 22 2 | 39 1 | 22 27 | 39 43 | 22 52 | 40 25 | 23 17 | 41 7 | 23 42 | 41 49 | 24 7 |
| 32 | 36 53 | 21 13 | 37 35 | 21 38 | 38 17 | 22 3 | 38 59 | 22 28 | 39 41 | 22 53 | 40 23 | 23 18 | 41 5 | 23 43 | 41 47 | 24 8 |
| 34 | 36 52 | 21 14 | 37 34 | 21 39 | 38 16 | 22 4 | 38 58 | 22 29 | 39 40 | 22 54 | 40 22 | 23 19 | 41 4 | 23 44 | 41 46 | 24 9 |
| 36 | 36 51 | 21 15 | 37 33 | 21 40 | 38 15 | 22 5 | 38 57 | 22 30 | 39 39 | 22 54 | 40 20 | 23 19 | 41 2 | 23 44 | 41 44 | 24 9 |
| 38 | 36 49 | 21 16 | 37 31 | 21 40 | 38 13 | 22 6 | 38 55 | 22 30 | 39 37 | 22 55 | 40 19 | 23 20 | 41 1 | 23 45 | 41 43 | 24 10 |
| 40 | 36 48 | 21 16 | 37 30 | 21 41 | 38 12 | 22 6 | 38 54 | 22 31 | 39 36 | 22 56 | 40 18 | 23 21 | 41 0 | 23 46 | 41 42 | 24 11 |
| 42 | 36 47 | 21 17 | 37 29 | 21 42 | 38 11 | 22 7 | 38 52 | 22 32 | 39 34 | 22 57 | 40 16 | 23 22 | 40 58 | 23 47 | 41 40 | 24 12 |
| 44 | 36 45 | 21 18 | 37 27 | 21 43 | 38 9 | 22 8 | 38 51 | 22 33 | 39 33 | 22 58 | 40 15 | 23 23 | 40 57 | 23 48 | 41 39 | 24 13 |
| 46 | 36 44 | 21 18 | 37 26 | 21 43 | 38 8 | 22 8 | 38 50 | 22 33 | 39 32 | 22 59 | 40 13 | 23 24 | 40 55 | 23 49 | 41 37 | 24 14 |
| 48 | 36 43 | 21 19 | 37 25 | 21 44 | 38 7 | 22 9 | 38 48 | 22 34 | 39 30 | 22 59 | 40 12 | 23 24 | 40 54 | 23 49 | 41 36 | 24 15 |
| 50 | 36 42 | 21 20 | 37 23 | 21 45 | 38 5 | 22 10 | 38 47 | 22 35 | 39 29 | 23 0 | 40 11 | 23 25 | 40 52 | 23 50 | 41 34 | 24 15 |
| 52 | 36 40 | 21 21 | 37 22 | 21 45 | 38 4 | 22 11 | 38 46 | 22 36 | 39 28 | 23 1 | 40 9 | 23 26 | 40 51 | 23 51 | 41 33 | 24 16 |
| 54 | 36 39 | 21 21 | 37 21 | 21 46 | 38 3 | 22 12 | 38 44 | 22 37 | 39 26 | 23 2 | 40 8 | 23 27 | 40 50 | 23 52 | 41 31 | 24 17 |
| 56 | 36 38 | 21 22 | 37 20 | 21 47 | 38 1 | 22 12 | 38 43 | 22 37 | 39 25 | 23 3 | 40 6 | 23 28 | 40 48 | 23 53 | 41 30 | 24 18 |
| 58 | 36 36 | 21 23 | 37 18 | 21 48 | 38 0 | 22 13 | 38 42 | 22 38 | 39 23 | 23 3 | 40 5 | 23 29 | 40 47 | 23 54 | 41 29 | 24 19 |

| Seconds of H. P. | Corr. | A |
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| ″ | ″ | ″ |
| 1 | 1 | 0 |
| 2 | 1 | 1 |
| 3 | 2 | 1 |
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| 6 | 4 | 2 |
| 7 | 5 | 3 |
| 8 | 6 | 3 |
| 9 | 6 | 4 |
| 10 | 7 | 4 |
| 11 | 8 | 5 |
| 12 | 8 | 5 |
| 13 | 9 | 5 |
| 14 | 10 | 6 |
| 15 | 11 | 6 |
| 16 | 11 | 7 |
| 17 | 12 | 7 |
| 18 | 13 | 7 |
| 19 | 13 | 8 |
| 20 | 14 | 8 |
| 21 | 15 | 9 |
| 22 | 15 | 9 |
| 23 | 16 | 10 |
| 24 | 17 | 10 |
| 25 | 18 | 10 |
| 26 | 18 | 11 |
| 27 | 19 | 11 |
| 28 | 20 | 12 |
| 29 | 20 | 12 |
| 30 | 21 | 13 |
| 31 | 22 | 13 |
| 32 | 23 | 13 |
| 33 | 23 | 14 |
| 34 | 24 | 14 |
| 35 | 25 | 15 |
| 36 | 25 | 15 |
| 37 | 26 | 15 |
| 38 | 27 | 16 |
| 39 | 28 | 16 |
| 40 | 28 | 17 |
| 41 | 29 | 17 |
| 42 | 30 | 18 |
| 43 | 30 | 18 |
| 44 | 31 | 18 |
| 45 | 32 | 19 |
| 46 | 33 | 19 |
| 47 | 33 | 20 |
| 48 | 34 | 20 |
| 49 | 35 | 20 |
| 50 | 35 | 21 |
| 51 | 36 | 21 |
| 52 | 37 | 22 |
| 53 | 38 | 22 |
| 54 | 39 | 23 |
| 55 | 39 | 23 |
| 56 | 40 | 23 |
| 57 | 40 | 24 |
| 58 | 41 | 24 |
| 59 | 42 | 25 |
| | A | A |
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| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| 4 | 0 | 0 |
| 5 | 0 | 0 |
| 6 | 1 | 1 |
| 7 | 1 | 1 |
| 8 | 1 | 1 |
| 9 | 1 | 1 |
| 10 | 1 | 1 |
| 20 | 2 | 2 |
| 30 | 3 | 3 |
| 40 | 3 | 3 |
| 50 | 4 | 4 |
| 60 | 4 | 4 |
| 70 | 5 | 5 |
| 80 | 5 | 5 |

## (46° and 47°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ Corr. + | A 60° | 55′ Corr. + | A 60° | 56′ Corr. + | A 60° | 57′ Corr. + | A 60° | 58′ Corr. + | A 60° | 59′ Corr. + | A 60° | 60′ Corr. + | A 60° | 61′ Corr. + | A 60° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 36 35 | 21 24 | 37 17 | 21 49 | 37 59 | 22 14 | 38 40 | 22 39 | 39 22 | 23 4 | 40 4 | 23 29 | 40 45 | 23 55 | 41 27 | 24 20 |
| 2 | 36 34 | 21 24 | 37 16 | 21 50 | 37 57 | 22 15 | 38 39 | 22 40 | 39 21 | 23 5 | 40 2 | 23 30 | 40 44 | 23 55 | 41 26 | 24 21 |
| 4 | 36 33 | 21 25 | 37 14 | 21 50 | 37 56 | 22 16 | 38 38 | 22 41 | 39 19 | 23 6 | 40 1 | 23 31 | 40 42 | 23 56 | 41 24 | 24 21 |
| 6 | 36 31 | 21 26 | 37 13 | 21 51 | 37 55 | 22 16 | 38 36 | 22 41 | 39 18 | 23 7 | 39 59 | 23 32 | 40 41 | 23 57 | 41 23 | 24 22 |
| 8 | 36 30 | 21 27 | 37 12 | 21 52 | 37 53 | 22 17 | 38 35 | 22 42 | 39 16 | 23 7 | 39 58 | 23 33 | 40 40 | 23 58 | 41 21 | 24 23 |
| 10 | 36 28 | 21 27 | 37 10 | 21 53 | 37 52 | 22 18 | 38 33 | 22 43 | 39 15 | 23 8 | 39 57 | 23 33 | 40 38 | 23 59 | 41 20 | 24 24 |
| 12 | 36 27 | 21 28 | 37 9 | 21 53 | 37 51 | 22 19 | 38 32 | 22 44 | 39 14 | 23 9 | 39 55 | 23 34 | 40 37 | 24 0 | 41 18 | 24 25 |
| 14 | 36 26 | 21 29 | 37 8 | 21 54 | 37 49 | 22 19 | 38 31 | 22 45 | 39 12 | 23 10 | 39 54 | 23 35 | 40 35 | 24 0 | 41 17 | 24 26 |
| 16 | 36 25 | 21 30 | 37 6 | 21 55 | 37 48 | 22 20 | 38 29 | 22 45 | 39 11 | 23 11 | 39 52 | 23 36 | 40 34 | 24 1 | 41 15 | 24 26 |
| 18 | 36 23 | 21 30 | 37 5 | 21 56 | 37 46 | 22 21 | 38 28 | 22 46 | 39 9 | 23 11 | 39 51 | 23 37 | 40 32 | 24 2 | 41 14 | 24 27 |
| 20 | 36 22 | 21 31 | 37 4 | 21 56 | 37 45 | 22 22 | 38 26 | 22 47 | 39 8 | 23 12 | 39 49 | 23 37 | 40 31 | 24 3 | 41 12 | 24 28 |
| 22 | 36 21 | 21 32 | 37 2 | 21 57 | 37 44 | 22 22 | 38 25 | 22 48 | 39 7 | 23 13 | 39 48 | 23 38 | 40 29 | 24 4 | 41 11 | 24 29 |
| 24 | 36 20 | 21 33 | 37 1 | 21 58 | 37 42 | 22 23 | 38 24 | 22 48 | 39 5 | 23 14 | 39 47 | 23 39 | 40 28 | 24 4 | 41 9 | 24 30 |
| 26 | 36 18 | 21 33 | 37 0 | 21 58 | 37 41 | 22 24 | 38 22 | 22 49 | 39 4 | 23 15 | 39 45 | 23 40 | 40 26 | 24 5 | 41 8 | 24 30 |
| 28 | 36 17 | 21 34 | 36 58 | 21 59 | 37 40 | 22 25 | 38 21 | 22 50 | 39 2 | 23 15 | 39 44 | 23 41 | 40 25 | 24 6 | 41 6 | 24 31 |
| 30 | 36 16 | 21 35 | 36 57 | 22 0 | 37 38 | 22 25 | 38 20 | 22 51 | 39 0 | 23 16 | 39 42 | 23 41 | 40 23 | 24 7 | 41 5 | 24 32 |
| 32 | 36 14 | 21 36 | 36 56 | 22 0 | 37 37 | 22 26 | 38 18 | 22 52 | 38 59 | 23 17 | 39 41 | 23 42 | 40 22 | 24 8 | 41 3 | 24 33 |
| 34 | 36 13 | 21 36 | 36 54 | 22 1 | 37 36 | 22 27 | 38 17 | 22 52 | 38 58 | 23 18 | 39 39 | 23 43 | 40 21 | 24 8 | 41 2 | 24 34 |
| 36 | 36 12 | 21 37 | 36 53 | 22 2 | 37 34 | 22 28 | 38 15 | 22 53 | 38 57 | 23 18 | 39 38 | 23 44 | 40 19 | 24 9 | 41 0 | 24 35 |
| 38 | 36 10 | 21 38 | 36 52 | 22 2 | 37 33 | 22 29 | 38 14 | 22 54 | 38 55 | 23 19 | 39 36 | 23 45 | 40 18 | 24 10 | 40 59 | 24 35 |
| 40 | 36 9 | 21 38 | 36 50 | 22 4 | 37 31 | 22 29 | 38 13 | 22 55 | 38 54 | 23 20 | 39 35 | 23 45 | 40 16 | 24 11 | 40 57 | 24 36 |
| 42 | 36 8 | 21 39 | 36 49 | 22 5 | 37 30 | 22 30 | 38 11 | 22 55 | 38 52 | 23 21 | 39 34 | 23 46 | 40 15 | 24 12 | 40 56 | 24 37 |
| 44 | 36 6 | 21 40 | 36 48 | 22 5 | 37 29 | 22 31 | 38 10 | 22 56 | 38 51 | 23 22 | 39 32 | 23 47 | 40 13 | 24 12 | 40 54 | 24 38 |
| 46 | 36 5 | 21 41 | 36 46 | 22 6 | 37 27 | 22 32 | 38 9 | 22 57 | 38 50 | 23 22 | 39 31 | 23 48 | 40 12 | 24 13 | 40 53 | 24 39 |
| 48 | 36 4 | 21 41 | 36 45 | 22 7 | 37 26 | 22 32 | 38 7 | 22 58 | 38 48 | 23 23 | 39 29 | 23 49 | 40 10 | 24 14 | 40 51 | 24 40 |
| 50 | 36 3 | 21 42 | 36 44 | 22 8 | 37 25 | 22 33 | 38 6 | 22 59 | 38 47 | 23 24 | 39 28 | 23 49 | 40 9 | 24 15 | 40 50 | 24 40 |
| 52 | 36 1 | 21 43 | 36 42 | 22 8 | 37 23 | 22 34 | 38 4 | 22 59 | 38 45 | 23 25 | 39 26 | 23 50 | 40 7 | 24 16 | 40 49 | 24 41 |
| 54 | 36 0 | 21 44 | 36 41 | 22 9 | 37 22 | 22 35 | 38 3 | 23 0 | 38 44 | 23 26 | 39 25 | 23 51 | 40 6 | 24 17 | 40 47 | 24 42 |
| 56 | 35 59 | 21 44 | 36 40 | 22 10 | 37 21 | 22 35 | 38 2 | 23 1 | 38 43 | 23 26 | 39 24 | 23 52 | 40 5 | 24 17 | 40 46 | 24 43 |
| 58 | 35 57 | 21 45 | 36 38 | 22 11 | 37 19 | 22 36 | 38 0 | 23 2 | 38 41 | 23 27 | 39 22 | 23 53 | 40 3 | 24 18 | 40 44 | 24 44 |

| 47° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 35 56 | 21 46 | 36 37 | 22 11 | 37 18 | 22 37 | 37 59 | 23 2 | 38 40 | 23 28 | 39 21 | 23 53 | 40 2 | 24 19 | 40 43 | 24 44 |
| 2 | 35 55 | 21 47 | 36 36 | 22 12 | 37 17 | 22 38 | 37 57 | 23 3 | 38 38 | 23 29 | 39 19 | 23 54 | 40 0 | 24 20 | 40 41 | 24 45 |
| 4 | 35 53 | 21 47 | 36 34 | 22 13 | 37 15 | 22 38 | 37 56 | 23 4 | 38 37 | 23 29 | 39 18 | 23 55 | 39 59 | 24 21 | 40 40 | 24 46 |
| 6 | 35 52 | 21 48 | 36 33 | 22 14 | 37 14 | 22 39 | 37 55 | 23 5 | 38 36 | 23 30 | 39 16 | 23 56 | 39 57 | 24 21 | 40 38 | 24 47 |
| 8 | 35 51 | 21 49 | 36 32 | 22 14 | 37 12 | 22 40 | 37 53 | 23 6 | 38 34 | 23 31 | 39 15 | 23 57 | 39 56 | 24 22 | 40 37 | 24 48 |
| 10 | 35 49 | 21 49 | 36 30 | 22 15 | 37 11 | 22 41 | 37 52 | 23 6 | 38 33 | 23 32 | 39 13 | 23 58 | 39 54 | 24 23 | 40 35 | 24 49 |
| 12 | 35 48 | 21 50 | 36 29 | 22 16 | 37 10 | 22 41 | 37 50 | 23 7 | 38 31 | 23 33 | 39 12 | 23 58 | 39 53 | 24 24 | 40 34 | 24 50 |
| 14 | 35 47 | 21 51 | 36 28 | 22 17 | 37 8 | 22 42 | 37 49 | 23 8 | 38 30 | 23 33 | 39 11 | 23 59 | 39 51 | 24 25 | 40 32 | 24 50 |
| 16 | 35 45 | 21 52 | 36 26 | 22 17 | 37 7 | 22 43 | 37 48 | 23 9 | 38 28 | 23 34 | 39 9 | 24 0 | 39 50 | 24 26 | 40 31 | 24 51 |
| 18 | 35 44 | 21 52 | 36 25 | 22 18 | 37 5 | 22 44 | 37 46 | 23 9 | 38 27 | 23 35 | 39 8 | 24 1 | 39 48 | 24 27 | 40 29 | 24 52 |
| 20 | 35 43 | 21 53 | 36 23 | 22 19 | 37 4 | 22 44 | 37 45 | 23 10 | 38 25 | 23 36 | 39 6 | 24 2 | 39 47 | 24 27 | 40 27 | 24 53 |
| 22 | 35 41 | 21 54 | 36 22 | 22 20 | 37 2 | 22 45 | 37 43 | 23 11 | 38 24 | 23 37 | 39 5 | 24 2 | 39 45 | 24 28 | 40 26 | 24 54 |
| 24 | 35 40 | 21 55 | 36 21 | 22 20 | 37 1 | 22 46 | 37 42 | 23 12 | 38 23 | 23 37 | 39 3 | 24 3 | 39 44 | 24 29 | 40 24 | 24 55 |
| 26 | 35 39 | 21 55 | 36 19 | 22 21 | 37 0 | 22 47 | 37 41 | 23 12 | 38 21 | 23 38 | 39 2 | 24 4 | 39 42 | 24 30 | 40 23 | 24 55 |
| 28 | 35 37 | 21 56 | 36 18 | 22 22 | 36 59 | 22 47 | 37 39 | 23 13 | 38 20 | 23 39 | 39 0 | 24 5 | 39 41 | 24 30 | 40 21 | 24 56 |
| 30 | 35 36 | 21 57 | 36 17 | 22 22 | 36 57 | 22 48 | 37 38 | 23 14 | 38 18 | 23 40 | 38 59 | 24 5 | 39 39 | 24 31 | 40 20 | 24 57 |
| 32 | 35 35 | 21 57 | 36 15 | 22 23 | 36 56 | 22 49 | 37 36 | 23 15 | 38 17 | 23 40 | 38 57 | 24 6 | 39 38 | 24 32 | 40 18 | 24 58 |
| 34 | 35 33 | 21 58 | 36 14 | 22 24 | 36 55 | 22 50 | 37 35 | 23 16 | 38 15 | 23 41 | 38 56 | 24 7 | 39 37 | 24 33 | 40 17 | 24 58 |
| 36 | 35 32 | 21 59 | 36 13 | 22 25 | 36 53 | 22 50 | 37 34 | 23 16 | 38 14 | 23 42 | 38 55 | 24 8 | 39 35 | 24 33 | 40 15 | 24 59 |
| 38 | 35 31 | 22 0 | 36 11 | 22 25 | 36 52 | 22 51 | 37 32 | 23 17 | 38 13 | 23 43 | 38 53 | 24 9 | 39 34 | 24 34 | 40 14 | 25 0 |
| 40 | 35 29 | 22 0 | 36 10 | 22 26 | 36 50 | 22 52 | 37 31 | 23 18 | 38 11 | 23 43 | 38 52 | 24 9 | 39 32 | 24 35 | 40 12 | 25 1 |
| 42 | 35 28 | 22 1 | 36 9 | 22 27 | 36 49 | 22 53 | 37 29 | 23 18 | 38 10 | 23 44 | 38 50 | 24 10 | 39 31 | 24 36 | 40 11 | 25 2 |
| 44 | 35 27 | 22 2 | 36 7 | 22 28 | 36 48 | 22 53 | 37 28 | 23 19 | 38 8 | 23 45 | 38 49 | 24 11 | 39 29 | 24 37 | 40 9 | 25 2 |
| 46 | 35 26 | 22 3 | 36 6 | 22 28 | 36 46 | 22 54 | 37 27 | 23 20 | 38 7 | 23 46 | 38 47 | 24 12 | 39 28 | 24 37 | 40 8 | 25 3 |
| 48 | 35 24 | 22 3 | 36 5 | 22 29 | 36 45 | 22 55 | 37 25 | 23 21 | 38 5 | 23 47 | 38 46 | 24 12 | 39 26 | 24 38 | 40 6 | 25 4 |
| 50 | 35 23 | 22 4 | 36 3 | 22 30 | 36 43 | 22 56 | 37 24 | 23 21 | 38 4 | 23 47 | 38 44 | 24 13 | 39 25 | 24 39 | 40 5 | 25 5 |
| 52 | 35 22 | 22 5 | 36 2 | 22 31 | 36 42 | 22 56 | 37 22 | 23 22 | 38 3 | 23 48 | 38 43 | 24 14 | 39 23 | 24 40 | 40 3 | 25 6 |
| 54 | 35 20 | 22 5 | 36 0 | 22 31 | 36 41 | 22 57 | 37 21 | 23 23 | 38 1 | 23 49 | 38 41 | 24 15 | 39 22 | 24 41 | 40 2 | 25 7 |
| 56 | 35 19 | 22 6 | 35 59 | 22 32 | 36 39 | 22 58 | 37 20 | 23 24 | 38 0 | 23 50 | 38 40 | 24 16 | 39 20 | 24 41 | 40 0 | 25 7 |
| 58 | 35 18 | 22 7 | 35 58 | 22 33 | 36 38 | 22 59 | 37 18 | 23 25 | 37 58 | 23 50 | 38 39 | 24 16 | 39 19 | 24 42 | 39 59 | 25 8 |

### Seconds of H. P.

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| 1 | 1 | 0 |
| 2 | 1 | 1 |
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| 7 | 5 | 3 |
| 8 | 5 | 3 |
| 9 | 6 | 4 |
| 10 | 7 | 4 |
| 11 | 7 | 5 |
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| 16 | 11 | 7 |
| 17 | 12 | 7 |
| 18 | 13 | 8 |
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| 20 | 14 | 9 |
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| 22 | 15 | 9 |
| 23 | 16 | 10 |
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| 25 | 17 | 11 |
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| 36 | 25 | 15 |
| 37 | 25 | 16 |
| 38 | 26 | 16 |
| 39 | 27 | 17 |
| 40 | 27 | 17 |
| 41 | 28 | 17 |
| 42 | 29 | 18 |
| 43 | 29 | 18 |
| 44 | 30 | 19 |
| 45 | 31 | 19 |
| 46 | 31 | 20 |
| 47 | 32 | 20 |
| 48 | 33 | 20 |
| 49 | 33 | 21 |
| 50 | 34 | 21 |
| 51 | 35 | 22 |
| 52 | 35 | 22 |
| 53 | 36 | 23 |
| 54 | 37 | 23 |
| 55 | 38 | 23 |
| 56 | 38 | 24 |
| 57 | 39 | 24 |
| 58 | 40 | 25 |
| 59 | 40 | 25 |
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| Alt. | ☉ | * |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (48° and 49°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 48° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 35 16 | 22 8 | 35 56 | 22 33 | 36 37 | 22 59 | 37 17 | 23 25 | 37 57 | 23 51 | 38 37 | 24 17 | 39 17 | 24 43 | 39 57 | 25 9 |
| 2 | 35 15 | 22 8 | 35 55 | 22 34 | 36 35 | 23 0 | 37 15 | 23 26 | 37 56 | 23 52 | 38 36 | 24 18 | 39 16 | 24 44 | 39 56 | 25 10 |
| 4 | 35 13 | 22 9 | 35 54 | 22 35 | 36 34 | 23 1 | 37 14 | 23 27 | 37 54 | 23 53 | 38 34 | 24 19 | 39 14 | 24 45 | 39 54 | 25 11 |
| 6 | 35 12 | 22 10 | 35 52 | 22 36 | 36 32 | 23 2 | 37 12 | 23 28 | 37 53 | 23 54 | 38 33 | 24 19 | 39 13 | 24 45 | 39 53 | 25 11 |
| 8 | 35 11 | 22 10 | 35 51 | 22 36 | 36 31 | 23 2 | 37 11 | 23 28 | 37 51 | 23 54 | 38 31 | 24 20 | 39 11 | 24 46 | 39 51 | 25 12 |
| 10 | 35 9 | 22 11 | 35 49 | 22 37 | 36 30 | 23 3 | 37 10 | 23 29 | 37 50 | 23 55 | 38 30 | 24 21 | 39 10 | 24 47 | 39 50 | 25 13 |
| 12 | 35 8 | 22 12 | 35 48 | 22 38 | 36 28 | 23 4 | 37 8 | 23 30 | 37 48 | 23 56 | 38 28 | 24 22 | 39 8 | 24 48 | 39 48 | 25 14 |
| 14 | 35 7 | 22 13 | 35 47 | 22 39 | 36 27 | 23 5 | 37 7 | 23 31 | 37 47 | 23 57 | 38 27 | 24 23 | 39 7 | 24 49 | 39 47 | 25 15 |
| 16 | 35 5 | 22 13 | 35 45 | 22 39 | 36 25 | 23 5 | 37 5 | 23 31 | 37 45 | 23 57 | 38 25 | 24 23 | 39 5 | 24 50 | 39 45 | 25 16 |
| 18 | 35 4 | 22 14 | 35 44 | 22 40 | 36 24 | 23 6 | 37 4 | 23 32 | 37 44 | 23 58 | 38 24 | 24 24 | 39 4 | 24 50 | 39 44 | 25 16 |
| 20 | 35 3 | 22 15 | 35 43 | 22 41 | 36 22 | 23 7 | 37 2 | 23 33 | 37 42 | 23 59 | 38 22 | 24 25 | 39 2 | 24 51 | 39 42 | 25 17 |
| 22 | 35 1 | 22 15 | 35 41 | 22 42 | 36 21 | 23 8 | 37 1 | 23 34 | 37 41 | 24 0 | 38 21 | 24 26 | 39 0 | 24 52 | 39 40 | 25 18 |
| 24 | 35 0 | 22 16 | 35 40 | 22 42 | 36 20 | 23 8 | 37 0 | 23 34 | 37 39 | 24 0 | 38 19 | 24 27 | 38 59 | 24 53 | 39 39 | 25 19 |
| 26 | 34 59 | 22 17 | 35 38 | 22 43 | 36 18 | 23 9 | 36 58 | 23 35 | 37 38 | 24 1 | 38 18 | 24 27 | 38 58 | 24 54 | 39 37 | 25 20 |
| 28 | 34 57 | 22 17 | 35 37 | 22 44 | 36 17 | 23 10 | 36 57 | 23 36 | 37 36 | 24 2 | 38 16 | 24 28 | 38 56 | 24 54 | 39 36 | 25 20 |
| 30 | 34 56 | 22 18 | 35 36 | 22 44 | 36 15 | 23 10 | 36 55 | 23 37 | 37 35 | 24 3 | 38 15 | 24 29 | 38 55 | 24 55 | 39 34 | 25 21 |
| 32 | 34 55 | 22 19 | 35 34 | 22 45 | 36 14 | 23 11 | 36 54 | 23 37 | 37 34 | 24 3 | 38 13 | 24 30 | 38 53 | 24 56 | 39 33 | 25 22 |
| 34 | 34 53 | 22 20 | 35 33 | 22 46 | 36 13 | 23 12 | 36 52 | 23 38 | 37 32 | 24 4 | 38 12 | 24 30 | 38 52 | 24 57 | 39 31 | 25 23 |
| 36 | 34 52 | 22 20 | 35 32 | 22 46 | 36 11 | 23 13 | 36 51 | 23 39 | 37 31 | 24 5 | 38 10 | 24 31 | 38 50 | 24 57 | 39 30 | 25 24 |
| 38 | 34 51 | 22 21 | 35 30 | 22 47 | 36 10 | 23 13 | 36 50 | 23 40 | 37 29 | 24 6 | 38 9 | 24 32 | 38 49 | 24 58 | 39 28 | 25 24 |
| 40 | 34 49 | 22 22 | 35 29 | 22 48 | 36 8 | 23 14 | 36 48 | 23 40 | 37 28 | 24 6 | 38 7 | 24 33 | 38 47 | 24 59 | 39 27 | 25 25 |
| 42 | 34 48 | 22 22 | 35 27 | 22 49 | 36 7 | 23 15 | 36 47 | 23 41 | 37 26 | 24 7 | 38 6 | 24 33 | 38 46 | 25 0 | 39 25 | 25 26 |
| 44 | 34 46 | 22 23 | 35 26 | 22 49 | 36 6 | 23 16 | 36 45 | 23 42 | 37 25 | 24 8 | 38 4 | 24 34 | 38 44 | 25 0 | 39 23 | 25 27 |
| 46 | 34 45 | 22 24 | 35 25 | 22 50 | 36 4 | 23 16 | 36 44 | 23 43 | 37 23 | 24 9 | 38 3 | 24 35 | 38 43 | 25 1 | 39 21 | 25 27 |
| 48 | 34 44 | 22 25 | 35 23 | 22 51 | 36 3 | 23 17 | 36 42 | 23 43 | 37 22 | 24 10 | 38 2 | 24 36 | 38 41 | 25 2 | 39 20 | 25 28 |
| 50 | 34 42 | 22 25 | 35 22 | 22 51 | 36 1 | 23 18 | 36 41 | 23 44 | 37 21 | 24 10 | 38 0 | 24 37 | 38 40 | 25 3 | 39 19 | 25 29 |
| 52 | 34 41 | 22 26 | 35 21 | 22 52 | 36 0 | 23 19 | 36 40 | 23 45 | 37 19 | 24 11 | 37 59 | 24 37 | 38 38 | 25 4 | 39 17 | 25 30 |
| 54 | 34 40 | 22 27 | 35 19 | 22 53 | 35 59 | 23 19 | 36 38 | 23 46 | 37 18 | 24 12 | 37 57 | 24 38 | 38 37 | 25 4 | 39 16 | 25 31 |
| 56 | 34 38 | 22 27 | 35 18 | 22 54 | 35 57 | 23 20 | 36 37 | 23 46 | 37 16 | 24 13 | 37 56 | 24 39 | 38 35 | 25 5 | 39 14 | 25 31 |
| 58 | 34 37 | 22 28 | 35 16 | 22 55 | 35 56 | 23 21 | 36 35 | 23 47 | 37 15 | 24 13 | 37 54 | 24 40 | 38 34 | 25 6 | 39 13 | 25 32 |

| 49° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 34 36 | 22 29 | 35 15 | 22 55 | 35 54 | 23 21 | 36 34 | 23 48 | 37 13 | 24 14 | 37 53 | 24 40 | 38 32 | 25 7 | 39 11 | 25 33 |
| 2 | 34 34 | 22 29 | 35 14 | 22 56 | 35 53 | 23 22 | 36 32 | 23 49 | 37 12 | 24 15 | 37 51 | 24 41 | 38 31 | 25 8 | 39 10 | 25 34 |
| 4 | 34 33 | 22 30 | 35 12 | 22 57 | 35 52 | 23 23 | 36 31 | 23 49 | 37 10 | 24 16 | 37 50 | 24 42 | 38 29 | 25 8 | 39 8 | 25 35 |
| 6 | 34 32 | 22 31 | 35 11 | 22 57 | 35 50 | 23 24 | 36 30 | 23 50 | 37 9 | 24 16 | 37 48 | 24 43 | 38 27 | 25 9 | 39 7 | 25 35 |
| 8 | 34 30 | 22 32 | 35 9 | 22 58 | 35 49 | 23 24 | 36 28 | 23 51 | 37 7 | 24 17 | 37 47 | 24 43 | 38 26 | 25 10 | 39 5 | 25 36 |
| 10 | 34 29 | 22 32 | 35 8 | 22 59 | 35 47 | 23 25 | 36 27 | 23 51 | 37 6 | 24 18 | 37 45 | 24 44 | 38 24 | 25 11 | 39 4 | 25 37 |
| 12 | 34 27 | 22 33 | 35 7 | 22 59 | 35 46 | 23 26 | 36 25 | 23 52 | 37 4 | 24 19 | 37 44 | 24 45 | 38 23 | 25 11 | 39 2 | 25 38 |
| 14 | 34 26 | 22 34 | 35 5 | 23 0 | 35 44 | 23 27 | 36 24 | 23 53 | 37 3 | 24 19 | 37 42 | 24 46 | 38 21 | 25 12 | 39 0 | 25 39 |
| 16 | 34 25 | 22 34 | 35 4 | 23 1 | 35 43 | 23 27 | 36 22 | 23 54 | 37 1 | 24 20 | 37 41 | 24 46 | 38 20 | 25 13 | 38 59 | 25 39 |
| 18 | 34 23 | 22 35 | 35 2 | 23 1 | 35 42 | 23 28 | 36 21 | 23 54 | 37 0 | 24 21 | 37 39 | 24 47 | 38 18 | 25 14 | 38 57 | 25 40 |
| 20 | 34 22 | 22 36 | 35 1 | 23 2 | 35 40 | 23 29 | 36 19 | 23 55 | 36 58 | 24 22 | 37 37 | 24 48 | 38 17 | 25 14 | 38 56 | 25 41 |
| 22 | 34 21 | 22 36 | 35 0 | 23 3 | 35 39 | 23 29 | 36 18 | 23 56 | 36 57 | 24 22 | 37 36 | 24 49 | 38 15 | 25 15 | 38 54 | 25 42 |
| 24 | 34 19 | 22 37 | 34 58 | 23 4 | 35 37 | 23 30 | 36 16 | 23 57 | 36 55 | 24 23 | 37 34 | 24 50 | 38 14 | 25 16 | 38 53 | 25 42 |
| 26 | 34 18 | 22 38 | 34 57 | 23 4 | 35 36 | 23 31 | 36 15 | 23 57 | 36 54 | 24 24 | 37 33 | 24 50 | 38 12 | 25 17 | 38 51 | 25 43 |
| 28 | 34 16 | 22 39 | 34 55 | 23 5 | 35 34 | 23 32 | 36 13 | 23 58 | 36 52 | 24 25 | 37 31 | 24 51 | 38 10 | 25 18 | 38 50 | 25 44 |
| 30 | 34 15 | 22 39 | 34 54 | 23 6 | 35 33 | 23 32 | 36 12 | 23 59 | 36 51 | 24 25 | 37 30 | 24 52 | 38 9 | 25 18 | 38 48 | 25 45 |
| 32 | 34 14 | 22 40 | 34 53 | 23 7 | 35 32 | 23 33 | 36 11 | 24 0 | 36 49 | 24 26 | 37 28 | 24 53 | 38 7 | 25 19 | 38 46 | 25 46 |
| 34 | 34 12 | 22 41 | 34 51 | 23 7 | 35 30 | 23 34 | 36 9 | 24 0 | 36 48 | 24 27 | 37 27 | 24 53 | 38 6 | 25 20 | 38 45 | 25 46 |
| 36 | 34 11 | 22 41 | 34 50 | 23 8 | 35 29 | 23 34 | 36 8 | 24 1 | 36 46 | 24 28 | 37 25 | 24 54 | 38 4 | 25 21 | 38 43 | 25 47 |
| 38 | 34 9 | 22 42 | 34 48 | 23 9 | 35 27 | 23 35 | 36 6 | 24 2 | 36 45 | 24 28 | 37 24 | 24 55 | 38 3 | 25 21 | 38 42 | 25 48 |
| 40 | 34 8 | 22 43 | 34 47 | 23 9 | 35 26 | 23 36 | 36 4 | 24 2 | 36 43 | 24 29 | 37 22 | 24 56 | 38 1 | 25 22 | 38 40 | 25 49 |
| 42 | 34 7 | 22 43 | 34 46 | 23 10 | 35 24 | 23 37 | 36 3 | 24 3 | 36 42 | 24 30 | 37 21 | 24 56 | 38 0 | 25 23 | 38 39 | 25 50 |
| 44 | 34 5 | 22 44 | 34 44 | 23 11 | 35 23 | 23 37 | 36 2 | 24 4 | 36 41 | 24 31 | 37 19 | 24 57 | 37 58 | 25 24 | 38 37 | 25 50 |
| 46 | 34 4 | 22 45 | 34 43 | 23 12 | 35 22 | 23 38 | 36 0 | 24 5 | 36 39 | 24 31 | 37 18 | 24 58 | 37 57 | 25 25 | 38 35 | 25 51 |
| 48 | 34 3 | 22 46 | 34 41 | 23 12 | 35 20 | 23 39 | 35 59 | 24 5 | 36 38 | 24 32 | 37 16 | 24 59 | 37 55 | 25 25 | 38 34 | 25 52 |
| 50 | 34 1 | 22 46 | 34 40 | 23 13 | 35 19 | 23 40 | 35 57 | 24 6 | 36 36 | 24 33 | 37 15 | 24 59 | 37 54 | 25 26 | 38 32 | 25 53 |
| 52 | 34 0 | 22 47 | 34 39 | 23 14 | 35 17 | 23 40 | 35 56 | 24 7 | 36 35 | 24 34 | 37 13 | 25 0 | 37 52 | 25 27 | 38 31 | 25 53 |
| 54 | 33 59 | 22 48 | 34 37 | 23 14 | 35 16 | 23 41 | 35 55 | 24 8 | 36 33 | 24 34 | 37 12 | 25 1 | 37 50 | 25 28 | 38 29 | 25 54 |
| 56 | 33 57 | 22 48 | 34 36 | 23 15 | 35 14 | 23 42 | 35 53 | 24 8 | 36 32 | 24 35 | 37 10 | 25 2 | 37 49 | 25 28 | 38 28 | 25 55 |
| 58 | 33 56 | 22 49 | 34 34 | 23 16 | 35 13 | 23 42 | 35 52 | 24 9 | 36 30 | 24 36 | 37 9 | 25 2 | 37 47 | 25 29 | 38 26 | 25 56 |

| Seconds of H. P. | Corr. | A |
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| 1 | 1 | 0 |
| 2 | 1 | 1 |
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| 10 | 7 | 4 |
| 11 | 7 | 5 |
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| 14 | 9 | 6 |
| 15 | 10 | 7 |
| 16 | 11 | 7 |
| 17 | 11 | 8 |
| 18 | 12 | 8 |
| 19 | 13 | 8 |
| 20 | 13 | 9 |
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| 24 | 16 | 11 |
| 25 | 16 | 11 |
| 26 | 17 | 11 |
| 27 | 18 | 12 |
| 28 | 18 | 12 |
| 29 | 19 | 13 |
| 30 | 20 | 13 |
| 31 | 20 | 14 |
| 32 | 21 | 14 |
| 33 | 22 | 15 |
| 34 | 22 | 15 |
| 35 | 23 | 15 |
| 36 | 24 | 16 |
| 37 | 24 | 16 |
| 38 | 25 | 17 |
| 39 | 26 | 17 |
| 40 | 26 | 18 |
| 41 | 27 | 18 |
| 42 | 28 | 19 |
| 43 | 28 | 19 |
| 44 | 29 | 19 |
| 45 | 30 | 20 |
| 46 | 30 | 20 |
| 47 | 31 | 21 |
| 48 | 32 | 21 |
| 49 | 32 | 22 |
| 50 | 33 | 22 |
| 51 | 34 | 23 |
| 52 | 34 | 23 |
| 53 | 35 | 23 |
| 54 | 36 | 24 |
| 55 | 36 | 24 |
| 56 | 37 | 25 |
| 57 | 38 | 25 |
| 58 | 38 | 26 |
| 59 | 39 | 26 |
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| 0 | 0 | 0 |
| 1 | 0 | 0 |
| 2 | 1 | 0 |
| 3 | 1 | 1 |
| 4 | 1 | 1 |
| 5 | 2 | 1 |
| 6 | 2 | 1 |
| 7 | 2 | 1 |
| 8 | 2 | 1 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (50° and 51°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 33 34 | 22 50 | 34 33 | 23 16 | 35 12 | 23 43 | 35 50 | 24 10 | 36 29 | 24 36 | 37 7 | 25 3 | 37 46 | 25 30 | 38 24 | 25 57 |
| 2 | 33 53 | 22 50 | 34 32 | 23 17 | 35 10 | 23 44 | 35 49 | 24 11 | 36 27 | 24 37 | 37 6 | 25 4 | 37 44 | 25 31 | 38 23 | 25 57 |
| 4 | 33 52 | 22 51 | 34 30 | 23 18 | 35 9 | 23 45 | 35 47 | 24 11 | 36 26 | 24 38 | 37 4 | 25 5 | 37 43 | 25 31 | 38 21 | 25 58 |
| 6 | 33 50 | 22 52 | 34 29 | 23 19 | 35 7 | 23 45 | 35 46 | 24 12 | 36 24 | 24 39 | 37 3 | 25 5 | 37 41 | 25 32 | 38 20 | 25 59 |
| 8 | 33 49 | 22 53 | 34 27 | 23 19 | 35 6 | 23 46 | 35 44 | 24 13 | 36 23 | 24 39 | 37 1 | 25 6 | 37 40 | 25 33 | 38 18 | 26 0 |
| 10 | 33 47 | 22 53 | 34 26 | 23 20 | 35 4 | 23 47 | 35 43 | 24 13 | 36 21 | 24 40 | 37 0 | 25 7 | 37 38 | 25 34 | 38 17 | 26 0 |
| 12 | 33 46 | 22 54 | 34 24 | 23 21 | 35 3 | 23 47 | 35 41 | 24 14 | 36 20 | 24 41 | 36 58 | 25 8 | 37 36 | 25 34 | 38 15 | 26 1 |
| 14 | 33 45 | 22 55 | 34 23 | 23 21 | 35 1 | 23 48 | 35 40 | 24 15 | 36 18 | 24 42 | 36 57 | 25 8 | 37 35 | 25 35 | 38 13 | 26 2 |
| 16 | 33 43 | 22 55 | 34 22 | 23 22 | 35 0 | 23 49 | 35 38 | 24 16 | 36 17 | 24 42 | 36 55 | 25 9 | 37 33 | 25 36 | 38 12 | 26 3 |
| 18 | 33 42 | 22 56 | 34 20 | 23 23 | 34 58 | 23 49 | 35 37 | 24 16 | 36 15 | 24 43 | 36 53 | 25 10 | 37 32 | 25 37 | 38 10 | 26 4 |
| 20 | 33 40 | 22 57 | 34 19 | 23 23 | 34 57 | 23 50 | 35 35 | 24 17 | 36 14 | 24 44 | 36 52 | 25 11 | 37 30 | 25 37 | 38 9 | 26 4 |
| 22 | 33 39 | 22 57 | 34 17 | 23 24 | 34 56 | 23 51 | 35 34 | 24 18 | 36 12 | 24 45 | 36 50 | 25 11 | 37 29 | 25 38 | 38 7 | 26 5 |
| 24 | 33 38 | 22 58 | 34 16 | 23 25 | 34 54 | 23 52 | 35 32 | 24 18 | 36 11 | 24 45 | 36 49 | 25 12 | 37 27 | 25 39 | 38 5 | 26 6 |
| 26 | 33 36 | 22 59 | 34 14 | 23 25 | 34 53 | 23 52 | 35 31 | 24 19 | 36 9 | 24 46 | 36 47 | 25 13 | 37 26 | 25 40 | 38 4 | 26 7 |
| 28 | 33 35 | 22 59 | 34 13 | 23 26 | 34 51 | 23 53 | 35 29 | 24 20 | 36 8 | 24 47 | 36 46 | 25 14 | 37 24 | 25 40 | 38 2 | 26 7 |
| 30 | 33 33 | 23 0 | 34 12 | 23 27 | 34 50 | 23 54 | 35 28 | 24 21 | 36 6 | 24 47 | 36 44 | 25 14 | 37 22 | 25 41 | 38 1 | 26 8 |
| 32 | 33 32 | 23 1 | 34 10 | 23 28 | 34 48 | 23 54 | 35 26 | 24 21 | 36 5 | 24 48 | 36 43 | 25 15 | 37 21 | 25 42 | 37 59 | 26 9 |
| 34 | 33 31 | 23 1 | 34 9 | 23 28 | 34 47 | 23 55 | 35 25 | 24 22 | 36 3 | 24 49 | 36 41 | 25 16 | 37 19 | 25 43 | 37 58 | 26 10 |
| 36 | 33 29 | 23 2 | 34 7 | 23 29 | 34 45 | 23 56 | 35 24 | 24 23 | 36 2 | 24 50 | 36 40 | 25 17 | 37 18 | 25 43 | 37 56 | 26 10 |
| 38 | 33 28 | 23 3 | 34 6 | 23 30 | 34 44 | 23 57 | 35 22 | 24 23 | 36 0 | 24 50 | 36 38 | 25 17 | 37 16 | 25 44 | 37 54 | 26 11 |
| 40 | 33 26 | 23 3 | 34 4 | 23 30 | 34 43 | 23 57 | 35 21 | 24 24 | 35 59 | 24 51 | 36 37 | 25 18 | 37 15 | 25 45 | 37 53 | 26 12 |
| 42 | 33 25 | 23 4 | 34 3 | 23 31 | 34 41 | 23 58 | 35 19 | 24 25 | 35 57 | 24 52 | 36 35 | 25 19 | 37 13 | 25 46 | 37 51 | 26 13 |
| 44 | 33 24 | 23 5 | 34 2 | 23 32 | 34 40 | 23 59 | 35 18 | 24 26 | 35 56 | 24 53 | 36 34 | 25 19 | 37 12 | 25 46 | 37 50 | 26 13 |
| 46 | 33 22 | 23 6 | 34 0 | 23 32 | 34 38 | 23 59 | 35 16 | 24 26 | 35 54 | 24 53 | 36 32 | 25 20 | 37 10 | 25 47 | 37 48 | 26 14 |
| 48 | 33 21 | 23 6 | 33 59 | 23 33 | 34 37 | 24 0 | 35 15 | 24 27 | 35 53 | 24 54 | 36 31 | 25 21 | 37 9 | 25 48 | 37 46 | 26 15 |
| 50 | 33 19 | 23 7 | 33 57 | 23 34 | 34 35 | 24 1 | 35 13 | 24 28 | 35 51 | 24 55 | 36 29 | 25 22 | 37 7 | 25 49 | 37 45 | 26 16 |
| 52 | 33 18 | 23 8 | 33 56 | 23 35 | 34 34 | 24 2 | 35 12 | 24 29 | 35 50 | 24 56 | 36 28 | 25 22 | 37 5 | 25 50 | 37 43 | 26 17 |
| 54 | 33 17 | 23 8 | 33 55 | 23 35 | 34 32 | 24 2 | 35 10 | 24 29 | 35 48 | 24 56 | 36 26 | 25 23 | 37 4 | 25 50 | 37 42 | 26 17 |
| 56 | 33 15 | 23 9 | 33 53 | 23 36 | 34 31 | 24 3 | 35 9 | 24 30 | 35 47 | 24 57 | 36 24 | 25 24 | 37 2 | 25 51 | 37 40 | 26 18 |
| 58 | 33 14 | 23 10 | 33 52 | 23 37 | 34 29 | 24 4 | 35 7 | 24 31 | 35 45 | 24 58 | 36 23 | 25 25 | 37 1 | 25 52 | 37 38 | 26 19 |
| 51° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 33 12 | 23 10 | 33 50 | 23 37 | 34 28 | 24 4 | 35 6 | 24 31 | 35 44 | 24 58 | 36 21 | 25 25 | 36 59 | 25 53 | 37 37 | 26 20 |
| 2 | 33 11 | 23 11 | 33 49 | 23 38 | 34 27 | 24 5 | 35 4 | 24 32 | 35 42 | 24 59 | 36 20 | 25 26 | 36 58 | 25 53 | 37 35 | 26 20 |
| 4 | 33 10 | 23 12 | 33 47 | 23 39 | 34 25 | 24 6 | 35 3 | 24 33 | 35 41 | 25 0 | 36 18 | 25 27 | 36 56 | 25 54 | 37 34 | 26 21 |
| 6 | 33 8 | 23 12 | 33 46 | 23 39 | 34 24 | 24 6 | 35 1 | 24 34 | 35 39 | 25 1 | 36 17 | 25 28 | 36 54 | 25 55 | 37 32 | 26 22 |
| 8 | 33 7 | 23 13 | 33 44 | 23 40 | 34 22 | 24 7 | 35 0 | 24 34 | 35 37 | 25 1 | 36 15 | 25 28 | 36 53 | 25 56 | 37 30 | 26 23 |
| 10 | 33 5 | 23 14 | 33 43 | 23 41 | 34 21 | 24 8 | 34 58 | 24 35 | 35 36 | 25 2 | 36 14 | 25 29 | 36 51 | 25 56 | 37 29 | 26 23 |
| 12 | 33 4 | 23 14 | 33 42 | 23 41 | 34 19 | 24 9 | 34 57 | 24 36 | 35 34 | 25 3 | 36 12 | 25 30 | 36 50 | 25 57 | 37 27 | 26 24 |
| 14 | 33 3 | 23 15 | 33 40 | 23 42 | 34 18 | 24 9 | 34 55 | 24 36 | 35 33 | 25 4 | 36 10 | 25 31 | 36 48 | 25 58 | 37 26 | 26 25 |
| 16 | 33 1 | 23 16 | 33 39 | 23 43 | 34 16 | 24 10 | 34 54 | 24 37 | 35 31 | 25 4 | 36 9 | 25 31 | 36 46 | 25 59 | 37 24 | 26 26 |
| 18 | 33 0 | 23 16 | 33 37 | 23 44 | 34 15 | 24 11 | 34 52 | 24 38 | 35 30 | 25 5 | 36 7 | 25 32 | 36 45 | 25 59 | 37 22 | 26 26 |
| 20 | 32 58 | 23 17 | 33 36 | 23 44 | 34 13 | 24 11 | 34 51 | 24 38 | 35 28 | 25 6 | 36 6 | 25 33 | 36 43 | 26 0 | 37 21 | 26 27 |
| 22 | 32 57 | 23 18 | 33 34 | 23 45 | 34 12 | 24 12 | 34 49 | 24 39 | 35 27 | 25 6 | 36 4 | 25 34 | 36 42 | 26 1 | 37 19 | 26 28 |
| 24 | 32 55 | 23 18 | 33 33 | 23 46 | 34 10 | 24 13 | 34 48 | 24 40 | 35 25 | 25 7 | 36 3 | 25 34 | 36 40 | 26 1 | 37 18 | 26 29 |
| 26 | 32 54 | 23 19 | 33 31 | 23 46 | 34 9 | 24 13 | 34 46 | 24 41 | 35 24 | 25 8 | 36 1 | 25 35 | 36 39 | 26 2 | 37 16 | 26 29 |
| 28 | 32 53 | 23 20 | 33 30 | 23 47 | 34 7 | 24 14 | 34 45 | 24 41 | 35 22 | 25 9 | 36 0 | 25 36 | 36 37 | 26 3 | 37 14 | 26 30 |
| 30 | 32 51 | 23 20 | 33 29 | 25 48 | 34 6 | 24 15 | 34 43 | 24 42 | 35 21 | 25 9 | 35 58 | 25 36 | 36 35 | 26 4 | 37 13 | 26 31 |
| 32 | 32 50 | 23 21 | 33 27 | 23 48 | 34 4 | 24 15 | 34 42 | 24 43 | 35 19 | 25 10 | 35 56 | 25 37 | 36 34 | 26 4 | 37 11 | 26 32 |
| 34 | 32 48 | 23 22 | 33 26 | 23 49 | 34 3 | 24 16 | 34 40 | 24 43 | 35 18 | 25 11 | 35 55 | 25 38 | 36 32 | 26 5 | 37 10 | 26 32 |
| 36 | 32 47 | 23 22 | 33 24 | 23 50 | 34 2 | 24 17 | 34 39 | 24 44 | 35 16 | 25 11 | 35 53 | 25 39 | 36 31 | 26 6 | 37 8 | 26 33 |
| 38 | 32 46 | 23 23 | 33 23 | 23 50 | 34 0 | 24 18 | 34 37 | 24 45 | 35 15 | 25 12 | 35 52 | 25 39 | 36 29 | 26 7 | 37 6 | 26 34 |
| 40 | 32 44 | 23 24 | 33 21 | 23 51 | 33 59 | 24 18 | 34 36 | 24 45 | 35 13 | 25 13 | 35 50 | 25 40 | 36 27 | 26 7 | 37 5 | 26 35 |
| 42 | 32 43 | 23 24 | 33 20 | 23 52 | 33 57 | 24 19 | 34 34 | 24 46 | 35 11 | 25 14 | 35 49 | 25 41 | 36 26 | 26 8 | 37 3 | 26 35 |
| 44 | 32 41 | 23 25 | 33 18 | 23 52 | 33 56 | 24 20 | 34 33 | 24 47 | 35 10 | 25 14 | 35 47 | 25 42 | 36 24 | 26 9 | 37 1 | 26 36 |
| 46 | 32 40 | 23 26 | 33 17 | 23 53 | 33 54 | 24 20 | 34 31 | 24 48 | 35 8 | 25 15 | 35 46 | 25 42 | 36 23 | 26 10 | 37 0 | 26 37 |
| 48 | 32 38 | 23 26 | 33 16 | 23 54 | 33 53 | 24 21 | 34 30 | 24 48 | 35 7 | 25 16 | 35 44 | 25 43 | 36 21 | 26 10 | 36 58 | 26 38 |
| 50 | 32 37 | 23 27 | 33 14 | 23 54 | 33 51 | 24 22 | 34 28 | 24 49 | 35 5 | 25 16 | 35 42 | 25 44 | 36 20 | 26 11 | 36 57 | 26 38 |
| 52 | 32 36 | 23 28 | 33 13 | 23 55 | 33 50 | 24 22 | 34 27 | 24 50 | 35 4 | 25 17 | 35 41 | 25 44 | 36 18 | 26 12 | 36 55 | 26 39 |
| 54 | 32 34 | 23 29 | 33 11 | 23 56 | 33 48 | 24 23 | 34 25 | 24 50 | 35 2 | 25 18 | 35 39 | 25 45 | 36 16 | 26 13 | 36 53 | 26 40 |
| 56 | 32 33 | 23 29 | 33 10 | 23 56 | 33 47 | 24 24 | 34 24 | 24 51 | 35 1 | 25 19 | 35 38 | 25 46 | 36 15 | 26 13 | 36 52 | 26 41 |
| 58 | 32 31 | 23 30 | 33 8 | 23 57 | 33 45 | 24 24 | 34 22 | 24 52 | 34 59 | 25 19 | 35 36 | 25 47 | 36 13 | 26 14 | 36 50 | 26 42 |

| Seconds of H. P. | Cor | A |
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| 43 | 27 | 19 |
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| 46 | 29 | 21 |
| 47 | 30 | 21 |
| 48 | 30 | 22 |
| 49 | 31 | 22 |
| 50 | 32 | 23 |
| 51 | 32 | 23 |
| 52 | 33 | 23 |
| 53 | 34 | 24 |
| 54 | 34 | 24 |
| 55 | 35 | 25 |
| 56 | 35 | 25 |
| 57 | 36 | 26 |
| 58 | 37 | 26 |
| 59 | 37 | 27 |
| Alt. | ☉ | ✶ |
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| 3 | 8 | 8 |
| 4 | 6 | 5 |
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| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 80 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (52° and 53°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 52° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 32 30 | 23 30 | 33 7 | 23 58 | 33 44 | 24 25 | 34 21 | 24 53 | 34 58 | 25 20 | 35 35 | 25 47 | 36 12 | 26 15 | 36 49 | 26 42 |
| 2 | 32 28 | 23 31 | 33 5 | 23 58 | 33 42 | 24 26 | 34 19 | 24 53 | 34 56 | 25 21 | 35 33 | 25 48 | 36 10 | 26 16 | 36 47 | 26 43 |
| 4 | 32 27 | 23 32 | 33 4 | 23 59 | 33 41 | 24 27 | 34 18 | 24 54 | 34 55 | 25 21 | 35 32 | 25 49 | 36 8 | 26 16 | 36 45 | 26 44 |
| 6 | 32 26 | 23 32 | 33 2 | 24 0 | 33 39 | 24 27 | 34 16 | 24 55 | 34 53 | 25 22 | 35 30 | 25 50 | 36 7 | 26 17 | 36 44 | 26 44 |
| 8 | 32 24 | 23 33 | 33 1 | 24 0 | 33 38 | 24 28 | 34 15 | 24 55 | 34 51 | 25 23 | 35 28 | 25 50 | 36 5 | 26 18 | 36 42 | 26 45 |
| 10 | 32 23 | 23 34 | 33 0 | 24 1 | 33 36 | 24 29 | 34 13 | 24 56 | 34 50 | 25 23 | 35 27 | 25 51 | 36 4 | 26 18 | 36 40 | 26 46 |
| 12 | 32 21 | 23 34 | 32 58 | 24 2 | 33 35 | 24 29 | 34 12 | 24 57 | 34 48 | 25 24 | 35 25 | 25 52 | 36 2 | 26 19 | 36 39 | 26 47 |
| 14 | 32 20 | 23 35 | 32 57 | 24 2 | 33 33 | 24 30 | 34 10 | 24 57 | 34 47 | 25 25 | 35 24 | 25 52 | 36 0 | 26 20 | 36 37 | 26 47 |
| 16 | 32 18 | 23 35 | 32 55 | 24 3 | 33 32 | 24 31 | 34 9 | 24 58 | 34 45 | 25 26 | 35 22 | 25 53 | 35 59 | 26 21 | 36 35 | 26 48 |
| 18 | 32 17 | 23 36 | 32 54 | 24 4 | 33 30 | 24 31 | 34 7 | 24 59 | 34 44 | 25 26 | 35 20 | 25 54 | 35 57 | 26 21 | 36 34 | 26 49 |
| 20 | 32 15 | 23 37 | 32 52 | 24 4 | 33 29 | 24 32 | 34 5 | 24 59 | 34 42 | 25 27 | 35 19 | 25 54 | 35 55 | 26 22 | 36 32 | 26 50 |
| 22 | 32 14 | 23 37 | 32 51 | 24 5 | 33 27 | 24 33 | 34 3 | 25 0 | 34 41 | 25 28 | 35 17 | 25 55 | 35 54 | 26 23 | 36 31 | 26 50 |
| 24 | 32 13 | 23 38 | 32 49 | 24 6 | 33 26 | 24 33 | 34 2 | 25 1 | 34 39 | 25 28 | 35 16 | 25 56 | 35 52 | 26 23 | 36 29 | 26 51 |
| 26 | 32 11 | 23 39 | 32 48 | 24 6 | 33 24 | 24 34 | 34 1 | 25 1 | 34 38 | 25 29 | 35 14 | 25 57 | 35 51 | 26 24 | 36 27 | 26 52 |
| 28 | 32 10 | 23 39 | 32 46 | 24 7 | 33 23 | 24 35 | 33 59 | 25 2 | 34 36 | 25 30 | 35 13 | 25 57 | 35 49 | 26 25 | 36 26 | 26 53 |
| 30 | 32 8 | 23 40 | 32 45 | 24 8 | 33 21 | 24 35 | 33 58 | 25 3 | 34 34 | 25 30 | 35 11 | 25 58 | 35 47 | 26 26 | 36 24 | 26 53 |
| 32 | 32 7 | 23 41 | 32 43 | 24 8 | 33 20 | 24 36 | 33 56 | 25 4 | 34 33 | 25 31 | 35 9 | 25 59 | 35 46 | 26 26 | 36 22 | 26 54 |
| 34 | 32 5 | 23 41 | 32 42 | 24 9 | 33 18 | 24 37 | 33 55 | 25 4 | 34 31 | 25 32 | 35 8 | 26 0 | 35 44 | 26 27 | 36 21 | 26 55 |
| 36 | 32 4 | 23 42 | 32 40 | 24 10 | 33 17 | 24 37 | 33 53 | 25 5 | 34 30 | 25 33 | 35 6 | 26 0 | 35 43 | 26 28 | 36 19 | 26 56 |
| 38 | 32 3 | 23 43 | 32 39 | 24 10 | 33 15 | 24 38 | 33 52 | 25 6 | 34 28 | 25 33 | 35 5 | 26 1 | 35 41 | 26 29 | 36 18 | 26 56 |
| 40 | 32 1 | 23 43 | 32 37 | 24 11 | 33 14 | 24 39 | 33 50 | 25 6 | 34 27 | 25 34 | 35 3 | 26 2 | 35 39 | 26 29 | 36 16 | 26 57 |
| 42 | 32 0 | 23 44 | 32 36 | 24 12 | 33 12 | 24 39 | 33 49 | 25 7 | 34 25 | 25 35 | 35 2 | 26 2 | 35 38 | 26 30 | 36 14 | 26 58 |
| 44 | 31 58 | 23 45 | 32 35 | 24 12 | 33 11 | 24 40 | 33 47 | 25 8 | 34 24 | 25 35 | 35 0 | 26 3 | 35 36 | 26 31 | 36 13 | 26 58 |
| 46 | 31 57 | 23 45 | 32 33 | 24 13 | 33 9 | 24 41 | 33 46 | 25 8 | 34 22 | 25 36 | 34 58 | 26 4 | 35 35 | 26 31 | 36 11 | 26 59 |
| 48 | 31 55 | 23 46 | 32 32 | 24 14 | 33 8 | 24 41 | 33 44 | 25 9 | 34 20 | 25 37 | 34 57 | 26 4 | 35 33 | 26 32 | 36 9 | 27 0 |
| 50 | 31 54 | 23 47 | 32 30 | 24 14 | 33 6 | 24 42 | 33 43 | 25 10 | 34 19 | 25 37 | 34 55 | 26 5 | 35 31 | 26 33 | 36 8 | 27 1 |
| 52 | 31 52 | 23 47 | 32 29 | 24 15 | 33 5 | 24 43 | 33 41 | 25 10 | 34 17 | 25 38 | 34 54 | 26 6 | 35 30 | 26 34 | 36 6 | 27 1 |
| 54 | 31 51 | 23 48 | 32 27 | 24 16 | 33 3 | 24 43 | 33 40 | 25 11 | 34 16 | 25 39 | 34 52 | 26 7 | 35 28 | 26 34 | 36 4 | 27 2 |
| 56 | 31 50 | 23 49 | 32 26 | 24 16 | 33 2 | 24 44 | 33 38 | 25 12 | 34 14 | 25 40 | 34 50 | 26 7 | 35 27 | 26 35 | 36 3 | 27 3 |
| 58 | 31 48 | 23 49 | 32 24 | 24 17 | 33 0 | 24 45 | 33 37 | 25 13 | 34 13 | 25 40 | 34 49 | 26 8 | 35 25 | 26 36 | 36 1 | 27 4 |
| 53° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 31 47 | 23 50 | 32 23 | 24 18 | 32 59 | 24 45 | 33 35 | 25 13 | 34 11 | 25 41 | 34 47 | 26 9 | 35 23 | 26 36 | 35 59 | 27 4 |
| 2 | 31 45 | 23 51 | 32 21 | 24 18 | 32 57 | 24 46 | 33 33 | 25 14 | 34 10 | 25 42 | 34 46 | 26 9 | 35 22 | 26 37 | 35 58 | 27 5 |
| 4 | 31 44 | 23 51 | 32 20 | 24 19 | 32 56 | 24 47 | 33 32 | 25 15 | 34 8 | 25 42 | 34 44 | 26 10 | 35 20 | 26 38 | 35 56 | 27 6 |
| 6 | 31 42 | 23 52 | 32 18 | 24 20 | 32 54 | 24 47 | 33 30 | 25 15 | 34 6 | 25 43 | 34 42 | 26 11 | 35 18 | 26 39 | 35 55 | 27 6 |
| 8 | 31 41 | 23 52 | 32 17 | 24 20 | 32 53 | 24 48 | 33 29 | 25 16 | 34 5 | 25 44 | 34 41 | 26 11 | 35 17 | 26 39 | 35 53 | 27 7 |
| 10 | 31 39 | 23 53 | 32 15 | 24 21 | 32 51 | 24 49 | 33 27 | 25 17 | 34 3 | 25 44 | 34 39 | 26 12 | 35 15 | 26 40 | 35 51 | 27 8 |
| 12 | 31 38 | 23 54 | 32 14 | 24 22 | 32 50 | 24 49 | 33 26 | 25 17 | 34 2 | 25 45 | 34 38 | 26 13 | 35 14 | 26 41 | 35 50 | 27 9 |
| 14 | 31 36 | 23 54 | 32 12 | 24 22 | 32 48 | 24 50 | 33 24 | 25 18 | 34 0 | 25 46 | 34 36 | 26 14 | 35 12 | 26 41 | 35 48 | 27 9 |
| 16 | 31 35 | 23 55 | 32 11 | 24 23 | 32 47 | 24 51 | 33 23 | 25 19 | 33 59 | 25 46 | 34 34 | 26 14 | 35 10 | 26 42 | 35 46 | 27 10 |
| 18 | 31 34 | 23 56 | 32 9 | 24 24 | 32 45 | 24 51 | 33 21 | 25 19 | 33 57 | 25 47 | 34 33 | 26 15 | 35 9 | 26 43 | 35 45 | 27 11 |
| 20 | 31 32 | 23 56 | 32 8 | 24 24 | 32 44 | 24 52 | 33 20 | 25 20 | 33 55 | 25 48 | 34 31 | 26 16 | 35 7 | 26 44 | 35 43 | 27 11 |
| 22 | 31 31 | 23 57 | 32 6 | 24 25 | 32 42 | 24 53 | 33 18 | 25 21 | 33 54 | 25 48 | 34 30 | 26 16 | 35 5 | 26 44 | 35 41 | 27 12 |
| 24 | 31 29 | 23 58 | 32 5 | 24 25 | 32 41 | 24 53 | 33 16 | 25 21 | 33 52 | 25 49 | 34 28 | 26 17 | 35 4 | 26 45 | 35 40 | 27 13 |
| 26 | 31 28 | 23 58 | 32 3 | 24 26 | 32 39 | 24 54 | 33 15 | 25 22 | 33 51 | 25 50 | 34 26 | 26 18 | 35 2 | 26 46 | 35 38 | 27 14 |
| 28 | 31 26 | 23 59 | 32 2 | 24 27 | 32 38 | 24 55 | 33 13 | 25 23 | 33 49 | 25 51 | 34 25 | 26 18 | 35 1 | 26 46 | 35 36 | 27 14 |
| 30 | 31 25 | 23 59 | 32 0 | 24 27 | 32 36 | 24 55 | 33 12 | 25 23 | 33 47 | 25 51 | 34 23 | 26 19 | 34 59 | 26 47 | 35 35 | 27 15 |
| 32 | 31 23 | 24 0 | 31 59 | 24 28 | 32 35 | 24 56 | 33 10 | 25 24 | 33 46 | 25 52 | 34 22 | 26 20 | 34 57 | 26 48 | 35 33 | 27 16 |
| 34 | 31 22 | 24 1 | 31 57 | 24 29 | 32 33 | 24 57 | 33 9 | 25 25 | 33 44 | 25 53 | 34 20 | 26 21 | 34 56 | 26 48 | 35 31 | 27 16 |
| 36 | 31 20 | 24 1 | 31 56 | 24 30 | 32 32 | 24 57 | 33 7 | 25 25 | 33 43 | 25 53 | 34 18 | 26 21 | 34 54 | 26 49 | 35 30 | 27 17 |
| 38 | 31 19 | 24 2 | 31 54 | 24 30 | 32 30 | 24 58 | 33 6 | 25 26 | 33 41 | 25 54 | 34 17 | 26 22 | 34 52 | 26 50 | 35 28 | 27 18 |
| 40 | 31 17 | 24 3 | 31 53 | 24 31 | 32 28 | 24 59 | 33 4 | 25 27 | 33 40 | 25 55 | 34 15 | 26 23 | 34 51 | 26 51 | 35 26 | 27 19 |
| 42 | 3 16 | 24 3 | 31 51 | 24 31 | 32 27 | 24 59 | 33 3 | 25 27 | 33 38 | 25 55 | 34 14 | 26 23 | 34 49 | 26 51 | 35 25 | 27 19 |
| 44 | 31 14 | 24 4 | 31 50 | 24 32 | 32 25 | 25 0 | 33 1 | 25 28 | 33 36 | 25 56 | 34 12 | 26 24 | 34 47 | 26 52 | 35 23 | 27 20 |
| 46 | 31 13 | 24 5 | 31 48 | 24 33 | 32 24 | 25 1 | 32 59 | 25 29 | 33 35 | 25 57 | 34 10 | 26 25 | 34 46 | 26 53 | 35 21 | 27 21 |
| 48 | 31 12 | 24 5 | 31 47 | 24 33 | 32 22 | 25 1 | 32 58 | 25 29 | 33 33 | 25 57 | 34 9 | 26 25 | 34 44 | 26 53 | 35 20 | 27 21 |
| 50 | 31 10 | 24 6 | 31 45 | 24 34 | 32 21 | 25 2 | 32 56 | 25 30 | 33 32 | 25 58 | 34 7 | 26 26 | 34 43 | 26 54 | 35 18 | 27 22 |
| 52 | 31 9 | 24 6 | 31 44 | 24 35 | 32 19 | 25 3 | 32 55 | 25 31 | 33 30 | 25 59 | 34 6 | 26 27 | 34 41 | 26 55 | 35 16 | 27 23 |
| 54 | 31 7 | 24 7 | 31 43 | 24 35 | 32 18 | 25 3 | 32 53 | 25 31 | 33 29 | 25 59 | 34 4 | 26 27 | 34 39 | 26 56 | 35 15 | 27 24 |
| 56 | 31 6 | 24 8 | 31 41 | 24 36 | 32 16 | 25 4 | 32 52 | 25 32 | 33 27 | 26 0 | 34 2 | 26 28 | 34 38 | 26 56 | 35 13 | 27 24 |
| 58 | 31 4 | 24 8 | 31 40 | 24 37 | 32 15 | 25 5 | 32 50 | 25 33 | 33 25 | 26 1 | 34 1 | 26 29 | 34 36 | 26 57 | 35 11 | 27 25 |

Secs of H. P.

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| 51 | 31 | 24 |
| 52 | 31 | 24 |
| 53 | 32 | 25 |
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| 20 | 3 | 2 |
| 30 | 3 | 2 |
| 40 | 3 | 2 |
| 50 | 4 | 2 |
| 60 | 4 | 2 |
| 70 | 5 | 2 |
| 90 | 5 | 2 |

## (54° and 55°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 31 3 | 24 9 | 31 38 | 24 37 | 32 13 | 25 5 | 32 49 | 25 33 | 33 24 | 26 1 | 33 59 | 26 30 | 34 34 | 26 58 | 35 10 | 27 26 |
| 2 | 31 1 | 24 10 | 31 37 | 24 38 | 32 12 | 25 6 | 32 47 | 25 34 | 33 22 | 26 2 | 33 58 | 26 30 | 34 33 | 26 58 | 35 8 | 27 26 |
| 4 | 31 0 | 24 10 | 31 35 | 24 38 | 32 10 | 25 7 | 32 45 | 25 35 | 33 21 | 26 3 | 33 56 | 26 31 | 34 31 | 26 59 | 35 6 | 27 27 |
| 6 | 30 58 | 24 11 | 31 34 | 24 39 | 32 9 | 25 7 | 32 44 | 25 35 | 33 19 | 26 3 | 33 54 | 26 32 | 34 29 | 27 0 | 35 5 | 27 28 |
| 8 | 30 57 | 24 12 | 31 32 | 24 40 | 32 7 | 25 8 | 32 42 | 25 36 | 33 17 | 26 4 | 33 53 | 26 32 | 34 28 | 27 0 | 35 3 | 27 29 |
| 10 | 30 55 | 24 12 | 31 30 | 24 40 | 32 6 | 25 8 | 32 41 | 25 37 | 35 16 | 26 5 | 33 51 | 26 33 | 34 26 | 27 1 | 35 1 | 27 29 |
| 12 | 30 54 | 24 13 | 31 29 | 24 41 | 32 4 | 25 9 | 32 39 | 25 37 | 33 14 | 26 5 | 33 49 | 26 34 | 34 24 | 27 2 | 35 0 | 27 30 |
| 14 | 30 52 | 24 13 | 31 27 | 24 42 | 32 3 | 25 10 | 32 38 | 25 38 | 33 13 | 26 6 | 33 48 | 26 34 | 34 23 | 27 2 | 34 58 | 27 31 |
| 16 | 30 51 | 24 14 | 31 26 | 24 42 | 32 1 | 25 10 | 32 36 | 25 39 | 33 11 | 26 7 | 33 46 | 26 35 | 34 21 | 27 3 | 34 56 | 27 31 |
| 18 | 30 49 | 24 15 | 31 24 | 24 43 | 31 59 | 25 11 | 32 34 | 25 39 | 33 9 | 26 7 | 33 44 | 26 36 | 34 19 | 27 4 | 34 54 | 27 32 |
| 20 | 30 48 | 24 15 | 31 23 | 24 43 | 31 58 | 25 12 | 32 33 | 25 40 | 33 8 | 26 8 | 33 43 | 26 36 | 34 18 | 27 4 | 34 53 | 27 33 |
| 22 | 30 46 | 24 16 | 31 21 | 24 44 | 31 56 | 25 12 | 32 31 | 25 41 | 33 6 | 26 9 | 33 41 | 26 37 | 34 16 | 27 5 | 34 51 | 27 33 |
| 24 | 30 45 | 24 17 | 31 20 | 24 45 | 31 55 | 25 13 | 32 30 | 25 41 | 33 5 | 26 9 | 33 40 | 26 38 | 34 14 | 27 6 | 34 49 | 27 34 |
| 26 | 30 43 | 24 17 | 31 18 | 24 45 | 31 53 | 25 14 | 32 28 | 25 42 | 33 3 | 26 10 | 33 38 | 26 38 | 34 13 | 27 7 | 34 48 | 27 35 |
| 28 | 30 42 | 24 18 | 31 17 | 24 46 | 31 52 | 25 14 | 32 27 | 25 42 | 33 1 | 26 11 | 33 36 | 26 39 | 34 11 | 27 7 | 34 46 | 27 36 |
| 30 | 30 40 | 24 18 | 31 15 | 24 47 | 31 50 | 25 15 | 32 25 | 25 43 | 33 0 | 26 11 | 33 35 | 26 40 | 34 9 | 27 8 | 34 44 | 27 36 |
| 32 | 30 39 | 24 19 | 31 14 | 24 47 | 31 49 | 25 16 | 32 23 | 25 44 | 32 58 | 26 12 | 33 33 | 26 40 | 34 8 | 27 9 | 34 43 | 27 37 |
| 34 | 30 37 | 24 20 | 31 12 | 24 48 | 31 47 | 25 16 | 32 22 | 25 44 | 32 57 | 26 13 | 33 31 | 26 41 | 34 6 | 27 9 | 34 41 | 27 38 |
| 36 | 30 36 | 24 20 | 31 11 | 24 48 | 31 45 | 25 17 | 32 20 | 25 45 | 32 55 | 26 13 | 33 30 | 26 42 | 34 5 | 27 10 | 34 39 | 27 38 |
| 38 | 30 34 | 24 21 | 31 9 | 24 49 | 31 44 | 25 17 | 32 19 | 25 46 | 32 53 | 26 14 | 33 28 | 26 42 | 34 3 | 27 11 | 34 38 | 27 39 |
| 40 | 30 33 | 24 21 | 31 8 | 24 50 | 31 42 | 25 18 | 32 17 | 25 46 | 32 52 | 26 15 | 33 26 | 26 43 | 34 1 | 27 11 | 34 36 | 27 40 |
| 42 | 30 32 | 24 22 | 31 6 | 24 50 | 31 41 | 25 19 | 32 16 | 25 47 | 32 50 | 26 15 | 33 25 | 26 44 | 34 0 | 27 12 | 34 34 | 27 40 |
| 44 | 30 30 | 24 23 | 31 5 | 24 51 | 31 39 | 25 19 | 32 14 | 25 48 | 32 49 | 26 16 | 33 23 | 26 44 | 33 58 | 27 13 | 34 33 | 27 41 |
| 46 | 30 29 | 24 23 | 31 3 | 24 52 | 31 38 | 25 20 | 32 12 | 25 48 | 32 47 | 26 17 | 33 22 | 26 45 | 33 56 | 27 14 | 34 31 | 27 42 |
| 48 | 30 27 | 24 24 | 31 2 | 24 52 | 31 36 | 25 21 | 32 11 | 25 49 | 32 45 | 26 17 | 33 20 | 26 46 | 33 55 | 27 14 | 34 29 | 27 43 |
| 50 | 30 26 | 24 24 | 31 0 | 24 53 | 31 35 | 25 21 | 32 9 | 25 50 | 32 44 | 26 18 | 33 18 | 26 46 | 33 53 | 27 15 | 34 28 | 27 43 |
| 52 | 30 24 | 24 25 | 30 59 | 24 54 | 31 33 | 25 22 | 32 8 | 25 50 | 32 42 | 26 19 | 33 17 | 26 47 | 33 51 | 27 16 | 34 26 | 27 44 |
| 54 | 30 23 | 24 26 | 30 57 | 24 54 | 31 32 | 25 23 | 32 6 | 25 51 | 32 41 | 26 19 | 33 15 | 26 48 | 33 50 | 27 16 | 34 24 | 27 45 |
| 56 | 30 21 | 24 26 | 30 56 | 24 55 | 31 30 | 25 23 | 32 5 | 25 52 | 32 39 | 26 20 | 33 13 | 26 49 | 33 48 | 27 17 | 34 22 | 27 45 |
| 58 | 30 20 | 24 27 | 30 54 | 24 55 | 31 29 | 25 24 | 32 3 | 25 52 | 32 37 | 26 21 | 33 12 | 26 49 | 33 46 | 27 18 | 34 21 | 27 46 |
| 55° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 30 18 | 24 28 | 30 52 | 24 56 | 31 27 | 25 24 | 32 1 | 25 53 | 32 36 | 26 21 | 33 10 | 26 50 | 33 45 | 27 18 | 34 19 | 27 47 |
| 2 | 30 17 | 24 28 | 30 51 | 24 57 | 31 25 | 25 25 | 32 0 | 25 54 | 32 34 | 26 22 | 33 9 | 26 51 | 33 43 | 27 19 | 34 17 | 27 47 |
| 4 | 30 15 | 24 29 | 30 49 | 24 57 | 31 24 | 25 26 | 31 58 | 25 54 | 32 33 | 26 23 | 33 7 | 26 51 | 33 41 | 27 20 | 34 16 | 27 48 |
| 6 | 30 14 | 24 29 | 30 48 | 24 58 | 31 22 | 25 26 | 31 57 | 25 55 | 32 31 | 26 23 | 33 5 | 26 52 | 33 40 | 27 20 | 34 14 | 27 49 |
| 8 | 30 12 | 24 30 | 30 46 | 24 59 | 31 21 | 25 27 | 31 55 | 25 56 | 32 29 | 26 24 | 33 4 | 26 53 | 33 38 | 27 21 | 34 12 | 27 50 |
| 10 | 30 11 | 24 31 | 30 45 | 24 59 | 31 19 | 25 28 | 31 53 | 25 56 | 32 28 | 26 25 | 33 2 | 26 53 | 33 36 | 27 22 | 34 11 | 27 50 |
| 12 | 30 9 | 24 31 | 30 43 | 25 0 | 31 18 | 25 28 | 31 52 | 25 57 | 32 26 | 26 25 | 33 0 | 26 54 | 33 35 | 27 22 | 34 9 | 27 51 |
| 14 | 30 8 | 24 32 | 30 42 | 25 0 | 31 16 | 25 29 | 31 50 | 25 57 | 32 24 | 26 26 | 32 59 | 26 55 | 33 33 | 27 23 | 34 7 | 27 52 |
| 16 | 30 6 | 24 32 | 30 40 | 25 1 | 31 15 | 25 30 | 31 49 | 25 58 | 32 23 | 26 27 | 32 57 | 26 56 | 33 31 | 27 24 | 34 5 | 27 52 |
| 18 | 30 5 | 24 33 | 30 39 | 25 2 | 31 13 | 25 30 | 31 47 | 25 59 | 32 21 | 26 27 | 32 55 | 26 56 | 33 30 | 27 24 | 34 4 | 27 53 |
| 20 | 30 3 | 24 34 | 30 37 | 25 2 | 31 11 | 25 31 | 31 45 | 25 59 | 32 20 | 26 28 | 32 54 | 26 56 | 33 28 | 27 25 | 34 2 | 27 54 |
| 22 | 30 2 | 24 34 | 30 36 | 25 3 | 31 10 | 25 31 | 31 44 | 26 0 | 32 18 | 26 29 | 32 52 | 26 57 | 33 26 | 27 26 | 34 0 | 27 54 |
| 24 | 30 0 | 24 35 | 30 34 | 25 4 | 31 8 | 25 32 | 31 42 | 26 1 | 32 16 | 26 29 | 32 50 | 26 58 | 33 25 | 27 26 | 33 59 | 27 55 |
| 26 | 29 59 | 24 35 | 30 33 | 25 4 | 31 7 | 25 33 | 31 41 | 26 1 | 32 15 | 26 30 | 32 49 | 26 58 | 33 23 | 27 27 | 33 57 | 27 56 |
| 28 | 29 57 | 24 36 | 30 31 | 25 5 | 31 5 | 25 33 | 31 39 | 26 2 | 32 13 | 26 30 | 32 47 | 26 59 | 33 21 | 27 28 | 33 55 | 27 56 |
| 30 | 29 56 | 24 37 | 30 30 | 25 5 | 31 4 | 25 34 | 31 38 | 26 3 | 32 11 | 26 31 | 32 45 | 27 0 | 33 19 | 27 28 | 33 53 | 27 57 |
| 32 | 29 54 | 24 37 | 30 28 | 25 6 | 31 2 | 25 35 | 31 36 | 26 3 | 32 10 | 26 32 | 32 44 | 27 0 | 33 18 | 27 29 | 33 52 | 27 58 |
| 34 | 29 53 | 24 38 | 30 26 | 25 7 | 31 0 | 25 35 | 31 34 | 26 4 | 32 8 | 26 32 | 32 42 | 27 1 | 33 16 | 27 30 | 33 50 | 27 58 |
| 36 | 29 51 | 24 38 | 30 25 | 25 7 | 30 59 | 25 36 | 31 33 | 26 5 | 32 7 | 26 33 | 32 41 | 27 2 | 33 14 | 27 30 | 33 48 | 27 59 |
| 38 | 29 50 | 24 39 | 30 23 | 25 8 | 30 57 | 25 36 | 31 31 | 26 5 | 32 5 | 26 34 | 32 39 | 27 2 | 33 13 | 27 31 | 33 47 | 28 0 |
| 40 | 29 48 | 24 40 | 30 22 | 25 8 | 30 56 | 25 37 | 31 30 | 26 6 | 32 3 | 26 34 | 32 37 | 27 3 | 33 11 | 27 32 | 33 45 | 28 0 |
| 42 | 29 46 | 24 40 | 30 20 | 25 9 | 30 54 | 25 38 | 31 28 | 26 6 | 32 2 | 26 35 | 32 36 | 27 4 | 33 9 | 27 32 | 33 43 | 28 1 |
| 44 | 29 45 | 24 41 | 30 19 | 25 10 | 30 53 | 25 38 | 31 26 | 26 7 | 32 0 | 26 36 | 32 34 | 27 4 | 33 8 | 27 33 | 33 42 | 28 2 |
| 46 | 29 43 | 24 42 | 30 17 | 25 10 | 30 51 | 25 39 | 31 25 | 26 8 | 31 59 | 26 36 | 32 32 | 27 5 | 33 6 | 27 34 | 33 40 | 28 3 |
| 48 | 29 42 | 24 42 | 30 16 | 25 11 | 30 49 | 25 40 | 31 23 | 26 8 | 31 57 | 26 37 | 32 31 | 27 6 | 33 4 | 27 34 | 33 38 | 28 3 |
| 50 | 29 40 | 24 43 | 30 14 | 25 11 | 30 48 | 25 40 | 31 22 | 26 9 | 31 55 | 26 38 | 32 29 | 27 6 | 33 3 | 27 35 | 33 36 | 28 4 |
| 52 | 29 39 | 24 43 | 30 13 | 25 12 | 30 46 | 25 41 | 31 20 | 26 10 | 31 54 | 26 38 | 32 27 | 27 7 | 33 1 | 27 36 | 33 35 | 28 5 |
| 54 | 29 37 | 24 44 | 30 11 | 25 13 | 30 45 | 25 42 | 31 18 | 26 10 | 31 52 | 26 39 | 32 26 | 27 8 | 32 59 | 27 36 | 33 33 | 28 5 |
| 56 | 29 36 | 24 45 | 30 10 | 25 13 | 30 43 | 25 42 | 31 17 | 26 11 | 31 50 | 26 40 | 32 24 | 27 8 | 32 58 | 27 37 | 33 31 | 28 6 |
| 58 | 29 34 | 24 45 | 30 8 | 25 14 | 30 42 | 25 43 | 31 15 | 26 12 | 31 49 | 26 40 | 32 22 | 27 9 | 32 56 | 27 38 | 33 30 | 28 7 |

| Seconds of H. P. | Corr. | A |
|---|---|---|
| ″ | ″ | ″ |
| 1 | 1 | 0 |
| 2 | 1 | 1 |
| 3 | 2 | 1 |
| 4 | 2 | 2 |
| 5 | 3 | 2 |
| 6 | 3 | 3 |
| 7 | 4 | 3 |
| 8 | 5 | 4 |
| 9 | 5 | 4 |
| 10 | 6 | 5 |
| 11 | 6 | 5 |
| 12 | 7 | 6 |
| 13 | 7 | 6 |
| 14 | 8 | 7 |
| 15 | 9 | 7 |
| 16 | 9 | 8 |
| 17 | 10 | 8 |
| 18 | 10 | 9 |
| 19 | 11 | 9 |
| 20 | 11 | 10 |
| 21 | 12 | 10 |
| 22 | 13 | 10 |
| 23 | 13 | 11 |
| 24 | 14 | 11 |
| 25 | 14 | 12 |
| 26 | 15 | 12 |
| 27 | 16 | 13 |
| 28 | 16 | 13 |
| 29 | 17 | 14 |
| 30 | 17 | 14 |
| 31 | 18 | 15 |
| 32 | 18 | 15 |
| 33 | 19 | 16 |
| 34 | 20 | 16 |
| 35 | 20 | 17 |
| 36 | 21 | 17 |
| 37 | 21 | 18 |
| 38 | 22 | 18 |
| 39 | 22 | 19 |
| 40 | 23 | 19 |
| 41 | 24 | 19 |
| 42 | 24 | 20 |
| 43 | 25 | 20 |
| 44 | 25 | 21 |
| 45 | 26 | 21 |
| 46 | 26 | 22 |
| 47 | 27 | 22 |
| 48 | 28 | 23 |
| 49 | 28 | 23 |
| 50 | 29 | 24 |
| 51 | 29 | 24 |
| 52 | 30 | 25 |
| 53 | 30 | 25 |
| 54 | 31 | 26 |
| 55 | 32 | 26 |
| 56 | 32 | 27 |
| 57 | 33 | 27 |
| 58 | 33 | 28 |
| 59 | 34 | 28 |

| Alt. | ☉ A | ✶ A |
|---|---|---|
| | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (56° and 57°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | Seconds of H. P. | Corr. | A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 56° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr + | A 60° | Corr. + | A 60° | | | |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | | |
| 0′ | 29 33 | 24 46 | 30 7 | 25 15 | 30 40 | 25 43 | 31 14 | 26 12 | 31 47 | 26 41 | 32 21 | 27 10 | 32 54 | 27 38 | 33 28 | 28 7 | 1 | 1 | 0 |
| 2 | 29 31 | 24 46 | 30 5 | 25 15 | 30 39 | 25 44 | 31 12 | 26 13 | 31 46 | 26 42 | 32 19 | 27 10 | 32 53 | 27 39 | 33 26 | 28 8 | 2 | 1 | 1 |
| 4 | 29 30 | 24 47 | 30 3 | 25 16 | 30 37 | 25 45 | 31 10 | 26 13 | 31 44 | 26 42 | 32 17 | 27 11 | 32 51 | 27 40 | 33 24 | 28 9 | 3 | 2 | 2 |
| 6 | 29 28 | 24 48 | 30 2 | 25 16 | 30 35 | 25 45 | 31 9 | 26 14 | 31 42 | 26 43 | 32 16 | 27 12 | 32 49 | 27 40 | 33 23 | 28 9 | 4 | 2 | 2 |
| 8 | 29 27 | 24 48 | 30 0 | 25 17 | 30 34 | 25 46 | 31 7 | 26 15 | 31 41 | 26 43 | 32 14 | 27 12 | 32 48 | 27 41 | 33 21 | 28 10 | 5 | 3 | 3 |
| 10 | 29 25 | 24 49 | 29 59 | 25 18 | 30 32 | 25 46 | 31 6 | 26 15 | 31 39 | 26 44 | 32 12 | 27 13 | 32 46 | 27 42 | 33 19 | 28 11 | 6 | 3 | 3 |
| 12 | 29 24 | 24 49 | 29 57 | 25 18 | 30 31 | 25 47 | 31 4 | 26 16 | 31 37 | 26 45 | 32 11 | 27 14 | 32 44 | 27 42 | 33 18 | 28 11 | 7 | 4 | 4 |
| 14 | 29 22 | 24 50 | 29 56 | 25 19 | 30 29 | 25 48 | 31 2 | 26 17 | 31 36 | 26 45 | 32 9 | 27 14 | 32 42 | 27 43 | 33 16 | 28 12 | 8 | 4 | 4 |
| 16 | 29 21 | 24 51 | 29 54 | 25 19 | 30 27 | 25 48 | 31 1 | 26 17 | 31 34 | 26 46 | 32 7 | 27 15 | 32 41 | 27 44 | 33 14 | 28 13 | 9 | 5 | 5 |
| 18 | 29 19 | 24 51 | 29 53 | 25 20 | 30 26 | 25 49 | 30 59 | 26 18 | 31 33 | 26 47 | 32 6 | 27 16 | 32 39 | 27 44 | 33 12 | 28 13 | 10 | 5 | 5 |
| 20 | 29 18 | 24 52 | 29 51 | 25 21 | 30 24 | 25 49 | 30 58 | 26 18 | 31 31 | 26 47 | 32 4 | 27 16 | 32 37 | 27 45 | 33 11 | 28 14 | 11 | 6 | 6 |
| 22 | 29 16 | 24 52 | 29 50 | 25 21 | 30 23 | 25 50 | 30 56 | 26 19 | 31 29 | 26 48 | 32 2 | 27 17 | 32 36 | 27 46 | 33 9 | 28 15 | 12 | 6 | 6 |
| 24 | 29 15 | 24 53 | 29 48 | 25 22 | 30 21 | 25 51 | 30 54 | 26 20 | 31 28 | 26 49 | 32 0 | 27 17 | 32 34 | 27 46 | 33 7 | 28 15 | 13 | 7 | 7 |
| 26 | 29 13 | 24 53 | 29 46 | 25 22 | 30 20 | 25 51 | 30 53 | 26 20 | 31 26 | 26 49 | 31 59 | 27 18 | 32 32 | 27 47 | 33 6 | 28 16 | 14 | 8 | 7 |
| 28 | 29 12 | 24 54 | 29 45 | 25 23 | 30 18 | 25 52 | 30 51 | 26 21 | 31 24 | 26 50 | 31 57 | 27 19 | 32 31 | 27 48 | 33 4 | 28 17 | 15 | 8 | 8 |
| 30 | 29 10 | 24 55 | 29 43 | 25 24 | 30 16 | 25 53 | 30 50 | 26 22 | 31 23 | 26 50 | 31 56 | 27 19 | 32 29 | 27 48 | 33 2 | 28 17 | 16 | 9 | 9 |
| 32 | 29 9 | 24 55 | 29 42 | 25 24 | 30 15 | 25 53 | 30 48 | 26 22 | 31 21 | 26 51 | 31 54 | 27 20 | 32 27 | 27 49 | 33 0 | 28 18 | 17 | 9 | 9 |
| 34 | 29 7 | 24 56 | 29 40 | 25 25 | 30 13 | 25 54 | 30 46 | 26 23 | 31 19 | 26 52 | 31 52 | 27 21 | 32 25 | 27 50 | 32 59 | 28 19 | 18 | 10 | 10 |
| 36 | 29 6 | 24 56 | 29 39 | 25 25 | 30 12 | 25 54 | 30 45 | 26 23 | 31 18 | 26 52 | 31 51 | 27 21 | 32 24 | 27 50 | 32 57 | 28 19 | 19 | 11 | 10 |
| 38 | 29 4 | 24 57 | 29 37 | 25 26 | 30 10 | 25 55 | 30 43 | 26 24 | 31 16 | 26 53 | 31 49 | 27 22 | 32 22 | 27 51 | 32 55 | 28 20 | 20 | 11 | 11 |
| 40 | 29 2 | 24 58 | 29 35 | 25 27 | 30 8 | 25 56 | 30 41 | 26 25 | 31 14 | 26 54 | 31 47 | 27 23 | 32 20 | 27 52 | 32 53 | 28 21 | 21 | 12 | 12 |
| 42 | 29 1 | 24 58 | 29 34 | 25 27 | 30 7 | 25 56 | 30 40 | 26 25 | 31 13 | 26 54 | 31 46 | 27 23 | 32 19 | 27 52 | 32 52 | 28 21 | 22 | 13 | 12 |
| 44 | 28 59 | 24 59 | 29 32 | 25 28 | 30 5 | 25 57 | 30 38 | 26 26 | 31 11 | 26 55 | 31 44 | 27 24 | 32 17 | 27 53 | 32 50 | 28 22 | 23 | 13 | 13 |
| 46 | 28 58 | 24 59 | 29 31 | 25 28 | 30 4 | 25 58 | 30 37 | 26 27 | 31 10 | 26 56 | 31 42 | 27 25 | 32 15 | 27 54 | 32 48 | 28 23 | 24 | 14 | 14 |
| 48 | 28 56 | 25 0 | 29 29 | 25 29 | 30 2 | 25 58 | 30 35 | 26 27 | 31 8 | 26 56 | 31 41 | 27 25 | 32 14 | 27 54 | 32 47 | 28 23 | 25 | 15 | 14 |
| 50 | 28 55 | 25 1 | 29 28 | 25 30 | 30 1 | 25 59 | 30 33 | 26 28 | 31 6 | 26 57 | 31 39 | 27 26 | 32 12 | 27 55 | 32 45 | 28 24 | 26 | 15 | 15 |
| 52 | 28 53 | 25 1 | 29 26 | 25 30 | 29 59 | 25 59 | 30 32 | 26 28 | 31 5 | 26 57 | 31 37 | 27 27 | 32 10 | 27 56 | 32 43 | 28 25 | 27 | 16 | 16 |
| 54 | 28 52 | 25 2 | 29 25 | 25 31 | 29 57 | 26 0 | 30 30 | 26 29 | 31 3 | 26 58 | 31 36 | 27 27 | 32 9 | 27 56 | 32 41 | 28 25 | 28 | 17 | 16 |
| 56 | 28 50 | 25 2 | 29 23 | 25 31 | 29 56 | 26 1 | 30 29 | 26 30 | 31 1 | 26 59 | 31 34 | 27 28 | 32 7 | 27 57 | 32 40 | 28 26 | 29 | 17 | 17 |
| 58 | 28 49 | 25 3 | 29 22 | 25 32 | 29 54 | 26 1 | 30 27 | 26 30 | 31 0 | 26 59 | 31 32 | 27 28 | 32 5 | 27 58 | 32 38 | 28 27 | 30 | 18 | 17 |
| 57° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 31 | 19 | 18 |
| 0′ | 28 47 | 25 4 | 29 20 | 25 33 | 29 53 | 26 2 | 30 25 | 26 31 | 30 58 | 27 0 | 31 31 | 27 29 | 32 3 | 27 58 | 32 36 | 28 27 | 32 | 19 | 19 |
| 2 | 28 46 | 25 4 | 29 18 | 25 33 | 29 51 | 26 2 | 30 24 | 26 32 | 30 56 | 27 1 | 31 29 | 27 30 | 32 2 | 27 59 | 32 34 | 28 28 | 33 | 20 | 20 |
| 4 | 28 44 | 25 5 | 29 17 | 25 34 | 29 49 | 26 3 | 30 22 | 26 32 | 30 55 | 27 1 | 31 27 | 27 30 | 32 0 | 27 59 | 32 33 | 28 29 | 34 | 21 | 21 |
| 6 | 28 43 | 25 5 | 29 15 | 25 34 | 29 48 | 26 4 | 30 21 | 26 33 | 30 53 | 27 2 | 31 26 | 27 31 | 31 58 | 28 0 | 32 31 | 28 29 | 35 | 22 | 22 |
| 8 | 28 41 | 25 6 | 29 14 | 25 35 | 29 46 | 26 4 | 30 19 | 26 33 | 30 51 | 27 2 | 31 24 | 27 32 | 31 57 | 28 1 | 32 29 | 28 30 | 36 | 23 | 23 |
| 10 | 28 40 | 25 6 | 29 12 | 25 36 | 29 45 | 26 5 | 30 17 | 26 34 | 30 50 | 27 3 | 31 22 | 27 32 | 31 55 | 28 1 | 32 27 | 28 31 | 37 | 24 | 24 |
| 12 | 28 38 | 25 7 | 29 11 | 25 36 | 29 43 | 26 5 | 30 16 | 26 35 | 30 48 | 27 4 | 31 21 | 27 33 | 31 53 | 28 2 | 32 26 | 28 31 | 38 | 25 | 25 |
| 14 | 28 37 | 25 8 | 29 9 | 25 37 | 29 41 | 26 6 | 30 14 | 26 35 | 30 46 | 27 4 | 31 19 | 27 34 | 31 51 | 28 3 | 32 24 | 28 32 | 39 | 26 | 26 |
| 16 | 28 35 | 25 8 | 29 7 | 25 37 | 29 40 | 26 7 | 30 12 | 26 36 | 30 45 | 27 5 | 31 17 | 27 34 | 31 50 | 28 3 | 32 22 | 28 33 | 40 | 27 | 27 |
| 18 | 28 33 | 25 9 | 29 6 | 25 38 | 29 38 | 26 7 | 30 11 | 26 36 | 30 43 | 27 6 | 31 16 | 27 35 | 31 48 | 28 4 | 32 20 | 28 33 | 41 | 28 | 28 |
| 20 | 28 32 | 25 9 | 29 4 | 25 38 | 29 37 | 26 8 | 30 9 | 26 37 | 30 41 | 27 6 | 31 14 | 27 35 | 31 46 | 28 5 | 32 19 | 28 34 | 42 | 29 | 29 |
| 22 | 28 30 | 25 10 | 29 3 | 25 39 | 29 35 | 26 8 | 30 7 | 26 38 | 30 40 | 27 7 | 31 12 | 27 36 | 31 45 | 28 5 | 32 17 | 28 35 | 43 | 30 | 29 |
| 24 | 28 29 | 25 10 | 29 1 | 25 40 | 29 33 | 26 9 | 30 6 | 26 38 | 30 38 | 27 7 | 31 10 | 27 37 | 31 43 | 28 6 | 32 15 | 28 35 | 44 | 31 | 30 |
| 26 | 28 27 | 25 11 | 28 59 | 25 40 | 29 32 | 26 10 | 30 4 | 26 39 | 30 36 | 27 8 | 31 9 | 27 37 | 31 41 | 28 7 | 32 13 | 28 36 | 45 | 32 | 31 |
| 28 | 28 26 | 25 12 | 28 58 | 25 41 | 29 30 | 26 10 | 30 3 | 26 39 | 30 35 | 27 9 | 31 7 | 27 38 | 31 39 | 28 7 | 32 12 | 28 36 | 46 | 33 | 32 |
| 30 | 28 24 | 25 12 | 28 56 | 25 41 | 29 29 | 26 11 | 30 1 | 26 40 | 30 33 | 27 9 | 31 5 | 27 38 | 31 38 | 28 8 | 32 10 | 28 37 | 47 | 34 | 33 |
| 32 | 28 23 | 25 13 | 28 55 | 25 42 | 29 27 | 26 11 | 29 59 | 26 41 | 30 31 | 27 10 | 31 4 | 27 39 | 31 36 | 28 8 | 32 8 | 28 38 | 48 | 35 | 34 |
| 34 | 28 21 | 25 13 | 28 53 | 25 43 | 29 25 | 26 12 | 29 58 | 26 41 | 30 30 | 27 10 | 31 2 | 27 40 | 31 34 | 28 9 | 32 6 | 28 38 | 49 | 36 | 35 |
| 36 | 28 19 | 25 14 | 28 52 | 25 43 | 29 24 | 26 13 | 29 56 | 26 42 | 30 28 | 27 11 | 31 0 | 27 40 | 31 32 | 28 10 | 32 5 | 28 39 | 50 | 37 | 36 |
| 38 | 28 18 | 25 15 | 28 50 | 25 44 | 29 22 | 26 13 | 29 54 | 26 42 | 30 26 | 27 12 | 30 59 | 27 41 | 31 31 | 28 10 | 32 3 | 28 40 | 51 | 38 | 37 |
| 40 | 28 16 | 25 15 | 28 48 | 25 44 | 29 21 | 26 14 | 29 53 | 26 43 | 30 25 | 27 12 | 30 57 | 27 42 | 31 29 | 28 11 | 32 1 | 28 40 | 52 | 39 | 38 |
| 42 | 28 15 | 25 16 | 28 47 | 25 45 | 29 19 | 26 14 | 29 51 | 26 44 | 30 23 | 27 13 | 30 55 | 27 42 | 31 27 | 28 12 | 31 59 | 28 41 | 53 | 40 | 39 |
| 44 | 28 13 | 25 16 | 28 45 | 25 46 | 29 17 | 26 15 | 29 49 | 26 44 | 30 21 | 27 14 | 30 54 | 27 43 | 31 26 | 28 12 | 31 58 | 28 42 | 54 | 41 | 40 |
| 46 | 28 12 | 25 17 | 28 44 | 25 46 | 29 16 | 26 15 | 29 48 | 26 45 | 30 20 | 27 14 | 30 52 | 27 43 | 31 24 | 28 13 | 31 56 | 28 42 | 55 | 42 | 41 |
| 48 | 28 10 | 25 17 | 28 42 | 25 47 | 29 14 | 26 16 | 29 46 | 26 45 | 30 18 | 27 15 | 30 50 | 27 44 | 31 22 | 28 13 | 31 54 | 28 43 | 56 | 43 | 42 |
| 50 | 28 9 | 25 18 | 28 41 | 25 47 | 29 13 | 26 17 | 29 45 | 26 46 | 30 16 | 27 15 | 30 48 | 27 45 | 31 20 | 28 14 | 31 52 | 28 44 | 57 | 44 | 43 |
| 52 | 28 7 | 25 19 | 28 39 | 25 48 | 29 11 | 26 17 | 29 43 | 26 47 | 30 15 | 27 16 | 30 47 | 27 45 | 31 19 | 28 15 | 31 51 | 28 44 | 58 | 45 | 44 |
| 54 | 28 6 | 25 19 | 28 38 | 25 48 | 29 9 | 26 18 | 29 41 | 26 47 | 30 13 | 27 17 | 30 45 | 27 46 | 31 17 | 28 15 | 31 49 | 28 45 | 59 | 46 | 45 |
| 56 | 28 4 | 25 20 | 28 36 | 25 49 | 29 8 | 26 18 | 29 40 | 26 48 | 30 12 | 27 17 | 30 43 | 27 47 | 31 15 | 28 16 | 31 47 | 28 45 | 60 | 47 | 46 |
| 58 | 28 3 | 25 20 | 28 34 | 25 50 | 29 6 | 26 19 | 29 38 | 26 48 | 30 10 | 27 18 | 30 42 | 27 47 | 31 14 | 28 17 | 31 45 | 28 46 | 90 | 71 | 70 |

## (58° and 59°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 28 1 | 25 21 | 28 33 | 25 50 | 29 5 | 26 20 | 29 36 | 26 49 | 30 8 | 27 18 | 30 40 | 27 48 | 31 12 | 28 17 | 31 44 | 28 47 |
| 2 | 27 59 | 25 21 | 28 31 | 25 51 | 29 3 | 26 20 | 29 35 | 26 50 | 30 7 | 27 19 | 30 38 | 27 49 | 31 10 | 28 18 | 31 42 | 28 47 |
| 4 | 27 58 | 25 22 | 28 30 | 25 51 | 29 1 | 26 21 | 29 33 | 26 50 | 30 5 | 27 20 | 30 37 | 27 49 | 31 8 | 28 19 | 31 40 | 28 48 |
| 6 | 27 56 | 25 22 | 28 28 | 25 52 | 29 0 | 26 21 | 29 31 | 26 51 | 30 3 | 27 20 | 30 35 | 27 50 | 31 7 | 28 19 | 31 38 | 28 49 |
| 8 | 27 55 | 25 23 | 28 26 | 25 52 | 28 58 | 26 22 | 29 30 | 26 51 | 30 1 | 27 21 | 30 33 | 27 50 | 31 5 | 28 20 | 31 37 | 28 49 |
| 10 | 27 53 | 25 24 | 28 25 | 25 53 | 28 56 | 26 23 | 29 28 | 26 52 | 30 0 | 27 21 | 30 31 | 27 51 | 31 3 | 28 20 | 31 35 | 28 50 |
| 12 | 27 52 | 25 24 | 28 23 | 25 54 | 28 55 | 26 23 | 29 26 | 26 53 | 29 58 | 27 22 | 30 30 | 27 52 | 31 1 | 28 21 | 31 33 | 28 51 |
| 14 | 27 50 | 25 25 | 28 22 | 25 54 | 28 53 | 26 24 | 29 25 | 26 53 | 29 56 | 27 23 | 30 28 | 27 52 | 31 0 | 28 22 | 31 31 | 28 51 |
| 16 | 27 49 | 25 25 | 28 20 | 25 55 | 28 52 | 26 24 | 29 23 | 26 54 | 29 55 | 27 23 | 30 26 | 27 53 | 30 58 | 28 22 | 31 30 | 28 52 |
| 18 | 27 47 | 25 26 | 28 18 | 25 55 | 28 50 | 26 25 | 29 22 | 26 54 | 29 53 | 27 24 | 30 25 | 27 53 | 30 56 | 28 23 | 31 28 | 28 52 |
| 20 | 27 45 | 25 26 | 28 17 | 25 56 | 28 48 | 26 25 | 29 20 | 26 55 | 29 51 | 27 24 | 30 23 | 27 54 | 30 54 | 28 24 | 31 26 | 28 53 |
| 22 | 27 44 | 25 27 | 28 15 | 25 56 | 28 47 | 26 26 | 29 18 | 26 56 | 29 50 | 27 25 | 30 21 | 27 55 | 30 53 | 28 24 | 31 24 | 28 54 |
| 24 | 27 42 | 25 28 | 28 14 | 25 57 | 28 45 | 26 27 | 29 17 | 26 56 | 29 48 | 27 26 | 30 19 | 27 55 | 30 51 | 28 25 | 31 22 | 28 54 |
| 26 | 27 41 | 25 28 | 28 12 | 25 58 | 28 44 | 26 27 | 29 15 | 26 57 | 29 46 | 27 26 | 30 18 | 27 56 | 30 49 | 28 25 | 31 21 | 28 55 |
| 28 | 27 39 | 25 29 | 28 11 | 25 58 | 28 42 | 26 28 | 29 13 | 26 57 | 29 45 | 27 27 | 30 16 | 27 56 | 30 47 | 28 26 | 31 19 | 28 56 |
| 30 | 27 38 | 25 29 | 28 9 | 25 59 | 28 40 | 26 28 | 29 12 | 26 58 | 29 43 | 27 27 | 30 14 | 27 57 | 30 46 | 28 27 | 31 17 | 28 56 |
| 32 | 27 36 | 25 30 | 28 7 | 25 59 | 28 39 | 26 29 | 29 10 | 26 59 | 29 41 | 27 28 | 30 13 | 27 58 | 30 44 | 28 27 | 31 15 | 28 57 |
| 34 | 27 34 | 25 30 | 28 6 | 26 0 | 28 37 | 26 30 | 29 8 | 26 59 | 29 40 | 27 29 | 30 11 | 27 58 | 30 42 | 28 28 | 31 14 | 28 57 |
| 36 | 27 33 | 25 31 | 28 4 | 26 0 | 28 35 | 26 30 | 29 7 | 27 0 | 29 38 | 27 29 | 30 9 | 27 59 | 30 40 | 28 29 | 31 12 | 28 58 |
| 38 | 27 31 | 25 31 | 28 3 | 26 1 | 28 34 | 26 31 | 29 5 | 27 0 | 29 36 | 27 30 | 30 8 | 27 59 | 30 39 | 28 29 | 31 10 | 28 59 |
| 40 | 27 30 | 25 32 | 28 1 | 26 2 | 28 32 | 26 31 | 29 3 | 27 1 | 29 35 | 27 30 | 30 6 | 28 0 | 30 37 | 28 30 | 31 8 | 28 59 |
| 42 | 27 28 | 25 33 | 27 59 | 26 2 | 28 31 | 26 32 | 29 2 | 27 1 | 29 33 | 27 31 | 30 4 | 28 1 | 30 35 | 28 30 | 31 7 | 29 0 |
| 44 | 27 27 | 25 33 | 27 58 | 26 3 | 28 29 | 26 32 | 29 0 | 27 2 | 29 31 | 27 32 | 30 2 | 28 1 | 30 34 | 28 31 | 31 5 | 29 1 |
| 46 | 27 25 | 25 34 | 27 56 | 26 3 | 28 27 | 26 33 | 28 58 | 27 3 | 29 30 | 27 32 | 30 1 | 28 2 | 30 32 | 28 32 | 31 3 | 29 1 |
| 48 | 27 24 | 25 34 | 27 55 | 26 4 | 28 26 | 26 34 | 28 57 | 27 3 | 29 28 | 27 33 | 29 59 | 28 3 | 30 30 | 28 32 | 31 1 | 29 2 |
| 50 | 27 22 | 25 35 | 27 53 | 26 4 | 28 24 | 26 34 | 28 55 | 27 4 | 29 26 | 27 33 | 29 57 | 28 3 | 30 28 | 28 33 | 30 59 | 29 3 |
| 52 | 27 20 | 25 35 | 27 51 | 26 5 | 28 22 | 26 35 | 28 53 | 27 4 | 29 25 | 27 34 | 29 56 | 28 4 | 30 27 | 28 34 | 30 58 | 29 3 |
| 54 | 27 19 | 25 36 | 27 50 | 26 6 | 28 21 | 26 35 | 28 52 | 27 5 | 29 23 | 27 35 | 29 54 | 28 4 | 30 25 | 28 34 | 30 56 | 29 4 |
| 56 | 27 17 | 25 36 | 27 48 | 26 6 | 28 19 | 26 36 | 28 50 | 27 6 | 29 21 | 27 35 | 29 52 | 28 5 | 30 23 | 28 35 | 30 54 | 29 4 |
| 58 | 27 16 | 25 37 | 27 47 | 26 7 | 28 18 | 26 37 | 28 49 | 27 6 | 29 19 | 27 36 | 29 50 | 28 6 | 30 21 | 28 35 | 30 52 | 29 5 |
| 59° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 27 14 | 25 38 | 27 45 | 26 7 | 28 16 | 26 37 | 28 47 | 27 7 | 29 18 | 27 36 | 29 49 | 28 6 | 30 20 | 28 36 | 30 51 | 29 6 |
| 2 | 27 13 | 25 38 | 27 43 | 26 8 | 28 14 | 26 38 | 28 45 | 27 7 | 29 16 | 27 37 | 29 47 | 28 7 | 30 18 | 28 37 | 30 49 | 29 6 |
| 4 | 27 11 | 25 39 | 27 42 | 26 8 | 28 13 | 26 38 | 28 44 | 27 8 | 29 14 | 27 38 | 29 45 | 28 7 | 30 16 | 28 37 | 30 47 | 29 7 |
| 6 | 27 9 | 25 39 | 27 40 | 26 9 | 28 11 | 26 39 | 28 42 | 27 9 | 29 13 | 27 38 | 29 44 | 28 8 | 30 14 | 28 38 | 30 45 | 29 7 |
| 8 | 27 8 | 25 40 | 27 39 | 26 9 | 28 9 | 26 39 | 28 40 | 27 9 | 29 11 | 27 39 | 29 42 | 28 9 | 30 13 | 28 38 | 30 43 | 29 8 |
| 10 | 27 6 | 25 40 | 27 37 | 26 10 | 28 8 | 26 40 | 28 39 | 27 10 | 29 9 | 27 39 | 29 40 | 28 9 | 30 11 | 28 39 | 30 42 | 29 8 |
| 12 | 27 5 | 25 41 | 27 35 | 26 11 | 28 6 | 26 40 | 28 37 | 27 10 | 29 8 | 27 40 | 29 38 | 28 10 | 30 9 | 28 40 | 30 40 | 29 9 |
| 14 | 27 3 | 25 41 | 27 34 | 26 11 | 28 5 | 26 41 | 28 35 | 27 11 | 29 6 | 27 41 | 29 37 | 28 10 | 30 7 | 28 40 | 30 38 | 29 9 |
| 16 | 27 2 | 25 42 | 27 32 | 26 12 | 28 3 | 26 42 | 28 34 | 27 11 | 29 4 | 27 41 | 29 35 | 28 11 | 30 6 | 28 41 | 30 36 | 29 10 |
| 18 | 27 0 | 25 42 | 27 31 | 26 12 | 28 1 | 26 42 | 28 32 | 27 12 | 29 3 | 27 42 | 29 33 | 28 12 | 30 4 | 28 41 | 30 34 | 29 11 |
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| 22 | 26 57 | 25 44 | 27 27 | 26 13 | 27 58 | 26 43 | 28 29 | 27 13 | 28 59 | 27 43 | 29 30 | 28 13 | 30 0 | 28 43 | 30 31 | 29 12 |
| 24 | 26 55 | 25 44 | 27 26 | 26 14 | 27 56 | 26 44 | 28 27 | 27 14 | 28 57 | 27 43 | 29 28 | 28 13 | 29 58 | 28 43 | 30 29 | 29 13 |
| 26 | 26 54 | 25 45 | 27 24 | 26 14 | 27 55 | 26 44 | 28 25 | 27 14 | 28 56 | 27 44 | 29 26 | 28 14 | 29 57 | 28 44 | 30 27 | 29 14 |
| 28 | 26 52 | 25 45 | 27 23 | 26 15 | 27 53 | 26 45 | 28 24 | 27 15 | 28 54 | 27 45 | 29 25 | 28 14 | 29 55 | 28 44 | 30 26 | 29 14 |
| 30 | 26 51 | 25 46 | 27 21 | 26 16 | 27 51 | 26 45 | 28 22 | 27 15 | 28 52 | 27 45 | 29 23 | 28 15 | 29 53 | 28 45 | 30 24 | 29 15 |
| 32 | 26 49 | 25 46 | 27 19 | 26 16 | 27 50 | 26 46 | 28 20 | 27 16 | 28 51 | 27 46 | 29 21 | 28 16 | 29 51 | 28 45 | 30 22 | 29 15 |
| 34 | 26 47 | 25 47 | 27 18 | 26 17 | 27 48 | 26 47 | 28 19 | 27 16 | 28 49 | 27 46 | 29 19 | 28 16 | 29 50 | 28 46 | 30 20 | 29 16 |
| 36 | 26 46 | 25 47 | 27 16 | 26 17 | 27 47 | 26 47 | 28 17 | 27 17 | 28 47 | 27 47 | 29 18 | 28 17 | 29 48 | 28 47 | 30 18 | 29 17 |
| 38 | 26 44 | 25 48 | 27 15 | 26 18 | 27 45 | 26 48 | 28 15 | 27 18 | 28 46 | 27 48 | 29 16 | 28 17 | 29 46 | 28 47 | 30 17 | 29 17 |
| 40 | 26 43 | 25 48 | 27 13 | 26 18 | 27 43 | 26 48 | 28 14 | 27 18 | 28 44 | 27 48 | 29 14 | 28 18 | 29 44 | 28 48 | 30 15 | 29 18 |
| 42 | 26 41 | 25 49 | 27 11 | 26 19 | 27 42 | 26 49 | 28 12 | 27 19 | 28 42 | 27 49 | 29 12 | 28 19 | 29 43 | 28 48 | 30 13 | 29 19 |
| 44 | 26 40 | 25 50 | 27 10 | 26 19 | 27 40 | 26 49 | 28 10 | 27 19 | 28 40 | 27 49 | 29 11 | 28 19 | 29 41 | 28 49 | 30 11 | 29 19 |
| 46 | 26 38 | 25 50 | 27 8 | 26 20 | 27 38 | 26 50 | 28 9 | 27 20 | 28 39 | 27 50 | 29 9 | 28 20 | 29 39 | 28 50 | 30 9 | 29 20 |
| 48 | 26 36 | 25 51 | 27 7 | 26 21 | 27 37 | 26 51 | 28 7 | 27 21 | 28 37 | 27 50 | 29 7 | 28 20 | 29 37 | 28 50 | 30 8 | 29 20 |
| 50 | 26 35 | 25 51 | 27 5 | 26 21 | 27 35 | 26 51 | 28 5 | 27 21 | 28 35 | 27 51 | 29 6 | 28 21 | 29 36 | 28 51 | 30 6 | 29 21 |
| 52 | 26 33 | 25 52 | 27 3 | 26 22 | 27 33 | 26 52 | 28 4 | 27 22 | 28 34 | 27 52 | 29 4 | 28 22 | 29 34 | 28 52 | 30 4 | 29 22 |
| 54 | 26 32 | 25 52 | 27 2 | 26 22 | 27 32 | 26 52 | 28 2 | 27 22 | 28 32 | 27 52 | 29 2 | 28 22 | 29 32 | 28 52 | 30 2 | 29 22 |
| 56 | 26 30 | 25 53 | 27 0 | 26 23 | 27 30 | 26 53 | 28 0 | 27 23 | 28 30 | 27 53 | 29 0 | 28 23 | 29 30 | 28 53 | 30 0 | 29 23 |
| 58 | 26 28 | 25 53 | 26 59 | 26 23 | 27 29 | 26 53 | 27 59 | 27 23 | 28 29 | 27 53 | 28 59 | 28 23 | 29 29 | 28 53 | 29 59 | 29 23 |

Seconds of H. P.

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| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (60° and 61°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 26 27 | 25 54 | 26 57 | 26 24 | 27 27 | 26 54 | 27 57 | 27 24 | 28 27 | 27 54 | 28 57 | 28 24 | 29 27 | 28 54 | 29 57 | 29 24 |
| 2 | 26 25 | 25 54 | 26 55 | 26 24 | 27 25 | 26 54 | 27 55 | 27 25 | 28 25 | 27 54 | 28 55 | 28 25 | 29 25 | 28 55 | 29 55 | 29 25 |
| 4 | 26 24 | 25 55 | 26 54 | 26 25 | 27 24 | 26 55 | 27 54 | 27 25 | 28 23 | 27 55 | 28 53 | 28 25 | 29 23 | 28 55 | 29 53 | 29 25 |
| 6 | 26 22 | 25 55 | 26 52 | 26 25 | 27 22 | 26 55 | 27 52 | 27 26 | 28 22 | 27 56 | 28 52 | 28 26 | 29 22 | 28 56 | 29 51 | 29 26 |
| 8 | 26 20 | 25 56 | 26 50 | 26 26 | 27 20 | 26 56 | 27 50 | 27 26 | 28 20 | 27 56 | 28 50 | 28 26 | 29 20 | 28 56 | 29 50 | 29 26 |
| 10 | 26 19 | 25 57 | 26 49 | 26 26 | 27 19 | 26 56 | 27 48 | 27 27 | 28 18 | 27 57 | 28 48 | 28 27 | 29 18 | 28 57 | 29 48 | 29 27 |
| 12 | 26 17 | 25 57 | 26 47 | 26 27 | 27 17 | 26 57 | 27 47 | 27 27 | 28 17 | 27 57 | 28 46 | 28 27 | 29 16 | 28 57 | 29 46 | 29 28 |
| 14 | 26 16 | 25 58 | 26 45 | 26 28 | 27 15 | 26 57 | 27 45 | 27 28 | 28 15 | 27 58 | 28 45 | 28 28 | 29 14 | 28 58 | 29 44 | 29 28 |
| 16 | 26 14 | 25 58 | 26 44 | 26 28 | 27 14 | 26 58 | 27 43 | 27 28 | 28 13 | 27 58 | 28 43 | 28 28 | 29 13 | 28 58 | 29 42 | 29 29 |
| 18 | 26 12 | 25 59 | 26 42 | 26 29 | 27 12 | 26 58 | 27 42 | 27 29 | 28 11 | 27 59 | 28 41 | 28 29 | 29 11 | 28 59 | 29 41 | 29 29 |
| 20 | 26 11 | 25 59 | 26 41 | 26 29 | 27 10 | 26 59 | 27 40 | 27 29 | 28 10 | 27 59 | 28 39 | 28 29 | 29 9 | 29 0 | 29 39 | 29 30 |
| 22 | 26 9 | 26 0 | 26 39 | 26 30 | 27 9 | 27 0 | 27 38 | 27 30 | 28 8 | 28 0 | 28 38 | 28 30 | 29 7 | 29 0 | 29 37 | 29 31 |
| 24 | 26 8 | 26 0 | 26 37 | 26 30 | 27 7 | 27 0 | 27 37 | 27 30 | 28 6 | 28 1 | 28 36 | 28 31 | 29 6 | 29 1 | 29 35 | 29 31 |
| 26 | 26 6 | 26 1 | 26 36 | 26 31 | 27 5 | 27 1 | 27 35 | 27 31 | 28 5 | 28 1 | 28 34 | 28 31 | 29 4 | 29 1 | 29 33 | 29 32 |
| 28 | 26 4 | 26 1 | 26 34 | 26 31 | 27 4 | 27 1 | 27 33 | 27 32 | 28 3 | 28 2 | 28 32 | 28 32 | 29 2 | 29 2 | 29 32 | 29 32 |
| 30 | 26 3 | 26 2 | 26 32 | 26 32 | 27 2 | 27 2 | 27 32 | 27 32 | 28 1 | 28 2 | 28 31 | 28 32 | 29 0 | 29 3 | 29 30 | 29 33 |
| 32 | 26 1 | 26 2 | 26 31 | 26 32 | 27 0 | 27 2 | 27 30 | 27 33 | 27 59 | 28 3 | 28 29 | 28 33 | 28 58 | 29 3 | 29 28 | 29 34 |
| 34 | 26 0 | 26 3 | 26 29 | 26 33 | 26 59 | 27 3 | 27 28 | 27 33 | 27 58 | 28 3 | 28 27 | 28 34 | 28 57 | 29 4 | 29 26 | 29 34 |
| 36 | 25 58 | 26 3 | 26 28 | 26 33 | 26 57 | 27 4 | 27 26 | 27 34 | 27 56 | 28 4 | 28 25 | 28 34 | 28 55 | 29 4 | 29 24 | 29 35 |
| 38 | 25 56 | 26 4 | 26 26 | 26 34 | 26 55 | 27 4 | 27 25 | 27 34 | 27 54 | 28 5 | 28 24 | 28 35 | 28 53 | 29 5 | 29 23 | 29 35 |
| 40 | 25 55 | 26 4 | 26 24 | 26 35 | 26 54 | 27 5 | 27 23 | 27 35 | 27 52 | 28 5 | 28 22 | 28 35 | 28 51 | 29 6 | 29 21 | 29 36 |
| 42 | 25 53 | 26 5 | 26 23 | 26 35 | 26 52 | 27 5 | 27 21 | 27 36 | 27 51 | 28 6 | 28 20 | 28 36 | 28 50 | 29 6 | 29 19 | 29 36 |
| 44 | 25 52 | 26 5 | 26 21 | 26 36 | 26 50 | 27 6 | 27 20 | 27 36 | 27 49 | 28 6 | 28 18 | 28 37 | 28 48 | 29 7 | 29 17 | 29 37 |
| 46 | 25 50 | 26 6 | 26 19 | 26 36 | 26 49 | 27 6 | 27 18 | 27 37 | 27 47 | 28 7 | 28 17 | 28 37 | 28 46 | 29 7 | 29 15 | 29 38 |
| 48 | 25 48 | 26 7 | 26 18 | 26 37 | 26 47 | 27 7 | 27 16 | 27 37 | 27 46 | 28 7 | 28 15 | 28 38 | 28 44 | 29 8 | 29 13 | 29 38 |
| 50 | 25 47 | 26 7 | 26 16 | 26 37 | 26 45 | 27 8 | 27 15 | 27 38 | 27 44 | 28 8 | 28 13 | 28 38 | 28 42 | 29 9 | 29 12 | 29 39 |
| 52 | 25 45 | 26 8 | 26 15 | 26 38 | 26 44 | 27 8 | 27 13 | 27 38 | 27 42 | 28 9 | 28 11 | 28 39 | 28 41 | 29 9 | 29 10 | 29 39 |
| 54 | 25 44 | 26 8 | 26 13 | 26 38 | 26 42 | 27 9 | 27 11 | 27 39 | 27 40 | 28 9 | 28 10 | 28 39 | 28 39 | 29 10 | 29 8 | 29 40 |
| 56 | 25 42 | 26 9 | 26 11 | 26 39 | 26 40 | 27 9 | 27 10 | 27 39 | 27 39 | 28 10 | 28 8 | 28 40 | 28 37 | 29 10 | 29 6 | 29 41 |
| 58 | 25 40 | 26 9 | 26 10 | 26 39 | 26 39 | 27 10 | 27 8 | 27 40 | 27 37 | 28 10 | 28 6 | 28 41 | 28 36 | 29 11 | 29 4 | 29 41 |
| 61° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 25 39 | 26 10 | 26 8 | 26 40 | 26 37 | 27 10 | 27 6 | 27 41 | 27 35 | 28 11 | 28 4 | 28 41 | 28 33 | 29 11 | 29 3 | 29 42 |
| 2 | 25 37 | 26 10 | 26 6 | 26 41 | 26 35 | 27 11 | 27 4 | 27 41 | 27 34 | 28 11 | 28 3 | 28 42 | 28 32 | 29 12 | 29 1 | 29 42 |
| 4 | 25 36 | 26 11 | 26 5 | 26 41 | 26 34 | 27 11 | 27 3 | 27 42 | 27 32 | 28 12 | 28 0 | 28 42 | 28 30 | 29 13 | 28 59 | 29 43 |
| 6 | 25 34 | 26 11 | 26 3 | 26 42 | 26 32 | 27 12 | 27 1 | 27 42 | 27 30 | 28 13 | 27 59 | 28 43 | 28 28 | 29 13 | 28 57 | 29 44 |
| 8 | 25 32 | 26 12 | 26 1 | 26 42 | 26 30 | 27 12 | 26 59 | 27 43 | 27 28 | 28 13 | 27 57 | 28 43 | 28 26 | 29 14 | 28 55 | 29 44 |
| 10 | 25 31 | 26 12 | 26 0 | 26 43 | 26 29 | 27 13 | 26 58 | 27 43 | 27 27 | 28 14 | 27 56 | 28 44 | 28 24 | 29 14 | 28 53 | 29 45 |
| 12 | 25 29 | 26 13 | 25 58 | 26 43 | 26 27 | 27 13 | 26 56 | 27 44 | 27 25 | 28 14 | 27 54 | 28 44 | 28 23 | 29 15 | 28 52 | 29 45 |
| 14 | 25 28 | 26 13 | 25 56 | 26 44 | 26 25 | 27 14 | 26 54 | 27 44 | 27 23 | 28 15 | 27 52 | 28 45 | 28 21 | 29 15 | 28 50 | 29 46 |
| 16 | 25 26 | 26 14 | 25 55 | 26 44 | 26 24 | 27 15 | 26 53 | 27 45 | 27 21 | 28 15 | 27 50 | 28 46 | 28 19 | 29 16 | 28 48 | 29 46 |
| 18 | 25 24 | 26 14 | 25 53 | 26 45 | 26 22 | 27 15 | 26 51 | 27 45 | 27 20 | 28 16 | 27 48 | 28 46 | 28 17 | 29 17 | 28 46 | 29 47 |
| 20 | 25 23 | 26 15 | 25 51 | 26 45 | 26 20 | 27 16 | 26 49 | 27 46 | 27 18 | 28 16 | 27 47 | 28 47 | 28 16 | 29 17 | 28 44 | 29 47 |
| 22 | 25 21 | 26 15 | 25 50 | 26 46 | 26 19 | 27 16 | 26 47 | 27 47 | 27 16 | 28 17 | 27 45 | 28 47 | 28 14 | 29 18 | 28 42 | 29 48 |
| 24 | 25 19 | 26 16 | 25 48 | 26 46 | 26 17 | 27 17 | 26 46 | 27 47 | 27 14 | 28 17 | 27 43 | 28 48 | 28 12 | 29 18 | 28 41 | 29 49 |
| 26 | 25 18 | 26 16 | 25 47 | 26 47 | 26 15 | 27 17 | 26 44 | 27 48 | 27 13 | 28 18 | 27 41 | 28 48 | 28 10 | 29 19 | 28 39 | 29 49 |
| 28 | 25 16 | 26 17 | 25 45 | 26 47 | 26 14 | 27 18 | 26 42 | 27 48 | 27 11 | 28 18 | 27 40 | 28 49 | 28 8 | 29 19 | 28 37 | 29 50 |
| 30 | 25 15 | 26 17 | 25 43 | 26 48 | 26 12 | 27 18 | 26 41 | 27 49 | 27 9 | 28 19 | 27 38 | 28 49 | 28 6 | 29 20 | 28 35 | 29 50 |
| 32 | 25 13 | 26 18 | 25 42 | 26 48 | 26 10 | 27 19 | 26 39 | 27 49 | 27 7 | 28 20 | 27 36 | 28 50 | 28 5 | 29 21 | 28 33 | 29 51 |
| 34 | 25 11 | 26 18 | 25 40 | 26 49 | 26 9 | 27 19 | 26 37 | 27 50 | 27 6 | 28 20 | 27 34 | 28 51 | 28 3 | 29 21 | 28 31 | 29 52 |
| 36 | 25 10 | 26 19 | 25 38 | 26 49 | 26 7 | 27 20 | 26 35 | 27 50 | 27 4 | 28 21 | 27 33 | 28 51 | 28 1 | 29 22 | 28 30 | 29 52 |
| 38 | 25 8 | 26 19 | 25 37 | 26 50 | 26 5 | 27 20 | 26 34 | 27 51 | 27 2 | 28 21 | 27 31 | 28 52 | 27 59 | 29 22 | 28 28 | 29 53 |
| 40 | 25 7 | 26 20 | 25 35 | 26 50 | 26 4 | 27 21 | 26 32 | 27 51 | 27 0 | 28 22 | 27 29 | 28 52 | 27 57 | 29 23 | 28 26 | 29 53 |
| 42 | 25 5 | 26 20 | 25 33 | 26 51 | 26 2 | 27 21 | 26 30 | 27 52 | 26 59 | 28 22 | 27 27 | 28 53 | 27 56 | 29 23 | 28 24 | 29 54 |
| 44 | 25 3 | 26 21 | 25 32 | 26 51 | 26 0 | 27 22 | 26 29 | 27 52 | 26 57 | 28 23 | 27 25 | 28 53 | 27 54 | 29 24 | 28 22 | 29 54 |
| 46 | 25 2 | 26 21 | 25 30 | 26 52 | 25 59 | 27 22 | 26 27 | 27 53 | 26 55 | 28 23 | 27 24 | 28 54 | 27 52 | 29 24 | 28 21 | 29 55 |
| 48 | 25 0 | 26 22 | 25 29 | 26 52 | 25 57 | 27 23 | 26 25 | 27 54 | 26 54 | 28 24 | 27 22 | 28 54 | 27 50 | 29 25 | 28 19 | 29 56 |
| 50 | 24 59 | 26 22 | 25 27 | 26 53 | 25 55 | 27 23 | 26 24 | 27 54 | 26 52 | 28 25 | 27 20 | 28 55 | 27 48 | 29 26 | 28 17 | 29 56 |
| 52 | 24 57 | 26 23 | 25 25 | 26 54 | 25 54 | 27 24 | 26 22 | 27 55 | 26 50 | 28 26 | 27 18 | 28 56 | 27 47 | 29 26 | 28 15 | 29 57 |
| 54 | 24 55 | 26 23 | 25 24 | 26 54 | 25 52 | 27 25 | 26 20 | 27 55 | 26 48 | 28 26 | 27 17 | 28 56 | 27 45 | 29 27 | 28 13 | 29 57 |
| 56 | 24 54 | 26 24 | 25 22 | 26 55 | 25 50 | 27 25 | 26 18 | 27 56 | 26 47 | 28 26 | 27 15 | 28 57 | 27 43 | 29 27 | 28 11 | 29 58 |
| 58 | 24 52 | 26 24 | 25 20 | 26 55 | 25 48 | 27 26 | 26 17 | 27 56 | 26 45 | 28 27 | 27 13 | 28 57 | 27 41 | 29 28 | 28 10 | 29 58 |

| Seconds of H. P. | Corr. | A |
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| 55 | 18 | 37 |
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| 59 | 19 | 40 |
| 60 | 20 | 40 |

## (62° and 63°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 62° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
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| 0′ | 24 50 | 26 25 | 25 19 | 26 56 | 25 47 | 27 26 | 26 15 | 27 57 | 26 43 | 28 27 | 27 11 | 28 58 | 27 39 | 29 28 | 28 8 | 29 59 |
| 2 | 24 49 | 26 25 | 25 17 | 26 56 | 25 45 | 27 27 | 26 13 | 27 57 | 26 41 | 28 28 | 27 10 | 28 58 | 27 38 | 29 29 | 23 6 | 30 0 |
| 4 | 24 47 | 26 26 | 25 15 | 26 57 | 25 43 | 27 27 | 26 12 | 27 58 | 26 40 | 28 28 | 27 8 | 28 59 | 27 36 | 29 29 | 28 4 | 30 0 |
| 6 | 24 46 | 26 26 | 25 14 | 26 57 | 25 42 | 27 28 | 26 10 | 27 58 | 26 38 | 28 29 | 27 6 | 29 0 | 27 34 | 29 30 | 28 2 | 30 1 |
| 8 | 24 44 | 26 27 | 25 12 | 26 58 | 25 40 | 27 28 | 26 8 | 27 59 | 26 36 | 29 29 | 27 4 | 29 0 | 27 32 | 29 31 | 28 0 | 30 1 |
| 10 | 24 42 | 26 27 | 25 10 | 26 58 | 25 38 | 27 29 | 26 6 | 27 59 | 26 34 | 28 30 | 27 2 | 29 1 | 27 30 | 29 31 | 27 58 | 30 2 |
| 12 | 24 41 | 26 28 | 25 9 | 26 59 | 25 37 | 27 29 | 26 5 | 28 0 | 26 33 | 28 30 | 27 1 | 29 1 | 27 29 | 29 32 | 27 57 | 30 2 |
| 14 | 24 39 | 26 28 | 25 7 | 26 59 | 25 35 | 27 30 | 26 3 | 28 0 | 26 31 | 28 31 | 26 59 | 29 2 | 27 27 | 29 32 | 27 55 | 30 3 |
| 16 | 24 37 | 26 29 | 25 5 | 27 0 | 25 33 | 27 30 | 26 1 | 28 1 | 26 29 | 28 32 | 26 57 | 29 2 | 27 25 | 29 33 | 27 53 | 30 3 |
| 18 | 24 36 | 26 29 | 25 4 | 27 0 | 25 32 | 27 31 | 26 0 | 28 1 | 26 27 | 28 32 | 26 55 | 29 3 | 27 23 | 29 33 | 27 51 | 30 4 |
| 20 | 24 34 | 26 30 | 25 2 | 27 1 | 25 30 | 27 31 | 25 58 | 28 2 | 26 26 | 28 33 | 26 54 | 29 3 | 27 21 | 29 34 | 27 49 | 30 5 |
| 22 | 24 33 | 26 30 | 25 0 | 27 1 | 25 28 | 27 32 | 25 56 | 28 2 | 26 24 | 28 33 | 26 52 | 29 4 | 27 20 | 29 34 | 27 47 | 30 5 |
| 24 | 24 31 | 26 31 | 24 59 | 27 2 | 25 27 | 27 32 | 25 54 | 28 3 | 26 22 | 28 34 | 26 50 | 29 4 | 27 18 | 29 35 | 27 46 | 30 6 |
| 26 | 24 29 | 26 31 | 24 57 | 27 2 | 25 25 | 27 33 | 25 53 | 28 3 | 26 20 | 28 34 | 26 48 | 29 5 | 27 16 | 29 36 | 27 44 | 30 6 |
| 28 | 24 28 | 26 32 | 24 55 | 27 3 | 25 23 | 27 33 | 25 51 | 28 4 | 26 19 | 28 35 | 26 46 | 29 5 | 27 14 | 29 36 | 27 42 | 30 7 |
| 30 | 24 26 | 26 32 | 24 54 | 27 3 | 25 21 | 27 34 | 25 49 | 28 4 | 26 17 | 28 35 | 26 45 | 29 6 | 27 12 | 29 37 | 27 40 | 30 7 |
| 32 | 24 24 | 26 33 | 24 52 | 27 4 | 25 20 | 27 34 | 25 47 | 28 5 | 26 15 | 28 36 | 26 43 | 29 6 | 27 10 | 29 37 | 27 38 | 30 8 |
| 34 | 24 23 | 26 33 | 24 50 | 27 4 | 25 18 | 27 35 | 25 46 | 28 5 | 26 13 | 28 36 | 26 41 | 29 7 | 27 9 | 29 38 | 27 36 | 30 9 |
| 36 | 24 21 | 26 34 | 24 49 | 27 5 | 25 16 | 27 35 | 25 44 | 28 6 | 26 12 | 28 37 | 26 39 | 29 8 | 27 7 | 29 38 | 27 34 | 30 9 |
| 38 | 24 20 | 26 34 | 24 47 | 27 5 | 25 15 | 27 36 | 25 42 | 28 7 | 26 10 | 28 37 | 26 37 | 29 8 | 27 5 | 29 39 | 27 33 | 30 10 |
| 40 | 24 18 | 26 35 | 24 45 | 27 6 | 25 13 | 27 36 | 25 41 | 28 7 | 26 8 | 28 38 | 26 36 | 29 9 | 27 3 | 29 39 | 27 31 | 30 10 |
| 42 | 24 16 | 26 35 | 24 44 | 27 6 | 25 11 | 27 37 | 25 39 | 28 8 | 26 6 | 28 38 | 26 34 | 29 9 | 27 1 | 29 40 | 27 29 | 30 11 |
| 44 | 24 15 | 26 36 | 24 42 | 27 7 | 25 10 | 27 37 | 25 37 | 28 8 | 26 5 | 28 39 | 26 32 | 29 10 | 27 0 | 29 40 | 27 27 | 30 11 |
| 46 | 24 13 | 26 36 | 24 41 | 27 7 | 25 8 | 27 38 | 25 35 | 28 9 | 26 3 | 28 39 | 26 30 | 29 10 | 26 58 | 29 41 | 27 25 | 30 12 |
| 48 | 24 11 | 26 37 | 24 39 | 27 8 | 25 6 | 27 38 | 25 34 | 28 9 | 26 1 | 28 40 | 26 29 | 29 11 | 26 56 | 29 42 | 27 23 | 30 12 |
| 50 | 24 10 | 26 37 | 24 37 | 27 8 | 25 5 | 27 39 | 25 32 | 28 10 | 25 59 | 28 41 | 26 27 | 29 11 | 26 54 | 29 42 | 27 22 | 30 13 |
| 52 | 24 8 | 26 38 | 24 36 | 27 9 | 25 3 | 27 39 | 25 30 | 28 10 | 25 58 | 28 41 | 26 25 | 29 12 | 26 52 | 29 43 | 27 20 | 30 14 |
| 54 | 24 6 | 26 38 | 24 34 | 27 9 | 25 0 | 27 40 | 25 29 | 28 11 | 25 56 | 28 42 | 26 23 | 29 12 | 26 51 | 29 43 | 27 18 | 30 14 |
| 56 | 24 5 | 26 39 | 24 32 | 27 10 | 24 59 | 27 40 | 25 27 | 28 11 | 25 54 | 28 42 | 26 21 | 29 13 | 26 49 | 29 44 | 27 16 | 30 15 |
| 58 | 24 3 | 26 39 | 24 31 | 27 10 | 24 58 | 27 41 | 25 25 | 28 12 | 25 52 | 28 43 | 26 20 | 29 13 | 26 47 | 29 44 | 27 14 | 30 15 |
| 63° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 24 2 | 26 40 | 24 29 | 27 11 | 24 56 | 27 41 | 25 23 | 28 12 | 25 51 | 28 43 | 26 18 | 29 14 | 26 45 | 29 45 | 27 12 | 30 16 |
| 2 | 24 0 | 26 40 | 24 27 | 27 11 | 24 54 | 27 42 | 25 22 | 28 13 | 25 49 | 28 44 | 26 16 | 29 15 | 26 43 | 29 45 | 27 11 | 30 16 |
| 4 | 23 58 | 26 41 | 24 26 | 27 12 | 24 53 | 27 42 | 25 20 | 28 13 | 25 47 | 28 44 | 26 14 | 29 15 | 26 41 | 29 46 | 27 9 | 30 17 |
| 6 | 23 57 | 26 41 | 24 24 | 27 12 | 24 51 | 27 43 | 25 18 | 28 14 | 25 45 | 28 45 | 26 13 | 29 16 | 26 40 | 29 47 | 27 7 | 30 17 |
| 8 | 23 55 | 26 42 | 24 22 | 27 13 | 24 49 | 27 43 | 25 16 | 28 14 | 25 44 | 28 45 | 26 11 | 29 16 | 26 38 | 29 47 | 27 5 | 30 18 |
| 10 | 23 53 | 26 42 | 24 20 | 27 13 | 24 48 | 27 44 | 25 15 | 28 15 | 25 42 | 28 46 | 26 9 | 29 17 | 26 36 | 29 48 | 27 3 | 30 18 |
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| 14 | 23 50 | 26 43 | 24 17 | 27 14 | 24 44 | 27 45 | 25 11 | 28 16 | 25 38 | 28 47 | 26 5 | 29 18 | 26 32 | 29 49 | 26 59 | 30 20 |
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| 20 | 23 45 | 26 44 | 24 12 | 27 15 | 24 39 | 27 46 | 25 6 | 28 17 | 25 33 | 28 48 | 26 0 | 29 19 | 26 27 | 29 50 | 26 54 | 30 21 |
| 22 | 23 44 | 26 45 | 24 10 | 27 16 | 24 37 | 27 47 | 25 4 | 28 18 | 25 31 | 28 49 | 25 58 | 29 20 | 26 25 | 29 51 | 26 52 | 30 22 |
| 24 | 23 42 | 26 45 | 24 9 | 27 16 | 24 36 | 27 47 | 25 3 | 28 18 | 25 29 | 28 49 | 25 56 | 29 20 | 26 23 | 29 51 | 26 50 | 30 22 |
| 26 | 23 40 | 26 46 | 24 7 | 27 17 | 24 34 | 27 48 | 25 1 | 28 19 | 25 28 | 28 50 | 25 55 | 29 21 | 26 21 | 29 52 | 26 48 | 30 23 |
| 28 | 23 39 | 26 46 | 24 5 | 27 17 | 24 32 | 27 48 | 24 59 | 28 19 | 25 26 | 28 50 | 25 53 | 29 21 | 26 20 | 29 52 | 26 46 | 30 23 |
| 30 | 23 37 | 26 47 | 24 4 | 27 18 | 24 30 | 27 49 | 24 57 | 28 20 | 25 24 | 28 51 | 25 51 | 29 22 | 26 18 | 29 53 | 26 44 | 30 24 |
| 32 | 23 35 | 26 47 | 24 2 | 27 18 | 24 29 | 27 49 | 24 56 | 28 20 | 25 22 | 28 51 | 25 49 | 29 22 | 26 16 | 29 53 | 26 43 | 30 24 |
| 34 | 23 34 | 26 48 | 24 0 | 27 19 | 24 27 | 27 50 | 24 54 | 28 21 | 25 21 | 28 52 | 25 47 | 29 23 | 26 14 | 29 54 | 26 41 | 30 25 |
| 36 | 23 32 | 26 48 | 23 59 | 27 19 | 24 25 | 27 50 | 24 52 | 28 21 | 25 19 | 28 52 | 25 45 | 29 23 | 26 12 | 29 54 | 26 39 | 30 25 |
| 38 | 23 30 | 26 49 | 23 57 | 27 20 | 24 24 | 27 51 | 24 50 | 28 22 | 25 17 | 28 53 | 25 44 | 29 24 | 26 10 | 29 55 | 26 37 | 30 26 |
| 40 | 23 29 | 26 49 | 23 55 | 27 20 | 24 22 | 27 51 | 24 49 | 28 22 | 25 15 | 28 53 | 25 42 | 29 24 | 26 8 | 29 55 | 26 35 | 30 26 |
| 42 | 23 27 | 26 50 | 23 54 | 27 21 | 24 20 | 27 52 | 24 47 | 28 23 | 25 13 | 28 54 | 25 40 | 29 25 | 26 7 | 29 56 | 26 33 | 30 27 |
| 44 | 23 25 | 26 50 | 23 52 | 27 21 | 24 18 | 27 52 | 24 45 | 28 23 | 25 12 | 28 54 | 25 38 | 29 25 | 26 4 | 29 57 | 26 31 | 30 28 |
| 46 | 23 24 | 26 51 | 23 50 | 27 22 | 24 17 | 27 53 | 24 43 | 28 24 | 25 10 | 28 55 | 25 36 | 29 26 | 26 3 | 29 57 | 26 30 | 30 28 |
| 48 | 23 22 | 26 51 | 23 49 | 27 22 | 24 15 | 27 53 | 24 42 | 28 24 | 25 8 | 28 55 | 25 35 | 29 26 | 26 1 | 29 58 | 26 28 | 30 29 |
| 50 | 23 20 | 26 52 | 23 47 | 27 23 | 24 13 | 27 54 | 24 40 | 28 25 | 25 6 | 28 56 | 25 33 | 29 27 | 25 59 | 29 58 | 26 26 | 30 29 |
| 52 | 23 19 | 26 52 | 23 45 | 27 23 | 24 12 | 27 54 | 24 38 | 28 25 | 25 5 | 28 56 | 25 31 | 29 28 | 25 57 | 29 59 | 26 24 | 30 30 |
| 54 | 23 17 | 26 53 | 23 44 | 27 24 | 24 10 | 27 55 | 24 36 | 28 26 | 25 3 | 28 57 | 25 29 | 29 28 | 25 56 | 29 59 | 26 22 | 30 30 |
| 56 | 23 16 | 26 53 | 23 42 | 27 24 | 24 8 | 27 55 | 24 35 | 28 26 | 25 1 | 28 57 | 25 27 | 29 29 | 25 54 | 30 0 | 26 20 | 30 31 |
| 58 | 23 14 | 26 54 | 23 40 | 27 25 | 24 6 | 27 56 | 24 33 | 28 27 | 24 59 | 28 58 | 25 26 | 29 29 | 25 52 | 30 1 | 26 18 | 30 31 |

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| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (64° and 65°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | Seconds of H. P. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 64° | Corr.+ | A 60° | Corr.+ | A 60° | Corr.+ | A 60° | Corr.+ | A 60° | Corr.+ | A 60° | Corr+ | A 60° | Corr.+ | A 60° | Corr.+ | A 60° | " | Corr. A |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | ″ ″ |
| 0′ | 23 12 | 26 54 | 23 39 | 27 25 | 24 5 | 27 56 | 24 31 | 28 27 | 24 57 | 28 58 | 25 24 | 29 30 | 25 50 | 30 1 | 26 16 | 30 32 | 1 | 0 1 |
| 2 | 23 11 | 26 55 | 23 37 | 27 26 | 24 3 | 27 57 | 24 29 | 28 28 | 24 56 | 28 59 | 25 22 | 29 30 | 25 48 | 30 1 | 26 15 | 30 32 | 2 | 1 1 |
| 4 | 23 9 | 26 55 | 23 35 | 27 26 | 24 1 | 27 57 | 24 28 | 28 28 | 24 54 | 28 59 | 25 20 | 29 31 | 25 46 | 30 2 | 26 13 | 30 33 | 3 | 1 2 |
| 6 | 23 7 | 26 55 | 23 34 | 27 27 | 24 0 | 27 58 | 24 26 | 28 29 | 24 52 | 29 0 | 25 18 | 29 31 | 25 45 | 30 2 | 26 11 | 30 33 | 4 | 2 2 |
| 8 | 23 6 | 26 56 | 23 32 | 27 27 | 23 58 | 27 58 | 24 24 | 28 29 | 24 50 | 29 0 | 25 17 | 29 32 | 25 43 | 30 3 | 26 9 | 30 34 | 5 | 2 3 |
| 10 | 23 4 | 26 56 | 23 30 | 27 28 | 23 56 | 27 59 | 24 22 | 28 30 | 24 49 | 29 1 | 25 15 | 29 32 | 25 41 | 30 3 | 26 7 | 30 34 | 6 | 3 3 |
| 12 | 23 2 | 26 57 | 23 28 | 27 28 | 23 55 | 27 59 | 24 21 | 28 30 | 24 47 | 29 1 | 25 13 | 29 33 | 25 39 | 30 4 | 26 5 | 30 35 | 7 | 3 4 |
| 14 | 23 1 | 26 57 | 23 27 | 27 28 | 23 53 | 28 0 | 24 19 | 28 31 | 24 45 | 29 2 | 25 11 | 29 33 | 25 37 | 30 4 | 26 3 | 30 36 | 8 | 3 4 |
| 16 | 22 59 | 26 58 | 23 25 | 27 29 | 23 51 | 28 0 | 24 17 | 28 31 | 24 43 | 29 2 | 25 9 | 29 34 | 25 35 | 30 5 | 26 0 | 30 36 | 9 | 4 5 |
| 18 | 22 58 | 26 58 | 23 23 | 27 29 | 23 49 | 28 1 | 24 15 | 28 32 | 24 41 | 29 3 | 25 7 | 29 34 | 25 33 | 30 5 | 25 59 | 30 37 | 10 | 4 5 |
| 20 | 22 56 | 26 59 | 23 22 | 27 30 | 23 48 | 28 1 | 24 14 | 28 32 | 24 40 | 29 3 | 25 6 | 29 35 | 25 32 | 30 6 | 25 58 | 30 37 | 11 | 5 6 |
| 22 | 22 54 | 26 59 | 23 20 | 27 30 | 23 46 | 28 2 | 24 12 | 28 33 | 24 38 | 29 4 | 25 4 | 29 35 | 25 30 | 30 6 | 25 56 | 30 38 | 12 | 5 6 |
| 24 | 22 52 | 27 0 | 23 18 | 27 31 | 23 44 | 28 2 | 24 10 | 28 33 | 24 36 | 29 5 | 25 2 | 29 36 | 25 28 | 30 7 | 25 54 | 30 38 | 13 | 6 7 |
| 26 | 22 51 | 27 0 | 23 17 | 27 31 | 23 43 | 28 3 | 24 8 | 28 34 | 24 34 | 29 5 | 25 0 | 29 36 | 25 26 | 30 7 | 25 52 | 30 39 | 14 | 6 7 |
| 28 | 22 49 | 27 1 | 23 15 | 27 32 | 23 41 | 28 3 | 24 7 | 28 34 | 24 32 | 29 6 | 24 58 | 29 37 | 25 24 | 30 8 | 25 50 | 30 39 | 15 | 7 8 |
| 30 | 22 47 | 27 1 | 23 13 | 27 32 | 23 39 | 28 4 | 24 5 | 28 35 | 24 31 | 29 6 | 24 57 | 29 37 | 25 22 | 30 8 | 25 48 | 30 40 | 16 | 7 8 |
| 32 | 22 46 | 27 2 | 23 12 | 27 33 | 23 37 | 28 4 | 24 3 | 28 35 | 24 29 | 29 7 | 24 55 | 29 38 | 25 20 | 30 9 | 25 46 | 30 40 | 17 | 8 9 |
| 34 | 22 44 | 27 2 | 23 10 | 27 33 | 23 36 | 28 5 | 24 1 | 28 36 | 24 27 | 29 7 | 24 53 | 29 38 | 25 19 | 30 10 | 25 44 | 30 41 | 18 | 8 9 |
| 36 | 22 42 | 27 3 | 23 8 | 27 34 | 23 34 | 28 5 | 24 0 | 28 36 | 24 25 | 29 8 | 24 51 | 29 39 | 25 17 | 30 10 | 25 43 | 30 41 | 19 | 8 10 |
| 38 | 22 41 | 27 3 | 23 6 | 27 34 | 23 32 | 28 6 | 23 58 | 28 37 | 24 24 | 29 8 | 24 49 | 29 39 | 25 15 | 30 11 | 25 41 | 30 42 | 20 | 9 10 |
| 40 | 22 39 | 27 4 | 23 5 | 27 35 | 23 30 | 28 6 | 23 56 | 28 37 | 24 22 | 29 9 | 24 47 | 29 40 | 25 13 | 30 11 | 25 39 | 30 42 | 21 | 9 11 |
| 42 | 22 37 | 27 4 | 23 3 | 27 35 | 23 29 | 28 7 | 23 54 | 28 38 | 24 20 | 29 9 | 24 46 | 29 40 | 25 11 | 30 12 | 25 37 | 30 43 | 22 | 10 11 |
| 44 | 22 36 | 27 4 | 23 1 | 27 36 | 23 27 | 28 7 | 23 53 | 28 38 | 24 18 | 29 10 | 24 44 | 29 41 | 25 9 | 30 12 | 25 35 | 30 43 | 23 | 10 12 |
| 46 | 22 34 | 27 5 | 23 0 | 27 36 | 23 25 | 28 7 | 23 51 | 28 39 | 24 16 | 29 10 | 24 42 | 29 41 | 25 8 | 30 13 | 25 33 | 30 44 | 24 | 11 12 |
| 48 | 22 32 | 27 5 | 22 58 | 27 37 | 23 24 | 28 8 | 23 49 | 28 39 | 24 15 | 29 11 | 24 40 | 29 42 | 25 6 | 30 13 | 25 31 | 30 44 | 25 | 11 13 |
| 50 | 22 31 | 27 6 | 22 56 | 27 37 | 23 22 | 28 8 | 23 47 | 28 40 | 24 13 | 29 11 | 24 38 | 29 42 | 25 4 | 30 14 | 25 29 | 30 45 | 26 | 12 13 |
| 52 | 22 29 | 27 6 | 22 55 | 27 38 | 23 20 | 28 9 | 23 46 | 28 40 | 24 11 | 29 12 | 24 37 | 29 43 | 25 2 | 30 14 | 25 28 | 30 46 | 27 | 12 14 |
| 54 | 22 27 | 27 7 | 22 53 | 27 38 | 23 18 | 28 9 | 23 44 | 28 41 | 24 9 | 29 12 | 24 35 | 29 43 | 25 0 | 30 15 | 25 26 | 30 46 | 28 | 13 14 |
| 56 | 22 26 | 27 7 | 22 51 | 27 38 | 23 17 | 28 10 | 23 42 | 28 41 | 24 7 | 29 13 | 24 33 | 29 44 | 24 58 | 30 15 | 25 24 | 30 47 | 29 | 13 15 |
| 58 | 22 24 | 27 8 | 22 50 | 27 39 | 23 15 | 28 10 | 23 40 | 28 42 | 24 6 | 29 13 | 24 31 | 29 44 | 24 56 | 30 16 | 25 22 | 30 47 | 30 | 14 15 |
| 65° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 31 | 14 16 |
| 0′ | 22 22 | 27 8 | 22 48 | 27 39 | 23 13 | 28 11 | 23 39 | 28 42 | 24 4 | 29 13 | 24 29 | 29 45 | 24 55 | 30 16 | 25 20 | 30 48 | 32 | 15 16 |
| 2 | 22 21 | 27 8 | 22 46 | 27 40 | 23 11 | 28 11 | 23 37 | 28 43 | 24 2 | 29 14 | 24 27 | 29 45 | 24 53 | 30 17 | 25 18 | 30 48 | 33 | 15 17 |
| 4 | 22 19 | 27 9 | 22 44 | 27 40 | 23 10 | 28 12 | 23 36 | 28 43 | 24 0 | 29 14 | 24 26 | 29 46 | 24 51 | 30 17 | 25 16 | 30 49 | 34 | 16 17 |
| 6 | 22 17 | 27 9 | 22 43 | 27 41 | 23 8 | 28 12 | 23 33 | 28 44 | 23 58 | 29 15 | 24 24 | 29 46 | 24 49 | 30 18 | 25 14 | 30 49 | 35 | 16 18 |
| 8 | 22 16 | 27 10 | 22 41 | 27 41 | 23 6 | 28 13 | 23 31 | 28 44 | 23 57 | 29 15 | 24 22 | 29 47 | 24 47 | 30 18 | 25 12 | 30 50 | 36 | 17 18 |
| 10 | 22 14 | 27 10 | 22 39 | 27 42 | 23 4 | 28 13 | 23 30 | 28 44 | 23 55 | 29 16 | 24 20 | 29 47 | 24 45 | 30 19 | 25 10 | 30 50 | 37 | 17 19 |
| 12 | 22 12 | 27 11 | 22 38 | 27 42 | 23 3 | 28 13 | 23 28 | 28 45 | 23 53 | 29 16 | 24 18 | 29 48 | 24 43 | 30 19 | 25 9 | 30 51 | 38 | 18 19 |
| 14 | 22 11 | 27 11 | 22 36 | 27 43 | 23 1 | 28 14 | 23 26 | 28 45 | 23 51 | 29 17 | 24 16 | 29 48 | 24 42 | 30 20 | 25 7 | 30 51 | 39 | 18 20 |
| 16 | 22 9 | 27 12 | 22 34 | 27 43 | 22 59 | 28 14 | 23 24 | 28 46 | 23 49 | 29 17 | 24 15 | 29 49 | 24 40 | 30 20 | 25 5 | 30 52 | 40 | 19 20 |
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| 20 | 22 6 | 27 13 | 22 31 | 27 44 | 22 56 | 28 15 | 23 21 | 28 47 | 23 46 | 29 18 | 24 11 | 29 50 | 24 36 | 30 21 | 25 1 | 30 53 | 42 | 20 21 |
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| 24 | 22 2 | 27 13 | 22 27 | 27 45 | 22 52 | 28 16 | 23 17 | 28 48 | 23 42 | 29 19 | 24 7 | 29 51 | 24 32 | 30 22 | 24 57 | 30 54 | 44 | 21 22 |
| 26 | 22 1 | 27 14 | 22 26 | 27 45 | 22 51 | 28 17 | 23 16 | 28 48 | 23 41 | 29 20 | 24 5 | 29 51 | 24 30 | 30 23 | 24 55 | 30 54 | 45 | 21 23 |
| 28 | 21 59 | 27 14 | 22 24 | 27 46 | 22 49 | 28 17 | 23 14 | 28 49 | 23 39 | 29 20 | 24 4 | 29 52 | 24 29 | 30 23 | 24 53 | 30 55 | 46 | 22 23 |
| 30 | 21 57 | 27 15 | 22 22 | 27 46 | 22 47 | 28 18 | 23 12 | 28 49 | 23 37 | 29 21 | 24 2 | 29 52 | 24 27 | 30 24 | 24 52 | 30 55 | 47 | 22 24 |
| 32 | 21 56 | 27 15 | 22 20 | 27 47 | 22 45 | 28 18 | 23 10 | 28 50 | 23 35 | 29 21 | 24 0 | 29 53 | 24 25 | 30 24 | 24 50 | 30 56 | 48 | 23 24 |
| 34 | 21 54 | 27 16 | 22 19 | 27 47 | 22 44 | 28 19 | 23 8 | 28 50 | 23 33 | 29 22 | 23 58 | 29 53 | 24 23 | 30 25 | 24 48 | 30 56 | 49 | 23 25 |
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| 38 | 21 51 | 27 16 | 22 15 | 27 48 | 22 40 | 28 20 | 23 5 | 28 51 | 23 30 | 29 23 | 23 54 | 29 54 | 24 19 | 30 26 | 24 44 | 30 57 | 51 | 24 26 |
| 40 | 21 49 | 27 17 | 22 14 | 27 48 | 22 38 | 28 20 | 23 3 | 28 51 | 23 28 | 29 23 | 23 53 | 29 54 | 24 17 | 30 26 | 24 42 | 30 58 | 52 | 25 26 |
| 42 | 21 47 | 27 17 | 22 12 | 27 49 | 22 37 | 28 20 | 23 1 | 28 52 | 23 26 | 29 23 | 23 51 | 29 55 | 24 16 | 30 27 | 24 40 | 30 58 | 53 | 25 27 |
| 44 | 21 46 | 27 18 | 22 10 | 27 49 | 22 35 | 28 21 | 23 0 | 28 52 | 23 24 | 29 24 | 23 49 | 29 55 | 24 14 | 30 27 | 24 38 | 30 59 | 54 | 26 27 |
| 46 | 21 44 | 27 18 | 22 9 | 27 50 | 22 33 | 28 21 | 22 58 | 28 53 | 23 23 | 29 24 | 23 47 | 29 56 | 24 12 | 30 28 | 24 36 | 30 59 | 55 | 26 28 |
| 48 | 21 42 | 27 19 | 22 7 | 27 50 | 22 32 | 28 22 | 22 56 | 28 53 | 23 21 | 29 25 | 23 45 | 29 56 | 24 10 | 30 28 | 24 35 | 31 0 | 56 | 27 28 |
| 50 | 21 41 | 27 19 | 22 5 | 27 51 | 22 30 | 28 22 | 22 54 | 28 54 | 23 19 | 29 25 | 23 43 | 29 57 | 24 8 | 30 28 | 24 33 | 31 0 | 57 | 27 29 |
| 52 | 21 39 | 27 20 | 22 3 | 27 51 | 22 28 | 28 23 | 22 53 | 28 54 | 23 17 | 29 26 | 23 42 | 29 57 | 24 6 | 30 29 | 24 31 | 31 1 | 58 | 28 29 |
| 54 | 21 37 | 27 20 | 22 2 | 27 52 | 22 26 | 28 23 | 22 51 | 28 55 | 23 15 | 29 26 | 23 40 | 29 58 | 24 4 | 30 29 | 24 29 | 31 1 | 59 | 28 30 |
| 56 | 21 36 | 27 20 | 22 0 | 27 52 | 22 25 | 28 24 | 22 49 | 28 55 | 23 14 | 29 27 | 23 38 | 29 58 | 24 2 | 30 30 | 24 27 | 31 2 | 60 | 29 30 |
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(66° and 67°) The Correction of the Moon's Altitude, and the Aux. Angle A. (W.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 66° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 21 32 | 27 21 | 21 57 | 27 53 | 22 21 | 28 24 | 22 45 | 28 56 | 23 10 | 29 28 | 23 34 | 29 59 | 23 59 | 30 31 | 24 23 | 31 3 |
| 2 | 21 31 | 27 22 | 21 55 | 27 53 | 22 19 | 28 25 | 22 44 | 28 57 | 23 8 | 29 28 | 23 32 | 30 0 | 23 57 | 30 31 | 24 21 | 31 3 |
| 4 | 21 29 | 27 22 | 21 53 | 27 54 | 22 18 | 28 25 | 22 42 | 28 57 | 23 6 | 29 29 | 23 31 | 30 0 | 23 55 | 30 32 | 24 19 | 31 4 |
| 6 | 21 27 | 27 23 | 21 52 | 27 54 | 22 16 | 28 26 | 22 40 | 28 57 | 23 4 | 29 29 | 23 29 | 30 1 | 23 53 | 30 32 | 24 17 | 31 4 |
| 8 | 21 26 | 27 23 | 21 50 | 27 55 | 22 14 | 28 26 | 22 38 | 28 58 | 23 3 | 29 30 | 23 27 | 30 1 | 23 51 | 30 33 | 24 16 | 31 5 |
| 10 | 21 24 | 27 23 | 21 48 | 27 55 | 22 12 | 28 27 | 22 37 | 28 58 | 23 1 | 29 30 | 23 25 | 30 2 | 23 49 | 30 33 | 24 14 | 31 5 |
| 12 | 21 22 | 27 24 | 21 46 | 27 56 | 22 11 | 28 27 | 22 35 | 28 59 | 22 59 | 29 30 | 23 23 | 30 2 | 23 47 | 30 34 | 24 12 | 31 5 |
| 14 | 21 20 | 27 24 | 21 45 | 27 56 | 22 9 | 28 28 | 22 33 | 28 59 | 22 57 | 29 31 | 23 21 | 30 3 | 23 46 | 30 34 | 24 10 | 31 6 |
| 16 | 21 19 | 27 25 | 21 43 | 27 56 | 22 7 | 28 28 | 22 31 | 29 0 | 22 55 | 29 31 | 23 19 | 30 3 | 23 44 | 30 35 | 24 8 | 31 6 |
| 18 | 21 17 | 27 25 | 21 41 | 27 57 | 22 5 | 28 28 | 22 29 | 29 0 | 22 54 | 29 32 | 23 18 | 30 4 | 23 42 | 30 35 | 24 6 | 31 7 |
| 20 | 21 15 | 27 25 | 21 39 | 27 57 | 22 4 | 28 29 | 22 28 | 29 1 | 22 52 | 29 32 | 23 16 | 30 4 | 23 40 | 30 36 | 24 4 | 31 7 |
| 22 | 21 14 | 27 26 | 21 38 | 27 58 | 22 2 | 28 29 | 22 26 | 29 1 | 22 50 | 29 33 | 23 14 | 30 4 | 23 38 | 30 36 | 24 2 | 31 8 |
| 24 | 21 12 | 27 26 | 21 36 | 27 58 | 22 0 | 28 30 | 22 24 | 29 1 | 22 48 | 29 33 | 23 12 | 30 5 | 23 36 | 30 37 | 24 0 | 31 8 |
| 26 | 21 10 | 27 27 | 21 34 | 27 59 | 21 58 | 28 30 | 22 22 | 29 2 | 22 46 | 29 34 | 23 10 | 30 5 | 23 34 | 30 37 | 23 58 | 31 9 |
| 28 | 21 9 | 27 27 | 21 33 | 27 59 | 21 57 | 28 31 | 22 21 | 29 2 | 22 44 | 29 34 | 23 8 | 30 6 | 23 32 | 30 38 | 23 56 | 31 9 |
| 30 | 21 7 | 27 28 | 21 31 | 27 59 | 21 55 | 28 31 | 22 19 | 29 3 | 22 43 | 29 35 | 23 7 | 30 6 | 23 30 | 30 38 | 23 54 | 31 10 |
| 32 | 21 5 | 27 28 | 21 29 | 28 0 | 21 53 | 28 32 | 22 17 | 29 3 | 22 41 | 29 35 | 23 5 | 30 7 | 23 29 | 30 38 | 23 53 | 31 10 |
| 34 | 21 4 | 27 29 | 21 27 | 28 0 | 21 51 | 28 32 | 22 15 | 29 4 | 22 39 | 29 35 | 23 3 | 30 7 | 23 27 | 30 39 | 23 51 | 31 11 |
| 36 | 21 2 | 27 29 | 21 26 | 28 1 | 21 50 | 28 32 | 22 13 | 29 4 | 22 37 | 29 36 | 23 1 | 30 8 | 23 25 | 30 39 | 23 49 | 31 11 |
| 38 | 21 0 | 27 29 | 21 24 | 28 1 | 21 48 | 28 33 | 22 12 | 29 5 | 22 35 | 29 36 | 22 59 | 30 8 | 23 23 | 30 40 | 23 47 | 31 12 |
| 40 | 20 58 | 27 30 | 21 22 | 28 2 | 21 46 | 28 33 | 22 10 | 29 5 | 22 34 | 29 37 | 22 57 | 30 9 | 23 21 | 30 40 | 23 45 | 31 12 |
| 42 | 20 57 | 27 30 | 21 21 | 28 2 | 21 44 | 28 34 | 22 8 | 29 6 | 22 32 | 29 37 | 22 55 | 30 9 | 23 19 | 30 41 | 23 43 | 31 13 |
| 44 | 20 55 | 27 31 | 21 19 | 28 2 | 21 43 | 28 34 | 22 6 | 29 6 | 22 30 | 29 38 | 22 54 | 30 10 | 23 17 | 30 41 | 23 41 | 31 13 |
| 46 | 20 53 | 27 31 | 21 17 | 28 3 | 21 41 | 28 35 | 22 4 | 29 6 | 22 28 | 29 38 | 22 52 | 30 10 | 23 16 | 30 42 | 23 39 | 31 14 |
| 48 | 20 52 | 27 31 | 21 15 | 28 3 | 21 39 | 28 35 | 22 3 | 29 7 | 22 26 | 29 39 | 22 50 | 30 10 | 23 14 | 30 42 | 23 37 | 31 14 |
| 50 | 20 50 | 27 32 | 21 14 | 28 4 | 21 37 | 28 35 | 22 1 | 29 7 | 22 25 | 29 39 | 22 48 | 30 11 | 23 12 | 30 43 | 23 35 | 31 14 |
| 52 | 20 48 | 27 32 | 21 12 | 28 4 | 21 36 | 28 36 | 21 59 | 29 8 | 22 23 | 29 40 | 22 46 | 30 11 | 23 10 | 30 43 | 23 33 | 31 15 |
| 54 | 20 47 | 27 33 | 21 10 | 28 5 | 21 34 | 28 36 | 21 57 | 29 8 | 22 21 | 29 40 | 22 44 | 30 12 | 23 8 | 30 44 | 23 32 | 31 15 |
| 56 | 20 45 | 27 33 | 21 9 | 28 5 | 21 32 | 28 37 | 21 56 | 29 9 | 22 19 | 29 40 | 22 43 | 30 12 | 23 6 | 30 44 | 23 30 | 31 16 |
| 58 | 20 43 | 27 34 | 21 7 | 28 5 | 21 30 | 28 37 | 21 54 | 29 9 | 22 17 | 29 41 | 22 41 | 30 13 | 23 4 | 30 45 | 23 28 | 31 16 |
| 67° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 20 42 | 27 34 | 21 5 | 28 6 | 21 29 | 28 38 | 21 52 | 29 9 | 22 15 | 29 41 | 22 39 | 30 13 | 23 2 | 30 45 | 23 26 | 31 17 |
| 2 | 20 40 | 27 34 | 21 3 | 28 6 | 21 27 | 28 38 | 21 50 | 29 10 | 22 14 | 29 42 | 22 37 | 30 14 | 23 1 | 30 46 | 23 24 | 31 17 |
| 4 | 20 38 | 27 35 | 21 2 | 28 7 | 21 25 | 28 39 | 21 49 | 29 10 | 22 12 | 29 42 | 22 35 | 30 14 | 22 59 | 30 46 | 23 22 | 31 18 |
| 6 | 20 36 | 27 35 | 21 0 | 28 7 | 21 23 | 28 39 | 21 47 | 29 11 | 22 10 | 29 43 | 22 33 | 30 15 | 22 57 | 30 46 | 23 20 | 31 18 |
| 8 | 20 35 | 27 36 | 20 58 | 28 7 | 21 22 | 28 39 | 21 45 | 29 11 | 22 8 | 29 43 | 22 31 | 30 15 | 22 55 | 30 47 | 23 18 | 31 19 |
| 10 | 20 33 | 27 36 | 20 56 | 28 8 | 21 20 | 28 40 | 21 43 | 29 12 | 22 6 | 29 44 | 22 30 | 30 15 | 22 53 | 30 47 | 23 16 | 31 19 |
| 12 | 20 31 | 27 36 | 20 55 | 28 8 | 21 18 | 28 40 | 21 42 | 29 12 | 22 4 | 29 44 | 22 28 | 30 16 | 22 51 | 30 48 | 23 14 | 31 20 |
| 14 | 20 30 | 27 37 | 20 53 | 28 9 | 21 16 | 28 41 | 21 40 | 29 13 | 22 3 | 29 44 | 22 26 | 30 16 | 22 49 | 30 48 | 23 12 | 31 20 |
| 16 | 20 28 | 27 37 | 20 51 | 28 9 | 21 14 | 28 41 | 21 38 | 29 13 | 22 1 | 29 45 | 22 24 | 30 17 | 22 47 | 30 49 | 23 10 | 31 21 |
| 18 | 20 26 | 27 38 | 20 49 | 28 10 | 21 13 | 28 41 | 21 37 | 29 13 | 21 59 | 29 45 | 22 22 | 30 17 | 22 45 | 30 49 | 23 8 | 31 21 |
| 20 | 20 25 | 27 38 | 20 48 | 28 10 | 21 11 | 28 42 | 21 35 | 29 14 | 21 57 | 29 46 | 22 20 | 30 18 | 22 43 | 30 49 | 23 6 | 31 21 |
| 22 | 20 23 | 27 39 | 20 46 | 28 10 | 21 9 | 28 42 | 21 33 | 29 14 | 21 55 | 29 46 | 22 18 | 30 18 | 22 41 | 30 50 | 23 5 | 31 22 |
| 24 | 20 21 | 27 39 | 20 44 | 28 11 | 21 7 | 28 43 | 21 31 | 29 15 | 21 53 | 29 47 | 22 16 | 30 19 | 22 40 | 30 50 | 23 3 | 31 22 |
| 26 | 20 19 | 27 39 | 20 43 | 28 11 | 21 6 | 28 43 | 21 29 | 29 15 | 21 52 | 29 47 | 22 15 | 30 19 | 22 38 | 30 51 | 23 1 | 31 23 |
| 28 | 20 18 | 27 40 | 20 41 | 28 12 | 21 4 | 28 44 | 21 27 | 29 16 | 21 50 | 29 47 | 22 13 | 30 19 | 22 36 | 30 51 | 22 59 | 31 23 |
| 30 | 20 16 | 27 40 | 20 39 | 28 12 | 21 2 | 28 44 | 21 25 | 29 16 | 21 48 | 29 48 | 22 11 | 30 20 | 22 34 | 30 52 | 22 57 | 31 24 |
| 32 | 20 14 | 27 41 | 20 37 | 28 13 | 21 0 | 28 44 | 21 24 | 29 16 | 21 46 | 29 48 | 22 9 | 30 20 | 22 32 | 30 52 | 22 55 | 31 24 |
| 34 | 20 13 | 27 41 | 20 36 | 28 13 | 20 59 | 28 45 | 21 22 | 29 17 | 21 44 | 29 49 | 22 7 | 30 21 | 22 30 | 30 53 | 22 53 | 31 25 |
| 36 | 20 11 | 27 41 | 20 34 | 28 13 | 20 57 | 28 45 | 21 20 | 29 17 | 21 42 | 29 49 | 22 5 | 30 21 | 22 28 | 30 53 | 22 51 | 31 25 |
| 38 | 20 9 | 27 42 | 20 32 | 28 14 | 20 55 | 28 46 | 21 18 | 29 18 | 21 41 | 29 50 | 22 3 | 30 22 | 22 26 | 30 54 | 22 49 | 31 26 |
| 40 | 20 8 | 27 42 | 20 30 | 28 14 | 20 53 | 28 46 | 21 16 | 29 18 | 21 39 | 29 50 | 22 2 | 30 22 | 22 24 | 30 54 | 22 47 | 31 26 |
| 42 | 20 6 | 27 43 | 20 29 | 28 15 | 20 51 | 28 47 | 21 14 | 29 19 | 21 37 | 29 51 | 22 0 | 30 23 | 22 23 | 30 55 | 22 45 | 31 27 |
| 44 | 20 4 | 27 43 | 20 27 | 28 15 | 20 50 | 28 47 | 21 12 | 29 19 | 21 35 | 29 51 | 21 58 | 30 23 | 22 21 | 30 55 | 22 43 | 31 27 |
| 46 | 20 2 | 27 43 | 20 25 | 28 15 | 20 48 | 28 47 | 21 11 | 29 20 | 21 33 | 29 52 | 21 56 | 30 24 | 22 19 | 30 56 | 22 42 | 31 28 |
| 48 | 20 1 | 27 44 | 20 23 | 28 16 | 20 46 | 28 48 | 21 9 | 29 20 | 21 31 | 29 52 | 21 54 | 30 24 | 22 17 | 30 56 | 22 40 | 31 28 |
| 50 | 19 59 | 27 44 | 20 22 | 28 16 | 20 44 | 28 48 | 21 7 | 29 20 | 21 30 | 29 52 | 21 52 | 30 24 | 22 15 | 30 56 | 22 38 | 31 28 |
| 52 | 19 57 | 27 45 | 20 20 | 28 17 | 20 43 | 28 49 | 21 5 | 29 21 | 21 28 | 29 53 | 21 50 | 30 25 | 22 13 | 30 57 | 22 36 | 31 29 |
| 54 | 19 56 | 27 45 | 20 18 | 28 17 | 20 41 | 28 49 | 21 3 | 29 21 | 21 26 | 29 53 | 21 49 | 30 25 | 22 11 | 30 57 | 22 34 | 31 29 |
| 56 | 19 54 | 27 46 | 20 17 | 28 18 | 20 39 | 28 50 | 21 2 | 29 22 | 21 24 | 29 54 | 21 47 | 30 26 | 22 9 | 30 58 | 22 32 | 31 30 |
| 58 | 19 52 | 27 46 | 20 15 | 28 18 | 20 37 | 28 50 | 21 0 | 29 22 | 21 22 | 29 54 | 21 45 | 30 26 | 22 7 | 30 58 | 22 30 | 31 30 |

Seconds of H. P.

| ″ | Corr. | A |
|---|---|---|
| | ″ | ″ |
| 1 | 0 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 2 |
| 4 | 2 | 2 |
| 5 | 2 | 3 |
| 6 | 2 | 3 |
| 7 | 3 | 4 |
| 8 | 3 | 4 |
| 9 | 4 | 5 |
| 10 | 4 | 5 |
| 11 | 4 | 6 |
| 12 | 5 | 6 |
| 13 | 5 | 7 |
| 14 | 5 | 7 |
| 15 | 6 | 8 |
| 16 | 6 | 9 |
| 17 | 7 | 9 |
| 18 | 7 | 10 |
| 19 | 7 | 10 |
| 20 | 8 | 11 |
| 21 | 8 | 11 |
| 22 | 9 | 12 |
| 23 | 9 | 12 |
| 24 | 9 | 13 |
| 25 | 10 | 13 |
| 26 | 10 | 14 |
| 27 | 11 | 14 |
| 28 | 11 | 15 |
| 29 | 11 | 15 |
| 30 | 12 | 16 |
| 31 | 12 | 17 |
| 32 | 13 | 17 |
| 33 | 13 | 18 |
| 34 | 13 | 18 |
| 35 | 14 | 19 |
| 36 | 14 | 19 |
| 37 | 14 | 20 |
| 38 | 15 | 20 |
| 39 | 15 | 21 |
| 40 | 16 | 21 |
| 41 | 16 | 22 |
| 42 | 16 | 22 |
| 43 | 17 | 23 |
| 44 | 17 | 23 |
| 45 | 18 | 24 |
| 46 | 18 | 25 |
| 47 | 18 | 25 |
| 48 | 19 | 26 |
| 49 | 19 | 26 |
| 50 | 20 | 27 |
| 51 | 20 | 27 |
| 52 | 20 | 28 |
| 53 | 21 | 28 |
| 54 | 21 | 29 |
| 55 | 22 | 29 |
| 56 | 22 | 30 |
| 57 | 22 | 30 |
| 58 | 23 | 31 |
| 59 | 23 | 31 |
| App. Alt. | = A ☉ | = A * |
| 3′ | 8 | 8 |
| 4 | 6 | 6 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (68° and 69°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | Seconds of H. P. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | ″ | ″ | ′ |
| 68° | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | | | |
| 0′ | 19 51 | 27 46 | 20 13 | 28 18 | 20 36 | 28 50 | 20 58 | 29 23 | 21 20 | 29 55 | 21 43 | 30 27 | 22 5 | 30 59 | 22 28 | 31 31 | 1 | 0 | 1 |
| 2 | 19 49 | 27 47 | 20 11 | 28 19 | 20 34 | 28 51 | 20 56 | 29 23 | 21 19 | 29 55 | 21 41 | 30 27 | 22 4 | 30 59 | 22 26 | 31 31 | 2 | 1 | 1 |
| 4 | 19 47 | 27 47 | 20 10 | 28 19 | 20 32 | 28 51 | 20 54 | 29 23 | 21 17 | 29 55 | 21 39 | 30 28 | 22 2 | 31 0 | 22 24 | 31 32 | 3 | 1 | 2 |
| 6 | 19 45 | 27 48 | 20 8 | 28 20 | 20 30 | 28 52 | 20 53 | 29 24 | 21 15 | 29 56 | 21 37 | 30 28 | 22 0 | 31 0 | 22 22 | 31 32 | 4 | 2 | 2 |
| 8 | 19 44 | 27 48 | 20 6 | 28 20 | 20 28 | 28 52 | 20 51 | 29 24 | 21 13 | 29 56 | 21 35 | 30 28 | 21 58 | 31 0 | 22 20 | 31 33 | 5 | 2 | 3 |
| 10 | 19 42 | 27 48 | 20 4 | 28 20 | 20 27 | 28 53 | 20 49 | 29 25 | 21 11 | 29 57 | 21 34 | 30 29 | 21 56 | 31 1 | 22 18 | 31 33 | 6 | 3 | 3 |
| 12 | 19 40 | 27 49 | 20 3 | 28 21 | 20 25 | 28 53 | 20 47 | 29 25 | 21 9 | 29 57 | 21 32 | 30 29 | 21 54 | 31 1 | 22 16 | 31 33 | 7 | 3 | 4 |
| 14 | 19 39 | 27 49 | 20 1 | 28 21 | 20 23 | 28 53 | 20 45 | 29 25 | 21 8 | 29 58 | 21 30 | 30 30 | 21 52 | 31 2 | 22 14 | 31 34 | 8 | 4 | 4 |
| 16 | 19 37 | 27 50 | 19 59 | 28 22 | 20 21 | 28 54 | 20 44 | 29 26 | 21 6 | 29 58 | 21 28 | 30 30 | 21 50 | 31 2 | 22 12 | 31 34 | 9 | 4 | 5 |
| 18 | 19 35 | 27 50 | 19 57 | 28 22 | 20 19 | 28 54 | 20 42 | 29 26 | 21 4 | 29 58 | 21 26 | 30 30 | 21 48 | 31 3 | 22 10 | 31 35 | 10 | 5 | 5 |
| 20 | 19 33 | 27 50 | 19 56 | 28 22 | 20 18 | 28 55 | 20 40 | 29 27 | 21 2 | 29 59 | 21 24 | 30 31 | 21 46 | 31 3 | 22 8 | 31 35 | 11 | 5 | 6 |
| 22 | 19 32 | 27 51 | 19 54 | 28 23 | 20 16 | 28 55 | 20 38 | 29 27 | 21 0 | 29 59 | 21 22 | 30 31 | 21 44 | 31 4 | 22 7 | 31 36 | 12 | 6 | 6 |
| 24 | 19 30 | 27 51 | 19 52 | 28 23 | 20 14 | 28 55 | 20 36 | 29 28 | 20 58 | 30 0 | 21 20 | 30 32 | 21 42 | 31 4 | 22 5 | 31 36 | 13 | 6 | 7 |
| 26 | 19 28 | 27 51 | 19 50 | 28 24 | 20 12 | 28 56 | 20 34 | 29 28 | 20 56 | 30 0 | 21 19 | 30 32 | 21 41 | 31 4 | 22 3 | 31 36 | 14 | 7 | 7 |
| 28 | 19 27 | 27 52 | 19 49 | 28 24 | 20 11 | 28 56 | 20 33 | 29 28 | 20 55 | 30 0 | 21 17 | 30 33 | 21 39 | 31 5 | 22 1 | 31 37 | 15 | 7 | 8 |
| 30 | 19 25 | 27 52 | 19 47 | 28 24 | 20 9 | 28 57 | 20 31 | 29 29 | 20 53 | 30 1 | 21 15 | 30 33 | 21 37 | 31 5 | 21 59 | 31 37 | 16 | 8 | 8 |
| 32 | 19 23 | 27 53 | 19 45 | 28 25 | 20 7 | 28 57 | 20 29 | 29 29 | 20 51 | 30 1 | 21 13 | 30 33 | 21 35 | 31 6 | 21 57 | 31 38 | 17 | 8 | 9 |
| 34 | 19 21 | 27 53 | 19 43 | 28 25 | 20 5 | 28 57 | 20 27 | 29 30 | 20 49 | 30 2 | 21 11 | 30 34 | 21 33 | 31 6 | 21 55 | 31 38 | 18 | 9 | 9 |
| 36 | 19 20 | 27 53 | 19 42 | 28 26 | 20 3 | 28 58 | 20 25 | 29 30 | 20 47 | 30 2 | 21 9 | 30 34 | 21 31 | 31 6 | 21 53 | 31 39 | 19 | 9 | 10 |
| 38 | 19 18 | 27 54 | 19 40 | 28 26 | 20 2 | 28 58 | 20 24 | 29 30 | 20 45 | 30 2 | 21 7 | 30 35 | 21 29 | 31 7 | 21 51 | 31 39 | 20 | 10 | 10 |
| 40 | 19 16 | 27 54 | 19 38 | 28 26 | 20 0 | 28 59 | 20 22 | 29 31 | 20 44 | 30 3 | 21 5 | 30 35 | 21 27 | 31 7 | 21 49 | 31 39 | 21 | 10 | 11 |
| 42 | 19 15 | 27 55 | 19 36 | 28 27 | 19 58 | 28 59 | 20 20 | 29 31 | 20 42 | 30 3 | 21 4 | 30 36 | 21 25 | 31 8 | 21 47 | 31 40 | 22 | 11 | 11 |
| 44 | 19 13 | 27 55 | 19 35 | 28 27 | 19 56 | 28 59 | 20 18 | 29 32 | 20 40 | 30 4 | 21 2 | 30 36 | 21 23 | 31 8 | 21 45 | 31 40 | 23 | 11 | 12 |
| 46 | 19 11 | 27 55 | 19 33 | 28 28 | 19 55 | 29 0 | 20 16 | 29 32 | 20 38 | 30 4 | 21 0 | 30 36 | 21 22 | 31 9 | 21 43 | 31 41 | 24 | 12 | 12 |
| 48 | 19 9 | 27 56 | 19 31 | 28 28 | 19 53 | 29 0 | 20 15 | 29 32 | 20 36 | 30 5 | 20 58 | 30 37 | 21 20 | 31 9 | 21 41 | 31 41 | 25 | 12 | 13 |
| 50 | 19 8 | 27 56 | 19 29 | 28 28 | 19 51 | 29 1 | 20 13 | 29 33 | 20 34 | 30 5 | 20 56 | 30 37 | 21 18 | 31 9 | 21 39 | 31 42 | 26 | 13 | 13 |
| 52 | 19 6 | 27 57 | 19 28 | 28 29 | 19 49 | 29 1 | 20 11 | 29 33 | 20 32 | 30 5 | 20 54 | 30 38 | 21 16 | 31 10 | 21 37 | 31 42 | 27 | 13 | 14 |
| 54 | 19 4 | 27 57 | 19 26 | 28 29 | 19 47 | 29 1 | 20 9 | 29 34 | 20 31 | 30 6 | 20 52 | 30 38 | 21 14 | 31 10 | 21 35 | 31 43 | 28 | 14 | 14 |
| 56 | 19 3 | 27 57 | 19 24 | 28 30 | 19 46 | 29 2 | 20 7 | 29 34 | 20 29 | 30 0 | 20 50 | 30 39 | 21 12 | 31 11 | 21 33 | 31 43 | 29 | 14 | 15 |
| 58 | 19 1 | 27 58 | 19 22 | 28 30 | 19 44 | 29 2 | 20 5 | 29 34 | 20 27 | 30 7 | 20 48 | 30 39 | 21 10 | 31 11 | 21 32 | 31 43 | 30 | 15 | 15 |
| 69° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | | 31 | 15 | 16 |
| 0′ | 18 59 | 27 58 | 19 21 | 28 30 | 19 42 | 29 3 | 20 4 | 29 35 | 20 25 | 30 7 | 20 47 | 30 39 | 21 8 | 31 12 | 21 30 | 31 44 | 32 | 16 | 16 |
| 2 | 18 57 | 27 58 | 19 19 | 28 31 | 19 40 | 29 3 | 20 2 | 29 35 | 20 23 | 30 7 | 20 45 | 30 40 | 21 6 | 31 12 | 21 28 | 31 44 | 33 | 16 | 17 |
| 4 | 18 56 | 27 59 | 19 17 | 28 31 | 19 38 | 29 3 | 20 0 | 29 36 | 20 21 | 30 8 | 20 43 | 30 40 | 21 4 | 31 12 | 21 26 | 31 45 | 34 | 17 | 17 |
| 6 | 18 54 | 27 59 | 19 15 | 28 32 | 19 37 | 29 4 | 19 58 | 29 36 | 20 20 | 30 8 | 20 41 | 30 41 | 21 2 | 31 13 | 21 24 | 31 45 | 35 | 17 | 18 |
| 8 | 18 52 | 28 0 | 19 14 | 28 32 | 19 35 | 29 4 | 19 56 | 29 36 | 20 18 | 30 9 | 20 39 | 30 41 | 21 0 | 31 13 | 21 22 | 31 46 | 36 | 18 | 18 |
| 10 | 18 50 | 28 0 | 19 12 | 28 32 | 19 33 | 29 5 | 19 54 | 29 37 | 20 16 | 30 9 | 20 37 | 30 41 | 20 58 | 31 14 | 21 20 | 31 46 | 37 | 18 | 19 |
| 12 | 18 49 | 28 0 | 19 10 | 28 33 | 19 31 | 29 5 | 19 53 | 29 37 | 20 14 | 30 9 | 20 35 | 30 42 | 20 57 | 31 14 | 21 18 | 31 46 | 38 | 19 | 19 |
| 14 | 18 47 | 28 1 | 19 8 | 28 33 | 19 29 | 29 5 | 19 51 | 29 38 | 20 12 | 30 10 | 20 33 | 30 42 | 20 55 | 31 15 | 21 16 | 31 47 | 39 | 19 | 20 |
| 16 | 18 45 | 28 1 | 19 7 | 28 33 | 19 28 | 29 6 | 19 49 | 29 38 | 20 10 | 30 10 | 20 31 | 30 43 | 20 53 | 31 15 | 21 14 | 31 47 | 40 | 20 | 20 |
| 18 | 18 44 | 28 1 | 19 5 | 28 34 | 19 26 | 29 6 | 19 47 | 29 38 | 20 8 | 30 11 | 20 30 | 30 43 | 20 51 | 31 15 | 21 12 | 31 48 | 41 | 20 | 21 |
| 20 | 18 42 | 28 2 | 19 3 | 28 34 | 19 24 | 29 6 | 19 45 | 29 39 | 20 6 | 30 11 | 20 28 | 30 43 | 20 49 | 31 16 | 21 10 | 31 48 | 42 | 21 | 21 |
| 22 | 18 40 | 28 2 | 19 1 | 28 34 | 19 22 | 29 7 | 19 43 | 29 39 | 20 5 | 30 11 | 20 26 | 30 44 | 20 47 | 31 16 | 21 8 | 31 49 | 43 | 21 | 22 |
| 24 | 18 38 | 28 3 | 18 59 | 28 35 | 19 21 | 29 7 | 19 42 | 29 40 | 20 3 | 30 12 | 20 24 | 30 44 | 20 45 | 31 17 | 21 6 | 31 49 | 44 | 22 | 22 |
| 26 | 18 37 | 28 3 | 18 58 | 28 35 | 19 19 | 29 8 | 19 40 | 29 40 | 20 1 | 30 12 | 20 22 | 30 45 | 20 43 | 31 17 | 21 4 | 31 49 | 45 | 22 | 23 |
| 28 | 18 35 | 28 3 | 18 56 | 28 36 | 19 17 | 29 8 | 19 38 | 29 40 | 19 59 | 30 13 | 20 20 | 30 45 | 20 41 | 31 17 | 21 2 | 31 50 | 46 | 23 | 23 |
| 30 | 18 33 | 28 4 | 18 54 | 28 36 | 19 15 | 29 8 | 19 36 | 29 41 | 19 57 | 30 13 | 20 18 | 30 45 | 20 39 | 31 18 | 21 0 | 31 50 | 47 | 23 | 24 |
| 32 | 18 31 | 28 4 | 18 52 | 28 36 | 19 13 | 29 9 | 19 34 | 29 41 | 19 55 | 30 13 | 20 16 | 30 46 | 20 37 | 31 18 | 20 58 | 31 51 | 48 | 24 | 24 |
| 34 | 18 30 | 28 4 | 18 51 | 28 37 | 19 12 | 29 9 | 19 33 | 29 42 | 19 53 | 30 14 | 20 14 | 30 46 | 20 35 | 31 19 | 20 56 | 31 51 | 49 | 24 | 25 |
| 36 | 18 28 | 28 5 | 18 49 | 28 37 | 19 10 | 29 10 | 19 31 | 29 42 | 19 52 | 30 14 | 20 13 | 30 47 | 20 33 | 31 19 | 20 54 | 31 51 | 50 | 25 | 25 |
| 38 | 18 26 | 28 5 | 18 47 | 28 38 | 19 8 | 29 10 | 19 29 | 29 42 | 19 50 | 30 15 | 20 11 | 30 47 | 20 32 | 31 19 | 20 52 | 31 52 | 51 | 25 | 26 |
| 40 | 18 24 | 28 5 | 18 45 | 28 38 | 19 6 | 29 10 | 19 27 | 29 43 | 19 48 | 30 15 | 20 9 | 30 47 | 20 30 | 31 20 | 20 50 | 31 52 | 52 | 26 | 26 |
| 42 | 18 23 | 28 6 | 18 44 | 28 38 | 19 4 | 29 11 | 19 25 | 29 43 | 19 46 | 30 15 | 20 7 | 30 48 | 20 28 | 31 20 | 20 49 | 31 53 | 53 | 26 | 27 |
| 44 | 18 21 | 28 6 | 18 42 | 28 39 | 19 3 | 29 11 | 19 23 | 29 43 | 19 44 | 30 16 | 20 5 | 30 48 | 20 26 | 31 21 | 20 47 | 31 53 | 54 | 27 | 27 |
| 46 | 18 19 | 28 7 | 18 40 | 28 39 | 19 1 | 29 11 | 19 22 | 29 44 | 19 42 | 30 16 | 20 3 | 30 49 | 20 24 | 31 21 | 20 45 | 31 54 | 55 | 27 | 28 |
| 48 | 18 18 | 28 7 | 18 38 | 28 39 | 18 59 | 29 12 | 19 20 | 29 44 | 19 40 | 30 17 | 20 1 | 30 49 | 20 22 | 31 22 | 20 43 | 31 54 | 56 | 28 | 28 |
| 50 | 18 16 | 28 7 | 18 37 | 28 40 | 18 57 | 29 12 | 19 18 | 29 45 | 19 39 | 30 17 | 19 59 | 30 50 | 20 20 | 31 22 | 20 41 | 31 54 | 57 | 28 | 29 |
| 52 | 18 14 | 28 8 | 18 35 | 28 40 | 18 55 | 29 13 | 19 16 | 29 45 | 19 37 | 30 17 | 19 57 | 30 50 | 20 18 | 31 22 | 20 39 | 31 55 | 58 | 29 | 29 |
| 54 | 18 12 | 28 8 | 18 33 | 28 41 | 18 54 | 29 13 | 19 14 | 29 45 | 19 35 | 30 18 | 19 55 | 30 50 | 20 16 | 31 23 | 20 37 | 31 55 | 59 | 29 | 30 |
| 56 | 18 11 | 28 9 | 18 31 | 28 41 | 18 52 | 29 13 | 19 12 | 29 46 | 19 33 | 30 18 | 19 54 | 30 51 | 20 14 | 31 23 | 20 35 | 31 55 | 60 | 30 | 30 |
| 58 | 18 9 | 28 9 | 18 29 | 28 41 | 18 50 | 29 14 | 19 11 | 29 46 | 19 31 | 30 19 | 19 52 | 30 51 | 20 12 | 31 24 | 20 33 | 31 56 | | | |

| Alt. ☉ | A ″ |
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| 0 | 0 |
| 3 | 1 |
| 8 | 2 |
| 14 | 3 |
| 20 | 4 |
| 27 | 5 |
| 34 | 6 |
| 41 | 7 |
| 48 | 8 |
| 55 | 9 |
| 62 | 10 |
| 69 | 11 |
| 76 | 12 |
| 83 | 13 |
| 90 | 14 |

(70° and 71°) The Correction of the Moon's Altitude, and the Aux. Angle A. (W.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57 | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 70° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 18 7 | 28 9 | 18 28 | 28 42 | 18 48 | 29 14 | 19 9 | 29 47 | 19 29 | 30 19 | 19 50 | 30 52 | 20 10 | 31 24 | 20 31 | 31 56 |
| 2 | 18 5 | 28 10 | 18 26 | 28 42 | 18 46 | 29 15 | 19 7 | 29 47 | 19 27 | 30 19 | 19 48 | 30 52 | 20 8 | 31 24 | 20 29 | 31 57 |
| 4 | 18 4 | 28 10 | 18 24 | 28 43 | 18 45 | 29 15 | 19 5 | 29 47 | 19 26 | 30 20 | 19 46 | 30 52 | 20 7 | 31 25 | 20 27 | 31 57 |
| 6 | 18 2 | 28 10 | 18 22 | 28 43 | 18 43 | 29 15 | 19 3 | 29 48 | 19 24 | 30 20 | 19 44 | 30 53 | 20 5 | 31 25 | 20 25 | 31 58 |
| 8 | 18 0 | 28 11 | 18 21 | 28 43 | 18 41 | 29 16 | 19 1 | 29 48 | 19 22 | 30 21 | 19 42 | 30 53 | 20 3 | 31 26 | 20 23 | 31 58 |
| 10 | 17 58 | 28 11 | 18 19 | 28 44 | 18 39 | 29 16 | 19 0 | 29 49 | 19 20 | 30 21 | 19 40 | 30 54 | 20 1 | 31 26 | 20 21 | 31 59 |
| 12 | 17 57 | 28 11 | 18 17 | 28 44 | 18 37 | 29 16 | 18 58 | 29 49 | 19 18 | 30,21 | 19 38 | 30 54 | 19 59 | 31 26 | 20 19 | 31 59 |
| 14 | 17 55 | 28 12 | 18 15 | 28 44 | 18 36 | 29 17 | 18 56 | 29 49 | 19 16 | 30 22 | 19 36 | 30 54 | 19 57 | 31 27 | 20 17 | 31 59 |
| 16 | 17 53 | 28 12 | 18 14 | 28 45 | 18 34 | 29 17 | 18 54 | 29 50 | 19 14 | 30 22 | 19 35 | 30 55 | 19 55 | 31 27 | 20 15 | 32 0 |
| 18 | 17 52 | 28 13 | 18 12 | 28 45 | 18 32 | 29 18 | 18 52 | 29 50 | 19 12 | 30 23 | 19 33 | 30 55 | 19 53 | 31 28 | 20 13 | 32 0 |
| 20 | 17 50 | 28 13 | 18 10 | 28 45 | 18 30 | 29 18 | 18 50 | 29 50 | 19 11 | 30 23 | 19 31 | 30 55 | 19 51 | 31 28 | 20 11 | 32 1 |
| 22 | 17 48 | 28 13 | 18 8 | 28 46 | 18 28 | 29 18 | 18 49 | 29 51 | 19 9 | 30 23 | 19 29 | 30 56 | 19 49 | 31 29 | 20 9 | 32 1 |
| 24 | 17 46 | 28 14 | 18 6 | 28 46 | 18 27 | 29 19 | 18 47 | 29 51 | 19 7 | 30 24 | 19 27 | 30 56 | 19 47 | 31 29 | 20 7 | 32 1 |
| 26 | 17 45 | 28 14 | 18 5 | 28 47 | 18 25 | 29 19 | 18 45 | 29 52 | 19 5 | 30 24 | 19 25 | 30 57 | 19 45 | 31 29 | 20 5 | 32 2 |
| 28 | 17 43 | 28 14 | 18 3 | 28 47 | 18 23 | 29 19 | 18 43 | 29 52 | 19 3 | 30 25 | 19 23 | 30 57 | 19 43 | 31 30 | 20 3 | 32 2 |
| 30 | 17 41 | 28 15 | 18 1 | 28 47 | 18 21 | 29 20 | 18 41 | 29 52 | 19 1 | 30 25 | 19 21 | 30 58 | 19 41 | 31 30 | 20 1 | 32 3 |
| 32 | 17 39 | 28 15 | 17 59 | 28 48 | 18 19 | 29 20 | 18 39 | 29 53 | 18 59 | 30 25 | 19 19 | 30 58 | 19 39 | 31 31 | 19 59 | 32 3 |
| 34 | 17 38 | 28 15 | 17 58 | 28 48 | 18 18 | 29 21 | 18 38 | 29 53 | 18 58 | 30 26 | 19 18 | 30 58 | 19 37 | 31 31 | 19 58 | 32 4 |
| 36 | 17 36 | 28 16 | 17 56 | 28 48 | 18 16 | 29 21 | 18 36 | 29 54 | 18 56 | 30 26 | 19 16 | 30 59 | 19 36 | 31 31 | 19 56 | 32 4 |
| 38 | 17 34 | 28 16 | 17 54 | 28 49 | 18 14 | 29 21 | 18 34 | 29 54 | 18 54 | 30 27 | 19 14 | 30 59 | 19 34 | 31 32 | 19 54 | 32 4 |
| 40 | 17 32 | 28 17 | 17 52 | 28 49 | 18 12 | 29 22 | 18 32 | 29 54 | 18 52 | 30 27 | 19 12 | 31 0 | 19 32 | 31 32 | 19 52 | 32 5 |
| 42 | 17 31 | 28 17 | 17 51 | 28 50 | 18 10 | 29 22 | 18 30 | 29 55 | 18 50 | 30 27 | 19 10 | 31 0 | 19 30 | 31 33 | 19 50 | 32 5 |
| 44 | 17 29 | 28 17 | 17 49 | 28 50 | 18 9 | 29 23 | 18 28 | 29 55 | 18 48 | 30 28 | 19 8 | 31 0 | 19 28 | 31 33 | 19 48 | 32 6 |
| 46 | 17 27 | 28 18 | 17 47 | 28 50 | 18 7 | 29 23 | 18 27 | 29 56 | 18 46 | 30 28 | 19 6 | 31 1 | 19 26 | 31 33 | 19 46 | 32 6 |
| 48 | 17 26 | 28 18 | 17 45 | 28 51 | 18 5 | 29 23 | 18 25 | 29 56 | 18 45 | 30 29 | 19 4 | 31 1 | 19 24 | 31 34 | 19 44 | 32 6 |
| 50 | 17 24 | 28 18 | 17 44 | 28 51 | 18 3 | 29 24 | 18 23 | 29 56 | 18 43 | 30 29 | 19 2 | 31 2 | 19 22 | 31 34 | 19 42 | 32 7 |
| 52 | 17 22 | 28 19 | 17 42 | 28 51 | 18 1 | 29 24 | 18 21 | 29 57 | 18 41 | 30 29 | 19 0 | 31 2 | 19 20 | 31 35 | 19 40 | 32 7 |
| 54 | 17 20 | 28 19 | 17 40 | 28 52 | 18 0 | 29 24 | 18 19 | 29 57 | 18 39 | 30 30 | 18 59 | 31 2 | 19 18 | 31 35 | 19 38 | 32 8 |
| 56 | 17 19 | 28 19 | 17 38 | 28 52 | 17 58 | 29 25 | 18 17 | 29 57 | 18 37 | 30 30 | 18 57 | 31 3 | 19 16 | 31 35 | 19 36 | 32 8 |
| 58 | 17 17 | 28 20 | 17 36 | 28 53 | 17 56 | 29 25 | 18 16 | 29 58 | 18 35 | 30 31 | 18 55 | 31 3 | 19 14 | 31 36 | 19 34 | 32 8 |
| 71° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 17 15 | 28 20 | 17 35 | 28 53 | 17 54 | 29 25 | 18 14 | 29 58 | 18 33 | 30 31 | 18 53 | 31 4 | 19 12 | 31 36 | 19 32 | 32 9 |
| 2 | 17 13 | 28 21 | 17 33 | 28 53 | 17 52 | 29 26 | 18 12 | 29 59 | 18 32 | 30 31 | 18 51 | 31 4 | 19 11 | 31 37 | 19 30 | 32 9 |
| 4 | 17 12 | 28 21 | 17 31 | 28 54 | 17 51 | 29 26 | 18 10 | 29 59 | 18 30 | 30 32 | 18 49 | 31 4 | 19 9 | 31 37 | 19 28 | 32 10 |
| 6 | 17 10 | 28 21 | 17 29 | 28 54 | 17 49 | 29 27 | 18 8 | 29 59 | 18 28 | 30 32 | 18 47 | 31 5 | 19 7 | 31 37 | 19 26 | 32 10 |
| 8 | 17 8 | 28 22 | 17 28 | 28 54 | 17 47 | 29 27 | 18 6 | 30 0 | 18 26 | 30 32 | 18 45 | 31 5 | 19 5 | 31 38 | 19 24 | 32 10 |
| 10 | 17 6 | 28 22 | 17 26 | 28 55 | 17 45 | 29 27 | 18 5 | 30 0 | 18 24 | 30 33 | 18 43 | 31 5 | 19 3 | 31 38 | 19 22 | 32 11 |
| 12 | 17 5 | 28 22 | 17 24 | 28 55 | 17 43 | 29 28 | 18 3 | 30 0 | 18 22 | 30 33 | 18 41 | 31 6 | 19 1 | 31 38 | 19 20 | 32 11 |
| 14 | 17 3 | 28 23 | 17 22 | 28 55 | 17 42 | 29 28 | 18 1 | 30 1 | 18 20 | 30 33 | 18 39 | 31 6 | 18 59 | 31 39 | 19 18 | 32 12 |
| 16 | 17 1 | 28 23 | 17 20 | 28 56 | 17 40 | 29 28 | 17 59 | 30 1 | 18 18 | 30 34 | 18 38 | 31 6 | 18 57 | 31 39 | 19 16 | 32 12 |
| 18 | 16 59 | 28 23 | 17 19 | 28 56 | 17 38 | 29 29 | 17 57 | 30 1 | 18 16 | 30 34 | 18 36 | 31 7 | 18 55 | 31 39 | 19 14 | 32 12 |
| 20 | 16 58 | 28 24 | 17 17 | 28 56 | 17 36 | 29 29 | 17 55 | 30 2 | 18 14 | 30 34 | 18 34 | 31 7 | 18 53 | 31 40 | 19 12 | 32 13 |
| 22 | 16 56 | 28 24 | 17 15 | 28 57 | 17 34 | 29 29 | 17 53 | 30 2 | 18 13 | 30 35 | 18 32 | 31 7 | 18 51 | 31 40 | 19 10 | 32 13 |
| 24 | 16 54 | 28 24 | 17 13 | 28 57 | 17 32 | 29 30 | 17 52 | 30 2 | 18 11 | 30 35 | 18 30 | 31 8 | 18 49 | 31 41 | 19 8 | 32 13 |
| 26 | 16 52 | 28 25 | 17 12 | 28 57 | 17 31 | 29 30 | 17 50 | 30 3 | 18 9 | 30 36 | 18 28 | 31 8 | 18 47 | 31 41 | 19 6 | 32 14 |
| 28 | 16 51 | 28 25 | 17 10 | 28 58 | 17 29 | 29 30 | 17 48 | 30 3 | 18 7 | 30 36 | 18 26 | 31 9 | 18 45 | 31 41 | 19 4 | 32 14 |
| 30 | 16 49 | 28 25 | 17 8 | 28 58 | 17 27 | 29 31 | 17 46 | 30 4 | 18 5 | 30 36 | 18 24 | 31 9 | 18 43 | 31 42 | 19 2 | 32 15 |
| 32 | 16 47 | 28 26 | 17 6 | 28 58 | 17 25 | 29 31 | 17 44 | 30 4 | 18 3 | 30 37 | 18 22 | 31 9 | 18 41 | 31 42 | 19 0 | 32 15 |
| 34 | 16 45 | 28 26 | 17 4 | 28 59 | 17 23 | 29 32 | 17 42 | 30 4 | 18 1 | 30 37 | 18 20 | 31 10 | 18 39 | 31 43 | 18 58 | 32 15 |
| 36 | 16 44 | 28 26 | 17 3 | 28 59 | 17 22 | 29 32 | 17 40 | 30 5 | 17 59 | 30 37 | 18 18 | 31 10 | 18 37 | 31 43 | 18 56 | 32 16 |
| 38 | 16 42 | 28 27 | 17 1 | 28 59 | 17 20 | 29 32 | 17 39 | 30 5 | 17 58 | 30 38 | 18 17 | 31 11 | 18 35 | 31 43 | 18 54 | 32 16 |
| 40 | 16 40 | 28 27 | 16 59 | 29 0 | 17 18 | 29 33 | 17 37 | 30 5 | 17 56 | 30 38 | 18 15 | 31 11 | 18 33 | 31 44 | 18 52 | 32 16 |
| 42 | 16 38 | 28 27 | 16 57 | 29 0 | 17 16 | 29 33 | 17 35 | 30 6 | 17 54 | 30 38 | 18 13 | 31 11 | 18 31 | 31 44 | 18 50 | 32 17 |
| 44 | 16 37 | 28 28 | 16 55 | 29 0 | 17 14 | 29 33 | 17 33 | 30 6 | 17 52 | 30 39 | 18 11 | 31 12 | 18 29 | 31 44 | 18 48 | 32 17 |
| 46 | 16 35 | 28 28 | 16 54 | 29 1 | 17 12 | 29 34 | 17 31 | 30 7 | 17 50 | 30 39 | 18 9 | 31 12 | 18 27 | 31 45 | 18 46 | 32 18 |
| 48 | 16 33 | 28 28 | 16 52 | 29 1 | 17 11 | 29 34 | 17 29 | 30 7 | 17 48 | 30 40 | 18 7 | 31 12 | 18 26 | 31 45 | 18 44 | 32 18 |
| 50 | 16 31 | 28 29 | 16 50 | 29 1 | 17 9 | 29 34 | 17 28 | 30 7 | 17 46 | 30 40 | 18 5 | 31 13 | 18 24 | 31 46 | 18 42 | 32 18 |
| 52 | 16 30 | 28 29 | 16 48 | 29 2 | 17 7 | 29 35 | 17 26 | 30 8 | 17 44 | 30 40 | 18 3 | 31 13 | 18 22 | 31 46 | 18 40 | 32 19 |
| 54 | 16 28 | 28 29 | 16 47 | 29 2 | 17 5 | 29 35 | 17 24 | 30 8 | 17 43 | 30 41 | 18 1 | 31 13 | 18 20 | 31 46 | 18 38 | 32 19 |
| 56 | 16 26 | 28 30 | 16 45 | 29 3 | 17 3 | 29 35 | 17 22 | 30 8 | 17 41 | 30 41 | 17 59 | 31 14 | 18 18 | 31 47 | 18 36 | 32 20 |
| 58 | 16 24 | 28 30 | 16 43 | 29 3 | 17 2 | 29 36 | 17 20 | 30 9 | 17 39 | 30 41 | 17 57 | 31 14 | 18 16 | 31 47 | 18 34 | 32 20 |

| Seconds of H. P. | | |
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| 56 | 18 | 30 |
| 57 | 19 | 31 |
| 58 | 19 | 31 |
| 59 | 19 | 32 |
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| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (72° and 73°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 72° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 16 23 | 28 30 | 16 41 | 29 3 | 17 0 | 29 36 | 17 18 | 30 9 | 17 37 | 30 42 | 17 55 | 31 15 | 18 14 | 31 47 | 18 32 | 32 20 |
| 2 | 16 21 | 28 31 | 16 39 | 29 4 | 16 58 | 29 36 | 17 16 | 30 9 | 17 35 | 30 42 | 17 53 | 31 15 | 18 12 | 31 48 | 18 30 | 32 21 |
| 4 | 16 19 | 28 31 | 16 38 | 29 4 | 16 56 | 29 37 | 17 15 | 30 10 | 17 33 | 30 42 | 17 52 | 31 15 | 18 10 | 31 48 | 18 28 | 32 21 |
| 6 | 16 17 | 28 31 | 16 36 | 29 4 | 16 54 | 29 37 | 17 13 | 30 10 | 17 31 | 30 43 | 17 50 | 31 16 | 18 8 | 31 49 | 18 26 | 32 21 |
| 8 | 16 16 | 28 32 | 16 34 | 29 5 | 16 52 | 29 37 | 17 11 | 30 10 | 17 29 | 30 43 | 17 48 | 31 16 | 18 6 | 31 49 | 18 24 | 32 22 |
| 10 | 16 14 | 28 32 | 16 32 | 29 5 | 16 51 | 29 38 | 17 9 | 30 11 | 17 27 | 30 43 | 17 46 | 31 16 | 18 4 | 31 49 | 18 22 | 32 22 |
| 12 | 16 12 | 28 32 | 16 30 | 29 5 | 16 49 | 29 38 | 17 7 | 30 11 | 17 25 | 30 44 | 17 44 | 31 17 | 18 2 | 31 50 | 18 20 | 32 22 |
| 14 | 16 10 | 28 33 | 16 29 | 29 6 | 16 47 | 29 38 | 17 5 | 30 11 | 17 24 | 30 44 | 17 42 | 31 17 | 18 0 | 31 50 | 18 18 | 32 23 |
| 16 | 16 9 | 28 33 | 16 27 | 29 6 | 16 45 | 29 39 | 17 3 | 30 12 | 17 22 | 30 45 | 17 40 | 31 17 | 17 58 | 31 50 | 18 16 | 32 23 |
| 18 | 16 7 | 28 33 | 16 25 | 29 6 | 16 43 | 29 39 | 17 2 | 30 12 | 17 20 | 30 45 | 17 38 | 31 18 | 17 56 | 31 51 | 18 14 | 32 24 |
| 20 | 16 5 | 28 34 | 16 23 | 29 6 | 16 41 | 29 39 | 17 0 | 30 12 | 17 18 | 30 45 | 17 36 | 31 18 | 17 54 | 31 51 | 18 12 | 32 24 |
| 22 | 16 3 | 28 34 | 16 21 | 29 7 | 16 40 | 29 40 | 16 58 | 30 13 | 17 16 | 30 46 | 17 34 | 31 18 | 17 52 | 31 51 | 18 11 | 32 24 |
| 24 | 16 2 | 28 34 | 16 20 | 29 7 | 16 38 | 29 40 | 16 56 | 30 13 | 17 14 | 30 46 | 17 32 | 31 19 | 17 50 | 31 52 | 18 9 | 32 25 |
| 26 | 16 0 | 28 35 | 16 18 | 29 7 | 16 36 | 29 41 | 16 54 | 30 13 | 17 12 | 30 46 | 17 30 | 31 19 | 17 48 | 31 52 | 18 7 | 32 25 |
| 28 | 15 58 | 28 35 | 16 16 | 29 8 | 16 34 | 29 41 | 16 52 | 30 14 | 17 10 | 30 47 | 17 28 | 31 19 | 17 46 | 31 52 | 18 5 | 32 25 |
| 30 | 15 56 | 28 35 | 16 14 | 29 8 | 16 32 | 29 41 | 16 50 | 30 14 | 17 8 | 30 47 | 17 26 | 31 20 | 17 44 | 31 53 | 18 3 | 32 26 |
| 32 | 15 54 | 28 35 | 16 12 | 29 8 | 16 31 | 29 42 | 16 49 | 30 14 | 17 6 | 30 47 | 17 25 | 31 20 | 17 43 | 31 53 | 18 1 | 32 26 |
| 34 | 15 53 | 28 36 | 16 11 | 29 9 | 16 29 | 29 42 | 16 47 | 30 15 | 17 5 | 30 48 | 17 23 | 31 21 | 17 41 | 31 53 | 17 59 | 32 26 |
| 36 | 15 51 | 28 36 | 16 9 | 29 9 | 16 27 | 29 42 | 16 45 | 30 15 | 17 3 | 30 48 | 17 21 | 31 21 | 17 39 | 31 54 | 17 57 | 32 27 |
| 38 | 15 49 | 28 36 | 16 7 | 29 9 | 16 25 | 29 43 | 16 43 | 30 15 | 17 1 | 30 49 | 17 19 | 31 21 | 17 37 | 31 54 | 17 55 | 32 27 |
| 40 | 15 47 | 28 37 | 16 5 | 29 10 | 16 23 | 29 43 | 16 41 | 30 16 | 16 59 | 30 49 | 17 17 | 31 22 | 17 35 | 31 54 | 17 53 | 32 27 |
| 42 | 15 46 | 28 37 | 16 4 | 29 10 | 16 21 | 29 43 | 16 39 | 30 16 | 16 57 | 30 49 | 17 14 | 31 22 | 17 33 | 31 55 | 17 51 | 32 28 |
| 44 | 15 44 | 28 37 | 16 2 | 29 10 | 16 20 | 29 43 | 16 37 | 30 16 | 16 55 | 30 49 | 17 12 | 31 22 | 17 31 | 31 55 | 17 49 | 32 28 |
| 46 | 15 42 | 28 38 | 16 0 | 29 11 | 16 18 | 29 44 | 16 36 | 30 17 | 16 53 | 30 50 | 17 10 | 31 23 | 17 29 | 31 56 | 17 47 | 32 29 |
| 48 | 15 40 | 28 38 | 15 58 | 29 11 | 16 16 | 29 44 | 16 34 | 30 17 | 16 51 | 30 50 | 17 9 | 31 23 | 17 27 | 31 56 | 17 45 | 32 29 |
| 50 | 15 39 | 28 38 | 15 56 | 29 11 | 16 14 | 29 44 | 16 32 | 30 17 | 16 49 | 30 50 | 17 7 | 31 23 | 17 25 | 31 56 | 17 43 | 32 29 |
| 52 | 15 37 | 28 39 | 15 55 | 29 12 | 16 12 | 29 45 | 16 30 | 30 18 | 16 48 | 30 51 | 17 5 | 31 24 | 17 23 | 31 57 | 17 41 | 32 30 |
| 54 | 15 35 | 28 39 | 15 53 | 29 12 | 16 10 | 29 45 | 16 28 | 30 18 | 16 46 | 30 51 | 17 3 | 31 24 | 17 21 | 31 57 | 17 39 | 32 30 |
| 56 | 15 33 | 28 39 | 15 51 | 29 12 | 16 9 | 29 45 | 16 26 | 30 18 | 16 44 | 30 51 | 17 1 | 31 24 | 17 19 | 31 57 | 17 37 | 32 30 |
| 58 | 15 32 | 28 40 | 15 49 | 29 13 | 16 7 | 29 46 | 16 24 | 30 19 | 16 42 | 30 52 | 16 59 | 31 25 | 17 17 | 31 58 | 17 35 | 32 31 |

| 73° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 15 30 | 28 40 | 15 47 | 29 13 | 16 5 | 29 46 | 16 22 | 30 19 | 16 40 | 30 52 | 16 57 | 31 25 | 17 15 | 31 58 | 17 33 | 32 31 |
| 2 | 15 28 | 28 40 | 15 46 | 29 13 | 16 3 | 29 46 | 16 21 | 30 19 | 16 38 | 30 52 | 16 56 | 31 25 | 17 13 | 31 59 | 17 31 | 32 32 |
| 4 | 15 26 | 28 40 | 15 44 | 29 14 | 16 1 | 29 47 | 16 19 | 30 20 | 16 36 | 30 53 | 16 54 | 31 26 | 17 11 | 31 59 | 17 29 | 32 32 |
| 6 | 15 24 | 28 41 | 15 42 | 29 14 | 15 59 | 29 47 | 16 17 | 30 20 | 16 34 | 30 53 | 16 52 | 31 26 | 17 9 | 31 59 | 17 27 | 32 32 |
| 8 | 15 23 | 28 41 | 15 40 | 29 14 | 15 58 | 29 47 | 16 15 | 30 20 | 16 32 | 30 53 | 16 50 | 31 26 | 17 7 | 32 0 | 17 25 | 32 33 |
| 10 | 15 21 | 28 41 | 15 38 | 29 14 | 15 56 | 29 48 | 16 13 | 30 21 | 16 30 | 30 54 | 16 48 | 31 27 | 17 5 | 32 0 | 17 23 | 32 33 |
| 12 | 15 19 | 28 42 | 15 37 | 29 15 | 15 54 | 29 48 | 16 11 | 30 21 | 16 29 | 30 54 | 16 46 | 31 27 | 17 3 | 32 0 | 17 21 | 32 33 |
| 14 | 15 17 | 28 42 | 15 35 | 29 15 | 15 52 | 29 48 | 16 9 | 30 21 | 16 27 | 30 54 | 16 44 | 31 27 | 17 1 | 32 1 | 17 19 | 32 34 |
| 16 | 15 16 | 28 42 | 15 33 | 29 15 | 15 50 | 29 48 | 16 7 | 30 22 | 16 25 | 30 55 | 16 42 | 31 28 | 16 59 | 32 1 | 17 17 | 32 34 |
| 18 | 15 14 | 28 43 | 15 31 | 29 16 | 15 48 | 29 49 | 16 6 | 30 22 | 16 23 | 30 55 | 16 40 | 31 28 | 16 57 | 32 1 | 17 15 | 32 34 |
| 20 | 15 12 | 28 43 | 15 29 | 29 16 | 15 46 | 29 49 | 16 4 | 30 22 | 16 21 | 30 55 | 16 38 | 31 28 | 16 55 | 32 1 | 17 13 | 32 35 |
| 22 | 15 10 | 28 43 | 15 27 | 29 16 | 15 45 | 29 49 | 16 2 | 30 23 | 16 19 | 30 56 | 16 36 | 31 29 | 16 53 | 32 2 | 17 11 | 32 35 |
| 24 | 15 9 | 28 44 | 15 26 | 29 17 | 15 43 | 29 50 | 16 0 | 30 23 | 16 17 | 30 56 | 16 34 | 31 29 | 16 51 | 32 2 | 17 9 | 32 35 |
| 26 | 15 7 | 28 44 | 15 24 | 29 17 | 15 41 | 29 50 | 15 58 | 30 23 | 16 15 | 30 56 | 16 32 | 31 29 | 16 49 | 32 3 | 17 7 | 32 36 |
| 28 | 15 5 | 28 44 | 15 22 | 29 17 | 15 39 | 29 50 | 15 56 | 30 24 | 16 13 | 30 57 | 16 30 | 31 30 | 16 47 | 32 3 | 17 5 | 32 36 |
| 30 | 15 3 | 28 44 | 15 20 | 29 18 | 15 37 | 29 51 | 15 54 | 30 24 | 16 11 | 30 57 | 16 28 | 31 30 | 16 45 | 32 3 | 17 3 | 32 36 |
| 32 | 15 1 | 28 45 | 15 18 | 29 18 | 15 36 | 29 51 | 15 53 | 30 24 | 16 9 | 30 57 | 16 27 | 31 30 | 16 44 | 32 4 | 17 1 | 32 37 |
| 34 | 15 0 | 28 45 | 15 17 | 29 18 | 15 34 | 29 51 | 15 51 | 30 25 | 16 8 | 30 58 | 16 25 | 31 31 | 16 42 | 32 4 | 16 59 | 32 37 |
| 36 | 14 58 | 28 45 | 15 15 | 29 19 | 15 32 | 29 52 | 15 48 | 30 25 | 16 6 | 30 58 | 16 23 | 31 31 | 16 40 | 32 4 | 16 57 | 32 37 |
| 38 | 14 56 | 28 46 | 15 13 | 29 19 | 15 30 | 29 52 | 15 47 | 30 25 | 16 4 | 30 58 | 16 21 | 31 31 | 16 38 | 32 5 | 16 55 | 32 38 |
| 40 | 14 54 | 28 46 | 15 11 | 29 19 | 15 28 | 29 52 | 15 45 | 30 25 | 16 2 | 30 59 | 16 19 | 31 32 | 16 36 | 32 5 | 16 53 | 32 38 |
| 42 | 14 53 | 28 46 | 15 9 | 29 19 | 15 26 | 29 53 | 15 43 | 30 26 | 16 0 | 30 59 | 16 17 | 31 32 | 16 34 | 32 5 | 16 51 | 32 39 |
| 44 | 14 51 | 28 47 | 15 8 | 29 20 | 15 25 | 29 53 | 15 41 | 30 26 | 15 58 | 30 59 | 16 15 | 31 32 | 16 32 | 32 6 | 16 49 | 32 39 |
| 46 | 14 49 | 28 47 | 15 6 | 29 20 | 15 23 | 29 53 | 15 39 | 30 26 | 15 56 | 31 0 | 16 13 | 31 33 | 16 30 | 32 6 | 16 47 | 32 39 |
| 48 | 14 47 | 28 47 | 15 4 | 29 20 | 15 21 | 29 54 | 15 38 | 30 27 | 15 54 | 31 0 | 16 11 | 31 33 | 16 28 | 32 6 | 16 45 | 32 39 |
| 50 | 14 46 | 28 47 | 15 2 | 29 21 | 15 19 | 29 54 | 15 36 | 30 27 | 15 52 | 31 0 | 16 9 | 31 33 | 16 26 | 32 7 | 16 43 | 32 40 |
| 52 | 14 44 | 28 48 | 15 0 | 29 21 | 15 17 | 29 54 | 15 34 | 30 27 | 15 50 | 31 1 | 16 7 | 31 34 | 16 24 | 32 7 | 16 41 | 32 40 |
| 54 | 14 42 | 28 48 | 14 59 | 29 21 | 15 15 | 29 54 | 15 32 | 30 28 | 15 49 | 31 1 | 16 5 | 31 34 | 16 22 | 32 7 | 16 39 | 32 40 |
| 56 | 14 40 | 28 48 | 14 57 | 29 22 | 15 13 | 29 55 | 15 30 | 30 28 | 15 47 | 31 1 | 16 3 | 31 34 | 16 20 | 32 8 | 16 37 | 32 41 |
| 58 | 14 38 | 28 49 | 14 55 | 29 22 | 15 12 | 29 55 | 15 28 | 30 28 | 15 45 | 31 1 | 16 1 | 31 35 | 16 18 | 32 8 | 16 35 | 32 41 |

| Seconds of H. P. | Corr. | A |
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| 47 | 14 | 26 |
| 48 | 14 | 26 |
| 49 | 14 | 27 |
| 50 | 15 | 28 |
| 51 | 15 | 28 |
| 52 | 15 | 29 |
| 53 | 15 | 29 |
| 54 | 16 | 30 |
| 55 | 16 | 30 |
| 56 | 16 | 31 |
| 57 | 17 | 31 |
| 58 | 17 | 32 |
| 59 | 17 | 32 |
| Alt. | ⊙ | A |
| ′ | ″ | ° |
| 0 | 3 | 8 |
| 1 | 3 | 8 |
| 2 | 3 | 7 |
| 3 | 3 | 7 |
| 4 | 3 | 6 |
| 5 | 3 | 6 |
| 6 | 3 | 5 |
| 7 | 3 | 5 |
| 8 | 2 | 4 |
| 9 | 2 | 4 |
| 10 | 2 | 3 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(74° and 75°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 74° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 14 37 | 28 49 | 14 53 | 29 22 | 15 10 | 29 55 | 15 26 | 30 29 | 15 43 | 31 2 | 15 59 | 31 35 | 16 16 | 32 8 | 16 32 | 32 41 |
| 2 | 14 35 | 28 49 | 14 51 | 29 22 | 15 8 | 29 56 | 15 24 | 30 29 | 15 41 | 31 2 | 15 57 | 31 35 | 16 14 | 32 9 | 16 30 | 32 42 |
| 4 | 14 33 | 28 50 | 14 50 | 29 23 | 15 6 | 29 56 | 15 23 | 30 29 | 15 39 | 31 2 | 15 55 | 31 36 | 16 12 | 32 9 | 16 28 | 32 42 |
| 6 | 14 31 | 28 50 | 14 48 | 29 23 | 15 4 | 29 56 | 15 21 | 30 30 | 15 37 | 31 3 | 15 54 | 31 36 | 16 10 | 32 9 | 16 26 | 32 42 |
| 8 | 14 30 | 28 50 | 14 46 | 29 23 | 15 2 | 29 57 | 15 19 | 30 30 | 15 35 | 31 3 | 15 52 | 31 36 | 16 8 | 32 9 | 16 24 | 32 43 |
| 10 | 14 28 | 28 50 | 14 44 | 29 24 | 15 1 | 29 57 | 15 17 | 30 30 | 15 33 | 31 3 | 15 50 | 31 37 | 16 6 | 32 10 | 16 22 | 32 43 |
| 12 | 14 26 | 28 51 | 14 42 | 29 24 | 14 59 | 29 57 | 15 15 | 30 30 | 15 31 | 31 4 | 15 48 | 31 37 | 16 4 | 32 10 | 16 20 | 32 43 |
| 14 | 14 24 | 28 51 | 14 41 | 29 24 | 14 57 | 29 57 | 15 13 | 30 31 | 15 29 | 31 4 | 15 46 | 31 37 | 16 2 | 32 10 | 16 18 | 32 44 |
| 16 | 14 22 | 28 51 | 14 39 | 29 25 | 14 55 | 29 58 | 15 11 | 30 31 | 15 28 | 31 4 | 15 44 | 31 38 | 16 0 | 32 11 | 16 16 | 32 44 |
| 18 | 14 21 | 28 52 | 14 37 | 29 25 | 14 53 | 29 58 | 15 9 | 30 31 | 15 26 | 31 5 | 15 42 | 31 38 | 15 58 | 32 11 | 16 14 | 32 44 |
| 20 | 14 19 | 28 52 | 14 35 | 29 25 | 14 51 | 29 58 | 15 7 | 30 32 | 15 24 | 31 5 | 15 40 | 31 38 | 15 56 | 32 11 | 16 12 | 32 45 |
| 22 | 14 17 | 28 52 | 14 33 | 29 25 | 14 49 | 29 59 | 15 6 | 30 32 | 15 22 | 31 5 | 15 38 | 31 39 | 15 54 | 32 12 | 16 10 | 32 45 |
| 24 | 14 15 | 28 52 | 14 31 | 29 26 | 14 48 | 29 59 | 15 4 | 30 32 | 15 20 | 31 6 | 15 36 | 31 39 | 15 52 | 32 12 | 16 8 | 32 45 |
| 26 | 14 14 | 28 53 | 14 30 | 29 26 | 14 46 | 29 59 | 15 2 | 30 33 | 15 18 | 31 6 | 15 34 | 31 39 | 15 50 | 32 12 | 16 6 | 32 46 |
| 28 | 14 12 | 28 53 | 14 28 | 29 26 | 14 44 | 30 0 | 15 0 | 30 33 | 15 16 | 31 6 | 15 32 | 31 39 | 15 48 | 32 13 | 16 4 | 32 46 |
| 30 | 14 10 | 28 53 | 14 26 | 29 27 | 14 42 | 30 0 | 14 58 | 30 33 | 15 14 | 31 6 | 15 30 | 31 40 | 15 46 | 32 13 | 16 2 | 32 46 |
| 32 | 14 8 | 28 54 | 14 24 | 29 27 | 14 40 | 30 0 | 14 56 | 30 33 | 15 12 | 31 7 | 15 28 | 31 40 | 15 44 | 32 13 | 16 0 | 32 47 |
| 34 | 14 6 | 28 54 | 14 22 | 29 27 | 14 38 | 30 0 | 14 54 | 30 34 | 15 10 | 31 7 | 15 26 | 31 40 | 15 42 | 32 14 | 15 58 | 32 47 |
| 36 | 14 5 | 28 54 | 14 21 | 29 28 | 14 36 | 30 1 | 14 52 | 30 34 | 15 8 | 31 7 | 15 24 | 31 41 | 15 40 | 32 14 | 15 56 | 32 47 |
| 38 | 14 3 | 28 55 | 14 19 | 29 28 | 14 35 | 30 1 | 14 51 | 30 34 | 15 7 | 31 8 | 15 22 | 31 41 | 15 38 | 32 14 | 15 54 | 32 48 |
| 40 | 14 1 | 28 55 | 14 17 | 29 28 | 14 33 | 30 1 | 14 49 | 30 35 | 15 5 | 31 8 | 15 20 | 31 41 | 15 36 | 32 15 | 15 52 | 32 48 |
| 42 | 13 59 | 28 55 | 14 15 | 29 28 | 14 31 | 30 2 | 14 47 | 30 35 | 15 3 | 31 8 | 15 19 | 31 42 | 15 34 | 32 15 | 15 50 | 32 48 |
| 44 | 13 58 | 28 55 | 14 13 | 29 29 | 14 29 | 30 2 | 14 45 | 30 35 | 15 0 | 31 9 | 15 17 | 31 42 | 15 32 | 32 15 | 15 48 | 32 49 |
| 46 | 13 56 | 28 56 | 14 12 | 29 29 | 14 27 | 30 2 | 14 43 | 30 36 | 14 59 | 31 9 | 15 15 | 31 42 | 15 30 | 32 16 | 15 46 | 32 49 |
| 48 | 13 54 | 28 56 | 14 10 | 29 29 | 14 25 | 30 3 | 14 41 | 30 36 | 14 57 | 31 9 | 15 13 | 31 43 | 15 28 | 32 16 | 15 44 | 32 49 |
| 50 | 13 52 | 28 56 | 14 8 | 29 30 | 14 24 | 30 3 | 14 39 | 30 36 | 14 55 | 31 10 | 15 11 | 31 43 | 15 26 | 32 16 | 15 42 | 32 49 |
| 52 | 13 50 | 28 57 | 14 6 | 29 30 | 14 22 | 30 3 | 14 37 | 30 36 | 14 53 | 31 10 | 15 9 | 31 43 | 15 24 | 32 17 | 15 40 | 32 50 |
| 54 | 13 49 | 28 57 | 14 4 | 29 30 | 14 20 | 30 3 | 14 36 | 30 37 | 14 51 | 31 10 | 15 7 | 31 43 | 15 22 | 32 17 | 15 38 | 32 50 |
| 56 | 13 47 | 28 57 | 14 2 | 29 30 | 14 18 | 30 4 | 14 34 | 30 37 | 14 49 | 31 10 | 15 5 | 31 44 | 15 20 | 32 17 | 15 36 | 32 50 |
| 58 | 13 45 | 28 57 | 14 1 | 29 31 | 14 16 | 30 4 | 14 32 | 30 37 | 14 47 | 31 11 | 15 2 | 31 44 | 15 18 | 32 17 | 15 34 | 32 51 |
| 75° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 13 43 | 28 58 | 13 59 | 29 31 | 14 14 | 30 4 | 14 30 | 30 38 | 14 45 | 31 11 | 15 1 | 31 44 | 15 16 | 32 18 | 15 32 | 32 51 |
| 2 | 13 41 | 28 58 | 13 57 | 29 31 | 14 13 | 30 5 | 14 28 | 30 38 | 14 43 | 31 11 | 14 59 | 31 45 | 15 14 | 32 18 | 15 30 | 32 51 |
| 4 | 13 39 | 28 58 | 13 55 | 29 32 | 14 11 | 30 5 | 14 26 | 30 38 | 14 42 | 31 12 | 14 57 | 31 45 | 15 12 | 32 18 | 15 28 | 32 52 |
| 6 | 13 38 | 28 59 | 13 53 | 29 32 | 14 9 | 30 5 | 14 24 | 30 39 | 14 40 | 31 12 | 14 55 | 31 45 | 15 10 | 32 19 | 15 26 | 32 52 |
| 8 | 13 36 | 28 59 | 13 52 | 29 32 | 14 7 | 30 6 | 14 22 | 30 39 | 14 38 | 31 12 | 14 53 | 31 46 | 15 8 | 32 19 | 15 24 | 32 52 |
| 10 | 13 34 | 28 59 | 13 50 | 29 32 | 14 5 | 30 6 | 14 20 | 30 39 | 14 36 | 31 12 | 14 51 | 31 46 | 15 6 | 32 19 | 15 22 | 32 53 |
| 12 | 13 33 | 28 59 | 13 48 | 29 33 | 14 3 | 30 6 | 14 19 | 30 39 | 14 34 | 31 13 | 14 49 | 31 46 | 15 4 | 32 20 | 15 20 | 32 53 |
| 14 | 13 31 | 29 0 | 13 46 | 29 33 | 14 1 | 30 6 | 14 17 | 30 40 | 14 32 | 31 13 | 14 47 | 31 46 | 15 2 | 32 20 | 15 18 | 32 53 |
| 16 | 13 29 | 29 0 | 13 44 | 29 33 | 14 0 | 30 7 | 14 15 | 30 40 | 14 30 | 31 13 | 14 45 | 31 47 | 15 0 | 32 20 | 15 16 | 32 53 |
| 18 | 13 27 | 29 0 | 13 42 | 29 34 | 13 58 | 30 7 | 14 13 | 30 40 | 14 28 | 31 14 | 14 43 | 31 47 | 14 58 | 32 20 | 15 14 | 32 54 |
| 20 | 13 25 | 29 0 | 13 40 | 29 34 | 13 56 | 30 7 | 14 11 | 30 41 | 14 26 | 31 14 | 14 41 | 31 47 | 14 56 | 32 21 | 15 12 | 32 54 |
| 22 | 13 24 | 29 1 | 13 39 | 29 34 | 13 54 | 30 7 | 14 9 | 30 41 | 14 24 | 31 14 | 14 39 | 31 48 | 14 55 | 32 21 | 15 10 | 32 54 |
| 24 | 13 22 | 29 1 | 13 37 | 29 34 | 13 52 | 30 8 | 14 7 | 30 41 | 14 22 | 31 14 | 14 38 | 31 48 | 14 53 | 32 21 | 15 8 | 32 55 |
| 26 | 13 20 | 29 1 | 13 35 | 29 35 | 13 50 | 30 8 | 14 5 | 30 41 | 14 21 | 31 15 | 14 36 | 31 48 | 14 51 | 32 22 | 15 6 | 32 55 |
| 28 | 13 18 | 29 1 | 13 33 | 29 35 | 13 48 | 30 8 | 14 3 | 30 42 | 14 19 | 31 15 | 14 34 | 31 48 | 14 49 | 32 22 | 15 4 | 32 55 |
| 30 | 13 16 | 29 2 | 13 31 | 29 35 | 13 46 | 30 9 | 14 2 | 30 42 | 14 17 | 31 15 | 14 32 | 31 49 | 14 47 | 32 22 | 15 2 | 32 56 |
| 32 | 13 15 | 29 2 | 13 30 | 29 35 | 13 45 | 30 9 | 14 0 | 30 42 | 14 15 | 31 16 | 14 30 | 31 49 | 14 45 | 32 22 | 15 0 | 32 56 |
| 34 | 13 13 | 29 2 | 13 28 | 29 36 | 13 43 | 30 9 | 13 58 | 30 43 | 14 13 | 31 16 | 14 28 | 31 49 | 14 43 | 32 23 | 14 58 | 32 56 |
| 36 | 13 11 | 29 2 | 13 26 | 29 36 | 13 41 | 30 9 | 13 56 | 30 43 | 14 12 | 31 16 | 14 26 | 31 50 | 14 41 | 32 23 | 14 56 | 32 57 |
| 38 | 13 9 | 29 3 | 13 24 | 29 36 | 13 39 | 30 10 | 13 54 | 30 43 | 14 10 | 31 17 | 14 25 | 31 50 | 14 39 | 32 23 | 14 54 | 32 57 |
| 40 | 13 7 | 29 3 | 13 22 | 29 36 | 13 37 | 30 10 | 13 52 | 30 43 | 14 8 | 31 17 | 14 23 | 31 50 | 14 38 | 32 24 | 14 51 | 32 57 |
| 42 | 13 6 | 29 3 | 13 21 | 29 37 | 13 35 | 30 10 | 13 50 | 30 44 | 14 6 | 31 17 | 14 21 | 31 51 | 14 36 | 32 24 | 14 49 | 32 57 |
| 44 | 13 4 | 29 4 | 13 19 | 29 37 | 13 33 | 30 10 | 13 48 | 30 44 | 14 4 | 31 17 | 14 19 | 31 51 | 14 33 | 32 24 | 14 47 | 32 58 |
| 46 | 13 2 | 29 4 | 13 17 | 29 37 | 13 32 | 30 11 | 13 46 | 30 44 | 14 2 | 31 18 | 14 17 | 31 51 | 14 31 | 32 25 | 14 45 | 32 58 |
| 48 | 13 0 | 29 4 | 13 15 | 29 38 | 13 30 | 30 11 | 13 45 | 30 45 | 14 0 | 31 18 | 14 15 | 31 51 | 14 29 | 32 25 | 14 43 | 32 58 |
| 50 | 12 59 | 29 4 | 13 13 | 29 38 | 13 28 | 30 11 | 13 43 | 30 45 | 13 58 | 31 18 | 14 12 | 31 52 | 14 27 | 32 25 | 14 41 | 32 59 |
| 52 | 12 57 | 29 5 | 13 11 | 29 38 | 13 26 | 30 12 | 13 41 | 30 45 | 13 56 | 31 19 | 14 10 | 31 52 | 14 25 | 32 25 | 14 39 | 32 59 |
| 54 | 12 55 | 29 5 | 13 10 | 29 38 | 13 24 | 30 12 | 13 39 | 30 45 | 13 54 | 31 19 | 14 8 | 31 52 | 14 23 | 32 26 | 14 37 | 32 59 |
| 56 | 12 53 | 29 5 | 13 8 | 29 39 | 13 22 | 30 12 | 13 37 | 30 46 | 13 52 | 31 19 | 14 6 | 31 53 | 14 21 | 32 26 | 14 35 | 33 0 |
| 58 | 12 51 | 29 5 | 13 6 | 29 39 | 13 21 | 30 12 | 13 35 | 30 46 | 13 50 | 31 19 | 14 4 | 31 53 | 14 19 | 32 26 | 14 33 | 33 0 |

| Seconds of H. P. | | |
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| ″ | Cor. | A |
| | ″ | ″ |
| 1 | 0 | 1 |
| 2 | 1 | 1 |
| 3 | 1 | 2 |
| 4 | 1 | 2 |
| 5 | 1 | 3 |
| 6 | 2 | 3 |
| 7 | 2 | 4 |
| 8 | 2 | 4 |
| 9 | 2 | 5 |
| 10 | 3 | 6 |
| 11 | 3 | 6 |
| 12 | 3 | 7 |
| 13 | 3 | 7 |
| 14 | 4 | 8 |
| 15 | 4 | 8 |
| 16 | 4 | 9 |
| 17 | 4 | 9 |
| 18 | 5 | 10 |
| 19 | 5 | 11 |
| 20 | 5 | 11 |
| 21 | 5 | 12 |
| 22 | 6 | 12 |
| 23 | 6 | 13 |
| 24 | 6 | 13 |
| 25 | 6 | 14 |
| 26 | 7 | 15 |
| 27 | 7 | 15 |
| 28 | 7 | 16 |
| 29 | 7 | 16 |
| 30 | 8 | 17 |
| 31 | 8 | 17 |
| 32 | 8 | 18 |
| 33 | 9 | 18 |
| 34 | 9 | 19 |
| 35 | 9 | 20 |
| 36 | 9 | 20 |
| 37 | 10 | 21 |
| 38 | 10 | 21 |
| 39 | 10 | 22 |
| 40 | 10 | 22 |
| 41 | 11 | 23 |
| 42 | 11 | 23 |
| 43 | 11 | 24 |
| 44 | 11 | 25 |
| 45 | 12 | 25 |
| 46 | 12 | 26 |
| 47 | 12 | 26 |
| 48 | 12 | 27 |
| 49 | 13 | 27 |
| 50 | 13 | 28 |
| 51 | 13 | 28 |
| 52 | 13 | 29 |
| 53 | 14 | 30 |
| 54 | 14 | 30 |
| 55 | 14 | 31 |
| 56 | 14 | 31 |
| 57 | 15 | 32 |
| 58 | 15 | 32 |
| 59 | 15 | 33 |

| Alt. | ☉ | ● |
|---|---|---|
| | A | A |
| | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 6 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (76° and 77°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 76° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 12 50 | 29 6 | 13 4 | 29 39 | 13 19 | 30 13 | 13 33 | 30 46 | 13 48 | 31 20 | 14 2 | 31 53 | 14 17 | 32 27 | 14 31 | 33 0 |
| 2 | 12 48 | 29 6 | 13 2 | 29 39 | 13 17 | 30 13 | 13 31 | 30 46 | 13 46 | 31 20 | 14 0 | 31 53 | 14 15 | 32 27 | 14 29 | 33 0 |
| 4 | 12 46 | 29 6 | 13 0 | 29 40 | 13 15 | 30 13 | 13 29 | 30 47 | 13 44 | 31 20 | 13 58 | 31 54 | 14 13 | 32 27 | 14 27 | 33 1 |
| 6 | 12 44 | 29 6 | 12 59 | 29 40 | 13 13 | 30 13 | 13 27 | 30 47 | 13 42 | 31 21 | 13 56 | 31 54 | 14 11 | 32 28 | 14 25 | 33 1 |
| 8 | 12 42 | 29 7 | 12 57 | 29 40 | 13 11 | 30 14 | 13 26 | 30 47 | 13 40 | 31 21 | 13 54 | 31 54 | 14 9 | 32 28 | 14 23 | 33 1 |
| 10 | 12 41 | 29 7 | 12 55 | 29 40 | 13 9 | 30 14 | 13 24 | 30 47 | 13 38 | 31 21 | 13 52 | 31 55 | 14 7 | 32 28 | 14 21 | 33 2 |
| 12 | 12 39 | 29 7 | 12 53 | 29 41 | 13 7 | 30 14 | 13 22 | 30 48 | 13 36 | 31 21 | 13 50 | 31 55 | 14 5 | 32 28 | 14 19 | 33 2 |
| 14 | 12 37 | 29 7 | 12 51 | 29 41 | 13 6 | 30 15 | 13 20 | 30 48 | 13 34 | 31 22 | 13 48 | 31 55 | 14 3 | 32 29 | 14 17 | 33 2 |
| 16 | 12 35 | 29 8 | 12 49 | 29 41 | 13 4 | 30 15 | 13 18 | 30 48 | 13 32 | 31 22 | 13 46 | 31 55 | 14 1 | 32 29 | 14 15 | 33 2 |
| 18 | 12 33 | 29 8 | 12 48 | 29 41 | 13 2 | 30 15 | 13 16 | 30 49 | 13 30 | 31 22 | 13 44 | 31 56 | 13 59 | 32 29 | 14 13 | 33 3 |
| 20 | 12 32 | 29 8 | 12 46 | 29 42 | 13 0 | 30 15 | 13 14 | 30 49 | 13 28 | 31 22 | 13 42 | 31 56 | 13 57 | 32 29 | 14 11 | 33 3 |
| 22 | 12 30 | 29 8 | 12 44 | 29 42 | 12 58 | 30 16 | 13 12 | 30 49 | 13 26 | 31 23 | 13 41 | 31 56 | 13 55 | 32 30 | 14 9 | 33 3 |
| 24 | 12 28 | 29 9 | 12 42 | 29 42 | 12 56 | 30 16 | 13 10 | 30 49 | 13 24 | 31 23 | 13 39 | 31 56 | 13 53 | 32 30 | 14 7 | 33 4 |
| 26 | 12 26 | 29 9 | 12 40 | 29 42 | 12 54 | 30 16 | 13 8 | 30 50 | 13 23 | 31 23 | 13 37 | 31 57 | 13 51 | 32 30 | 14 5 | 33 4 |
| 28 | 12 24 | 29 9 | 12 38 | 29 43 | 12 53 | 30 16 | 13 7 | 30 50 | 13 21 | 31 23 | 13 35 | 31 57 | 13 49 | 32 31 | 14 3 | 33 4 |
| 30 | 12 23 | 29 9 | 12 37 | 29 43 | 12 51 | 30 17 | 13 5 | 30 50 | 13 19 | 31 24 | 13 33 | 31 57 | 13 47 | 32 31 | 14 1 | 33 4 |
| 32 | 12 21 | 29 10 | 12 35 | 29 43 | 12 49 | 30 17 | 13 3 | 30 50 | 13 17 | 31 24 | 13 31 | 31 57 | 13 45 | 32 31 | 13 59 | 33 5 |
| 34 | 12 19 | 29 10 | 12 33 | 29 43 | 12 47 | 30 17 | 13 1 | 30 51 | 13 15 | 31 24 | 13 29 | 31 58 | 13 43 | 32 31 | 13 57 | 33 5 |
| 36 | 12 17 | 29 10 | 12 31 | 29 44 | 12 45 | 30 17 | 12 59 | 30 51 | 13 13 | 31 24 | 13 27 | 31 58 | 13 41 | 32 32 | 13 55 | 33 5 |
| 38 | 12 15 | 29 10 | 12 29 | 29 44 | 12 43 | 30 18 | 12 57 | 30 51 | 13 11 | 31 25 | 13 25 | 31 58 | 13 39 | 32 32 | 13 53 | 33 5 |
| 40 | 12 14 | 29 11 | 12 27 | 29 44 | 12 41 | 30 18 | 12 55 | 30 51 | 13 9 | 31 25 | 13 23 | 31 58 | 13 37 | 32 32 | 13 50 | 33 6 |
| 42 | 12 12 | 29 11 | 12 26 | 29 44 | 12 40 | 30 18 | 12 53 | 30 52 | 13 7 | 31 25 | 13 21 | 31 59 | 13 35 | 32 32 | 13 48 | 33 6 |
| 44 | 12 10 | 29 11 | 12 24 | 29 45 | 12 38 | 30 18 | 12 51 | 30 52 | 13 5 | 31 25 | 13 19 | 31 59 | 13 33 | 32 33 | 13 46 | 33 6 |
| 46 | 12 8 | 29 11 | 12 22 | 29 45 | 12 36 | 30 19 | 12 49 | 30 52 | 13 3 | 31 26 | 13 17 | 31 59 | 13 31 | 32 33 | 13 44 | 33 7 |
| 48 | 12 6 | 29 12 | 12 20 | 29 45 | 12 34 | 30 19 | 12 48 | 30 52 | 13 1 | 31 26 | 13 15 | 32 0 | 13 29 | 32 33 | 13 42 | 33 7 |
| 50 | 12 5 | 29 12 | 12 18 | 29 45 | 12 32 | 30 19 | 12 46 | 30 53 | 12 59 | 31 26 | 13 13 | 32 0 | 13 27 | 32 34 | 13 40 | 33 7 |
| 52 | 12 3 | 29 12 | 12 17 | 29 46 | 12 30 | 30 19 | 12 44 | 30 53 | 12 57 | 31 27 | 13 11 | 32 0 | 13 25 | 32 34 | 13 38 | 33 7 |
| 54 | 12 1 | 29 12 | 12 15 | 29 46 | 12 28 | 30 20 | 12 42 | 30 53 | 12 55 | 31 27 | 13 9 | 32 0 | 13 23 | 32 34 | 13 36 | 33 8 |
| 56 | 11 59 | 29 13 | 12 13 | 29 46 | 12 26 | 30 20 | 12 40 | 30 53 | 12 53 | 31 27 | 13 7 | 32 1 | 13 21 | 32 34 | 13 34 | 33 8 |
| 58 | 11 57 | 29 13 | 12 11 | 29 46 | 12 25 | 30 20 | 12 38 | 30 54 | 12 52 | 31 27 | 13 5 | 32 1 | 13 19 | 32 35 | 13 32 | 33 8 |
| 77° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 11 56 | 29 13 | 12 9 | 29 47 | 12 23 | 30 20 | 12 36 | 30 54 | 12 50 | 31 28 | 13 3 | 32 1 | 13 17 | 32 35 | 13 30 | 33 8 |
| 2 | 11 54 | 29 13 | 12 7 | 29 47 | 12 21 | 30 21 | 12 34 | 30 54 | 12 48 | 31 28 | 13 1 | 32 1 | 13 15 | 32 35 | 13 28 | 33 9 |
| 4 | 11 52 | 29 14 | 12 5 | 29 47 | 12 19 | 30 21 | 12 32 | 30 54 | 12 46 | 31 28 | 12 59 | 32 2 | 13 13 | 32 35 | 13 26 | 33 9 |
| 6 | 11 50 | 29 14 | 12 4 | 29 47 | 12 17 | 30 21 | 12 30 | 30 55 | 12 44 | 31 28 | 12 57 | 32 2 | 13 11 | 32 36 | 13 24 | 33 9 |
| 8 | 11 48 | 29 14 | 12 2 | 29 48 | 12 15 | 30 21 | 12 29 | 30 55 | 12 42 | 31 29 | 12 55 | 32 2 | 13 9 | 32 36 | 13 22 | 33 10 |
| 10 | 11 47 | 29 14 | 12 0 | 29 48 | 12 13 | 30 22 | 12 27 | 30 55 | 12 40 | 31 29 | 12 53 | 32 2 | 13 7 | 32 36 | 13 20 | 33 10 |
| 12 | 11 45 | 29 14 | 11 58 | 29 48 | 12 11 | 30 22 | 12 25 | 30 55 | 12 38 | 31 29 | 12 51 | 32 3 | 13 5 | 32 36 | 13 18 | 33 10 |
| 14 | 11 43 | 29 15 | 11 56 | 29 48 | 12 10 | 30 22 | 12 23 | 30 56 | 12 36 | 31 29 | 12 49 | 32 3 | 13 3 | 32 37 | 13 16 | 33 10 |
| 16 | 11 41 | 29 15 | 11 54 | 29 49 | 12 8 | 30 22 | 12 21 | 30 56 | 12 34 | 31 30 | 12 47 | 32 3 | 13 1 | 32 37 | 13 14 | 33 11 |
| 18 | 11 39 | 29 15 | 11 52 | 29 49 | 12 6 | 30 23 | 12 19 | 30 56 | 12 32 | 31 30 | 12 45 | 32 4 | 12 59 | 32 37 | 13 12 | 33 11 |
| 20 | 11 38 | 29 15 | 11 51 | 29 49 | 12 4 | 30 23 | 12 17 | 30 56 | 12 30 | 31 30 | 12 43 | 32 4 | 12 56 | 32 37 | 13 10 | 33 11 |
| 22 | 11 36 | 29 16 | 11 49 | 29 49 | 12 2 | 30 23 | 12 15 | 30 57 | 12 28 | 31 30 | 12 41 | 32 4 | 12 54 | 32 38 | 13 8 | 33 11 |
| 24 | 11 34 | 29 16 | 11 47 | 29 50 | 12 0 | 30 23 | 12 13 | 30 57 | 12 26 | 31 31 | 12 39 | 32 4 | 12 52 | 32 38 | 13 6 | 33 12 |
| 26 | 11 32 | 29 16 | 11 45 | 29 50 | 11 58 | 30 24 | 12 11 | 30 57 | 12 24 | 31 31 | 12 37 | 32 5 | 12 50 | 32 38 | 13 4 | 33 12 |
| 28 | 11 30 | 29 16 | 11 43 | 29 50 | 11 56 | 30 24 | 12 9 | 30 57 | 12 22 | 31 31 | 12 35 | 32 5 | 12 48 | 32 39 | 13 2 | 33 12 |
| 30 | 11 29 | 29 17 | 11 42 | 29 50 | 11 55 | 30 24 | 12 8 | 30 58 | 12 20 | 31 31 | 12 33 | 32 5 | 12 46 | 32 39 | 12 59 | 33 12 |
| 32 | 11 27 | 29 17 | 11 40 | 29 50 | 11 53 | 30 24 | 12 6 | 30 58 | 12 19 | 31 32 | 12 32 | 32 5 | 12 44 | 32 39 | 12 57 | 33 13 |
| 34 | 11 25 | 29 17 | 11 38 | 29 51 | 11 51 | 30 24 | 12 4 | 30 58 | 12 17 | 31 32 | 12 30 | 32 6 | 12 42 | 32 39 | 12 55 | 33 13 |
| 36 | 11 23 | 29 17 | 11 36 | 29 51 | 11 49 | 30 25 | 12 2 | 30 58 | 12 15 | 31 32 | 12 28 | 32 6 | 12 40 | 32 40 | 12 53 | 33 13 |
| 38 | 11 21 | 29 17 | 11 34 | 29 51 | 11 47 | 30 25 | 12 0 | 30 59 | 12 13 | 31 32 | 12 26 | 32 6 | 12 38 | 32 40 | 12 51 | 33 14 |
| 40 | 11 20 | 29 18 | 11 32 | 29 51 | 11 45 | 30 25 | 11 58 | 30 59 | 12 11 | 31 33 | 12 24 | 32 6 | 12 36 | 32 40 | 12 49 | 33 14 |
| 42 | 11 18 | 29 18 | 11 31 | 29 52 | 11 43 | 30 25 | 11 56 | 30 59 | 12 9 | 31 33 | 12 22 | 32 7 | 12 34 | 32 40 | 12 47 | 33 14 |
| 44 | 11 16 | 29 18 | 11 29 | 29 52 | 11 41 | 30 26 | 11 54 | 30 59 | 12 7 | 31 33 | 12 20 | 32 7 | 12 32 | 32 41 | 12 45 | 33 14 |
| 46 | 11 14 | 29 18 | 11 27 | 29 52 | 11 40 | 30 26 | 11 52 | 31 0 | 12 5 | 31 33 | 12 18 | 32 7 | 12 30 | 32 41 | 12 43 | 33 15 |
| 48 | 11 12 | 29 19 | 11 25 | 29 52 | 11 38 | 30 26 | 11 50 | 31 0 | 12 3 | 31 34 | 12 16 | 32 7 | 12 28 | 32 41 | 12 41 | 33 15 |
| 50 | 11 11 | 29 19 | 11 23 | 29 53 | 11 36 | 30 26 | 11 48 | 31 0 | 12 1 | 31 34 | 12 14 | 32 8 | 12 26 | 32 41 | 12 39 | 33 15 |
| 52 | 11 9 | 29 19 | 11 21 | 29 53 | 11 34 | 30 27 | 11 47 | 31 0 | 11 59 | 31 34 | 12 12 | 32 8 | 12 24 | 32 42 | 12 37 | 33 15 |
| 54 | 11 7 | 29 19 | 11 20 | 29 53 | 11 32 | 30 27 | 11 45 | 31 1 | 11 57 | 31 34 | 12 10 | 32 8 | 12 22 | 32 42 | 12 35 | 33 16 |
| 56 | 11 5 | 29 20 | 11 18 | 29 53 | 11 30 | 30 27 | 11 43 | 31 1 | 11 55 | 31 35 | 12 8 | 32 8 | 12 20 | 32 42 | 12 33 | 33 16 |
| 58 | 11 3 | 29 20 | 11 16 | 29 54 | 11 28 | 30 27 | 11 41 | 31 1 | 11 53 | 31 35 | 12 6 | 32 9 | 12 18 | 32 42 | 12 31 | 33 16 |

| Seconds of H. P. | | |
|---|---|---|
| ″ | Corr. | A |
| | ″ | ″ |
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 1 | 2 |
| 4 | 1 | 2 |
| 5 | 1 | 3 |
| 6 | 1 | 3 |
| 7 | 2 | 4 |
| 8 | 2 | 4 |
| 9 | 2 | 5 |
| 10 | 2 | 6 |
| 11 | 2 | 6 |
| 12 | 3 | 7 |
| 13 | 3 | 7 |
| 14 | 3 | 8 |
| 15 | 3 | 8 |
| 16 | 4 | 9 |
| 17 | 4 | 9 |
| 18 | 4 | 10 |
| 19 | 4 | 11 |
| 20 | 4 | 11 |
| 21 | 5 | 12 |
| 22 | 5 | 12 |
| 23 | 5 | 13 |
| 24 | 5 | 13 |
| 25 | 6 | 14 |
| 26 | 6 | 15 |
| 27 | 6 | 15 |
| 28 | 6 | 16 |
| 29 | 7 | 16 |
| 30 | 7 | 17 |
| 31 | 7 | 17 |
| 32 | 7 | 18 |
| 33 | 7 | 18 |
| 34 | 8 | 19 |
| 35 | 8 | 20 |
| 36 | 8 | 20 |
| 37 | 8 | 21 |
| 38 | 9 | 21 |
| 39 | 9 | 22 |
| 40 | 9 | 22 |
| 41 | 9 | 23 |
| 42 | 9 | 23 |
| 43 | 10 | 24 |
| 44 | 10 | 25 |
| 45 | 10 | 25 |
| 46 | 10 | 26 |
| 47 | 11 | 26 |
| 48 | 11 | 27 |
| 49 | 11 | 27 |
| 50 | 11 | 28 |
| 51 | 11 | 28 |
| 52 | 12 | 29 |
| 53 | 12 | 30 |
| 54 | 12 | 30 |
| 55 | 12 | 31 |
| 56 | 13 | 31 |
| 57 | 13 | 32 |
| 58 | 13 | 32 |
| 59 | 13 | 33 |

| App. Alt. | A ☉ | A ✶ |
|---|---|---|
| | ″ | ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 1 | 0 |
| 40 | 1 | 0 |
| 50 | 1 | 0 |
| 60 | 1 | 0 |
| 70 | 0 | 0 |
| 80 | 0 | 0 |

(78° and 79°) The Correction of the Moon's Altitude, and the Aux. Angle A (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 78° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 11 1 | 29 20 | 11 14 | 29 54 | 11 26 | 30 28 | 11 39 | 31 1 | 11 51 | 31 35 | 12 4 | 32 9 | 12 16 | 32 43 | 12 29 | 33 16 |
| 2 | 11 0 | 29 20 | 11 12 | 29 54 | 11 25 | 30 28 | 11 37 | 31 2 | 11 49 | 31 35 | 12 2 | 32 9 | 12 14 | 32 43 | 12 27 | 33 17 |
| 4 | 10 58 | 29 20 | 11 10 | 29 54 | 11 23 | 30 28 | 11 35 | 31 2 | 11 48 | 31 36 | 12 0 | 32 9 | 12 12 | 32 43 | 12 25 | 33 17 |
| 6 | 10 56 | 29 21 | 11 8 | 29 54 | 11 21 | 30 28 | 11 33 | 31 2 | 11 46 | 31 36 | 11 58 | 32 10 | 12 10 | 32 43 | 12 23 | 33 17 |
| 8 | 10 54 | 29 21 | 11 7 | 29 55 | 11 19 | 30 28 | 11 31 | 31 2 | 11 44 | 31 36 | 11 56 | 32 10 | 12 8 | 32 44 | 12 21 | 33 17 |
| 10 | 10 52 | 29 21 | 11 5 | 29 55 | 11 17 | 30 29 | 11 29 | 31 2 | 11 42 | 31 36 | 11 54 | 32 10 | 12 6 | 32 44 | 12 19 | 33 18 |
| 12 | 10 51 | 29 21 | 11 3 | 29 55 | 11 15 | 30 29 | 11 27 | 31 3 | 11 40 | 31 36 | 11 52 | 32 10 | 12 4 | 32 44 | 12 17 | 33 18 |
| 14 | 10 49 | 29 22 | 11 1 | 29 55 | 11 13 | 30 29 | 11 26 | 31 3 | 11 38 | 31 37 | 11 50 | 32 11 | 12 2 | 32 44 | 12 15 | 33 18 |
| 16 | 10 47 | 29 22 | 10 59 | 29 56 | 11 11 | 30 29 | 11 24 | 31 3 | 11 36 | 31 37 | 11 48 | 32 11 | 12 0 | 32 45 | 12 12 | 33 18 |
| 18 | 10 45 | 29 22 | 10 57 | 29 56 | 11 10 | 30 30 | 11 22 | 31 3 | 11 34 | 31 37 | 11 46 | 32 11 | 11 58 | 32 45 | 12 10 | 33 19 |
| 20 | 10 43 | 29 22 | 10 55 | 29 56 | 11 8 | 30 30 | 11 20 | 31 4 | 11 32 | 31 37 | 11 44 | 32 11 | 11 56 | 32 45 | 12 8 | 33 19 |
| 22 | 10 42 | 29 22 | 10 54 | 29 56 | 11 6 | 30 30 | 11 18 | 31 4 | 11 30 | 31 38 | 11 42 | 32 11 | 11 54 | 32 45 | 12 6 | 33 19 |
| 24 | 10 40 | 29 23 | 10 52 | 29 56 | 11 4 | 30 30 | 11 16 | 31 4 | 11 28 | 31 38 | 11 40 | 32 12 | 11 52 | 32 45 | 12 4 | 33 19 |
| 26 | 10 38 | 29 23 | 10 50 | 29 57 | 11 2 | 30 30 | 11 14 | 31 4 | 11 26 | 31 38 | 11 38 | 32 12 | 11 50 | 32 46 | 12 2 | 33 20 |
| 28 | 10 36 | 29 23 | 10 48 | 29 57 | 11 0 | 30 31 | 11 12 | 31 5 | 11 24 | 31 38 | 11 36 | 32 12 | 11 48 | 32 46 | 12 0 | 33 20 |
| 30 | 10 34 | 29 23 | 10 46 | 29 57 | 10 58 | 30 31 | 11 10 | 31 5 | 11 22 | 31 39 | 11 34 | 32 12 | 11 46 | 32 46 | 11 58 | 33 20 |
| 32 | 10 33 | 29 24 | 10 44 | 29 57 | 10 56 | 30 31 | 11 8 | 31 5 | 11 20 | 31 39 | 11 32 | 32 13 | 11 44 | 32 46 | 11 56 | 33 20 |
| 34 | 10 31 | 29 24 | 10 43 | 29 58 | 10 55 | 30 31 | 11 6 | 31 5 | 11 18 | 31 39 | 11 30 | 32 13 | 11 42 | 32 47 | 11 54 | 33 21 |
| 36 | 10 29 | 29 24 | 10 41 | 29 58 | 10 53 | 30 32 | 11 5 | 31 5 | 11 16 | 31 39 | 11 28 | 32 13 | 11 40 | 32 47 | 11 52 | 33 21 |
| 38 | 10 27 | 29 24 | 10 39 | 29 58 | 10 51 | 30 32 | 11 3 | 31 6 | 11 14 | 31 40 | 11 26 | 32 13 | 11 38 | 32 47 | 11 50 | 33 21 |
| 40 | 10 25 | 29 24 | 10 37 | 29 58 | 10 49 | 30 32 | 11 1 | 31 6 | 11 12 | 31 40 | 11 24 | 32 14 | 11 36 | 32 47 | 11 48 | 33 21 |
| 42 | 10 23 | 29 25 | 10 35 | 29 58 | 10 47 | 30 32 | 10 59 | 31 6 | 11 11 | 31 40 | 11 22 | 32 14 | 11 34 | 32 48 | 11 46 | 33 22 |
| 44 | 10 22 | 29 25 | 10 33 | 29 59 | 10 45 | 30 33 | 10 57 | 31 6 | 11 9 | 31 40 | 11 20 | 32 14 | 11 32 | 32 48 | 11 44 | 33 22 |
| 46 | 10 20 | 29 25 | 10 32 | 29 59 | 10 43 | 30 33 | 10 55 | 31 7 | 11 7 | 31 40 | 11 18 | 32 14 | 11 30 | 32 48 | 11 42 | 33 22 |
| 48 | 10 18 | 29 25 | 10 30 | 29 59 | 10 41 | 30 33 | 10 53 | 31 7 | 11 5 | 31 41 | 11 16 | 32 15 | 11 28 | 32 48 | 11 40 | 33 22 |
| 50 | 10 16 | 29 25 | 10 28 | 29 59 | 10 39 | 30 33 | 10 51 | 31 7 | 11 3 | 31 41 | 11 14 | 32 15 | 11 26 | 32 49 | 11 38 | 33 23 |
| 52 | 10 14 | 29 26 | 10 26 | 30 0 | 10 38 | 30 33 | 10 49 | 31 7 | 11 1 | 31 41 | 11 12 | 32 15 | 11 24 | 32 49 | 11 36 | 33 23 |
| 54 | 10 13 | 29 26 | 10 24 | 30 0 | 10 36 | 30 34 | 10 47 | 31 8 | 10 59 | 31 41 | 11 10 | 32 15 | 11 22 | 32 49 | 11 34 | 33 23 |
| 56 | 10 11 | 29 26 | 10 22 | 30 0 | 10 34 | 30 34 | 10 45 | 31 8 | 10 57 | 31 42 | 11 8 | 32 16 | 11 20 | 32 49 | 11 31 | 33 23 |
| 58 | 10 9 | 29 26 | 10 21 | 30 0 | 10 32 | 30 34 | 10 44 | 31 8 | 10 55 | 31 42 | 11 6 | 32 16 | 11 18 | 32 50 | 11 29 | 33 24 |
| 79° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 10 7 | 29 27 | 10 19 | 30 0 | 10 30 | 30 34 | 10 42 | 31 8 | 10 53 | 31 42 | 11 4 | 32 16 | 11 16 | 32 50 | 11 27 | 33 24 |
| 2 | 10 5 | 29 27 | 10 17 | 30 1 | 10 28 | 30 35 | 10 40 | 31 8 | 10 51 | 31 42 | 11 2 | 32 16 | 11 14 | 32 50 | 11 25 | 33 24 |
| 4 | 10 4 | 29 27 | 10 15 | 30 1 | 10 26 | 30 35 | 10 38 | 31 9 | 10 49 | 31 42 | 11 0 | 32 16 | 11 12 | 32 50 | 11 23 | 33 24 |
| 6 | 10 2 | 29 27 | 10 13 | 30 1 | 10 24 | 30 35 | 10 36 | 31 9 | 10 47 | 31 43 | 10 58 | 32 17 | 11 10 | 32 50 | 11 21 | 33 24 |
| 8 | 10 0 | 29 27 | 10 11 | 30 1 | 10 23 | 30 35 | 10 34 | 31 9 | 10 45 | 31 43 | 10 56 | 32 17 | 11 8 | 32 51 | 11 19 | 33 25 |
| 10 | 9 58 | 29 28 | 10 9 | 30 1 | 10 21 | 30 35 | 10 32 | 31 9 | 10 43 | 31 43 | 10 54 | 32 17 | 11 6 | 32 51 | 11 17 | 33 25 |
| 12 | 9 56 | 29 28 | 10 8 | 30 2 | 10 19 | 30 36 | 10 30 | 31 9 | 10 41 | 31 43 | 10 52 | 32 17 | 11 4 | 32 51 | 11 15 | 33 25 |
| 14 | 9 54 | 29 28 | 10 6 | 30 2 | 10 17 | 30 36 | 10 28 | 31 10 | 10 39 | 31 43 | 10 50 | 32 17 | 11 2 | 32 51 | 11 13 | 33 25 |
| 16 | 9 53 | 29 28 | 10 4 | 30 2 | 10 15 | 30 36 | 10 26 | 31 10 | 10 37 | 31 44 | 10 48 | 32 18 | 11 0 | 32 51 | 11 11 | 33 25 |
| 18 | 9 51 | 29 28 | 10 2 | 30 2 | 10 13 | 30 36 | 10 24 | 31 10 | 10 35 | 31 44 | 10 46 | 32 18 | 10 58 | 32 52 | 11 9 | 33 26 |
| 20 | 9 49 | 29 28 | 10 0 | 30 2 | 10 11 | 30 36 | 10 22 | 31 10 | 10 33 | 31 44 | 10 44 | 32 18 | 10 56 | 32 52 | 11 7 | 33 26 |
| 22 | 9 47 | 29 29 | 9 58 | 30 3 | 10 9 | 30 36 | 10 20 | 31 10 | 10 31 | 31 44 | 10 43 | 32 18 | 10 54 | 32 52 | 11 5 | 33 26 |
| 24 | 9 45 | 29 29 | 9 56 | 30 3 | 10 7 | 30 37 | 10 18 | 31 11 | 10 29 | 31 45 | 10 41 | 32 18 | 10 52 | 32 52 | 11 3 | 33 26 |
| 26 | 9 44 | 29 29 | 9 55 | 30 3 | 10 6 | 30 37 | 10 17 | 31 11 | 10 28 | 31 45 | 10 39 | 32 19 | 10 50 | 32 53 | 11 1 | 33 27 |
| 28 | 9 42 | 29 29 | 9 53 | 30 3 | 10 4 | 30 37 | 10 15 | 31 11 | 10 26 | 31 45 | 10 37 | 32 19 | 10 47 | 32 53 | 10 58 | 33 27 |
| 30 | 9 40 | 29 29 | 9 51 | 30 3 | 10 2 | 30 37 | 10 13 | 31 11 | 10 24 | 31 45 | 10 35 | 32 19 | 10 45 | 32 53 | 10 56 | 33 27 |
| 32 | 9 38 | 29 30 | 9 49 | 30 4 | 10 0 | 30 37 | 10 11 | 31 11 | 10 22 | 31 45 | 10 33 | 32 19 | 10 43 | 32 53 | 10 54 | 33 27 |
| 34 | 9 36 | 29 30 | 9 47 | 30 4 | 9 58 | 30 38 | 10 9 | 31 12 | 10 20 | 31 46 | 10 31 | 32 20 | 10 41 | 32 53 | 10 52 | 33 27 |
| 36 | 9 34 | 29 30 | 9 45 | 30 4 | 9 56 | 30 38 | 10 7 | 31 12 | 10 18 | 31 46 | 10 29 | 32 20 | 10 39 | 32 54 | 10 50 | 33 28 |
| 38 | 9 33 | 29 30 | 9 43 | 30 4 | 9 54 | 30 38 | 10 5 | 31 12 | 10 16 | 31 46 | 10 27 | 32 20 | 10 37 | 32 54 | 10 48 | 33 28 |
| 40 | 9 31 | 29 30 | 9 42 | 30 4 | 9 52 | 30 38 | 10 3 | 31 12 | 10 14 | 31 46 | 10 25 | 32 20 | 10 36 | 32 54 | 10 46 | 33 28 |
| 42 | 9 29 | 29 31 | 9 40 | 30 5 | 9 50 | 30 38 | 10 1 | 31 12 | 10 12 | 31 46 | 10 23 | 32 20 | 10 33 | 32 54 | 10 44 | 33 28 |
| 44 | 9 27 | 29 31 | 9 38 | 30 5 | 9 49 | 30 39 | 9 59 | 31 13 | 10 10 | 31 47 | 10 21 | 32 21 | 10 31 | 32 55 | 10 42 | 33 29 |
| 46 | 9 25 | 29 31 | 9 36 | 30 5 | 9 47 | 30 39 | 9 57 | 31 13 | 10 8 | 31 47 | 10 19 | 32 21 | 10 29 | 32 55 | 10 40 | 33 29 |
| 48 | 9 24 | 29 31 | 9 34 | 30 5 | 9 45 | 30 39 | 9 55 | 31 13 | 10 6 | 31 47 | 10 17 | 32 21 | 10 27 | 32 55 | 10 38 | 33 29 |
| 50 | 9 22 | 29 31 | 9 32 | 30 5 | 9 43 | 30 39 | 9 53 | 31 13 | 10 4 | 31 47 | 10 15 | 32 21 | 10 25 | 32 55 | 10 36 | 33 29 |
| 52 | 9 20 | 29 32 | 9 30 | 30 6 | 9 41 | 30 39 | 9 52 | 31 13 | 10 2 | 31 47 | 10 13 | 32 21 | 10 23 | 32 55 | 10 34 | 33 29 |
| 54 | 9 18 | 29 32 | 9 29 | 30 6 | 9 39 | 30 40 | 9 50 | 31 14 | 10 0 | 31 48 | 10 11 | 32 22 | 10 21 | 32 56 | 10 32 | 33 30 |
| 56 | 9 16 | 29 32 | 9 27 | 30 6 | 9 37 | 30 40 | 9 48 | 31 14 | 9 58 | 31 48 | 10 9 | 32 22 | 10 19 | 32 56 | 10 30 | 33 30 |
| 58 | 9 14 | 29 32 | 9 25 | 30 6 | 9 35 | 30 40 | 9 46 | 31 14 | 9 56 | 31 48 | 10 7 | 32 22 | 10 17 | 32 56 | 10 28 | 33 30 |

| Seconds of H. P. | Corr. | A |
|---|---|---|
| | ″ | ″ |
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 1 | 2 |
| 4 | 1 | 2 |
| 5 | 1 | 3 |
| 6 | 1 | 3 |
| 7 | 1 | 4 |
| 8 | 2 | 4 |
| 9 | 2 | 5 |
| 10 | 2 | 6 |
| 11 | 2 | 6 |
| 12 | 2 | 7 |
| 13 | 2 | 7 |
| 14 | 3 | 8 |
| 15 | 3 | 8 |
| 16 | 3 | 9 |
| 17 | 3 | 9 |
| 18 | 3 | 10 |
| 19 | 4 | 11 |
| 20 | 4 | 11 |
| 21 | 4 | 12 |
| 22 | 4 | 12 |
| 23 | 4 | 13 |
| 24 | 5 | 13 |
| 25 | 5 | 14 |
| 26 | 5 | 15 |
| 27 | 5 | 15 |
| 28 | 5 | 16 |
| 29 | 6 | 16 |
| 30 | 6 | 17 |
| 31 | 6 | 17 |
| 32 | 6 | 18 |
| 33 | 6 | 18 |
| 34 | 7 | 19 |
| 35 | 7 | 20 |
| 36 | 7 | 20 |
| 37 | 7 | 21 |
| 38 | 7 | 21 |
| 39 | 7 | 22 |
| 40 | 8 | 22 |
| 41 | 8 | 23 |
| 42 | 8 | 23 |
| 43 | 8 | 24 |
| 44 | 8 | 25 |
| 45 | 9 | 25 |
| 46 | 9 | 26 |
| 47 | 9 | 26 |
| 48 | 9 | 27 |
| 49 | 9 | 27 |
| 50 | 10 | 28 |
| 51 | 10 | 28 |
| 52 | 10 | 29 |
| 53 | 10 | 30 |
| 54 | 10 | 30 |
| 55 | 11 | 31 |
| 56 | 11 | 31 |
| 57 | 11 | 32 |
| 58 | 11 | 32 |
| 59 | 11 | 33 |
| ☽ | ☉ | ♃ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (80° and 81°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 80° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. − | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 9 13 | 29 32 | 9 23 | 30 6 | 9 33 | 30 40 | 9 44 | 31 14 | 9 54 | 31 48 | 10 5 | 32 22 | 10 15 | 32 56 | 10 25 | 33 30 |
| 2 | 9 11 | 29 33 | 9 21 | 30 7 | 9 31 | 30 40 | 9 42 | 31 14 | 9 52 | 31 48 | 10 3 | 32 22 | 10 13 | 32 56 | 10 24 | 33 30 |
| 4 | 9 9 | 29 33 | 9 19 | 30 7 | 9 30 | 30 41 | 9 40 | 31 15 | 9 50 | 31 49 | 10 1 | 32 23 | 10 11 | 32 57 | 10 21 | 33 31 |
| 6 | 9 7 | 29 33 | 9 17 | 30 7 | 9 28 | 30 41 | 9 38 | 31 15 | 9 48 | 31 49 | 9 59 | 32 23 | 10 9 | 32 57 | 10 19 | 33 31 |
| 8 | 9 5 | 29 33 | 9 16 | 30 7 | 9 26 | 30 41 | 9 36 | 31 15 | 9 46 | 31 49 | 9 57 | 32 23 | 10 7 | 32 57 | 10 17 | 33 31 |
| 10 | 9 3 | 29 33 | 9 14 | 30 7 | 9 24 | 30 41 | 9 34 | 31 15 | 9 44 | 31 49 | 9 54 | 32 23 | 10 5 | 32 57 | 10 15 | 33 31 |
| 12 | 9 2 | 29 33 | 9 12 | 30 7 | 9 22 | 30 41 | 9 32 | 31 15 | 9 42 | 31 49 | 9 52 | 32 23 | 10 3 | 32 57 | 10 13 | 33 31 |
| 14 | 9 0 | 29 34 | 9 10 | 30 8 | 9 20 | 30 42 | 9 30 | 31 16 | 9 40 | 31 50 | 9 50 | 32 24 | 10 1 | 32 58 | 10 11 | 33 32 |
| 16 | 8 58 | 29 34 | 9 8 | 30 8 | 9 18 | 30 42 | 9 28 | 31 16 | 9 38 | 31 50 | 9 48 | 32 24 | 9 59 | 32 58 | 10 9 | 33 32 |
| 18 | 8 56 | 29 34 | 9 6 | 30 8 | 9 16 | 30 42 | 9 26 | 31 16 | 9 36 | 31 50 | 9 46 | 32 24 | 9 57 | 32 58 | 10 7 | 33 32 |
| 20 | 8 54 | 29 34 | 9 4 | 30 8 | 9 14 | 30 42 | 9 24 | 31 16 | 9 34 | 31 50 | 9 44 | 32 24 | 9 55 | 32 58 | 10 5 | 33 32 |
| 22 | 8 52 | 29 34 | 9 2 | 30 8 | 9 13 | 30 42 | 9 22 | 31 16 | 9 32 | 31 50 | 9 42 | 32 24 | 9 53 | 32 58 | 10 3 | 33 32 |
| 24 | 8 51 | 29 34 | 9 1 | 30 8 | 9 11 | 30 42 | 9 21 | 31 16 | 9 31 | 31 50 | 9 40 | 32 24 | 9 51 | 32 58 | 10 1 | 33 32 |
| 26 | 8 49 | 29 35 | 8 59 | 30 9 | 9 9 | 30 43 | 9 19 | 31 17 | 9 29 | 31 51 | 9 38 | 32 25 | 9 49 | 32 59 | 9 59 | 33 33 |
| 28 | 8 47 | 29 35 | 8 57 | 30 9 | 9 7 | 30 43 | 9 17 | 31 17 | 9 27 | 31 51 | 9 37 | 32 25 | 9 47 | 32 59 | 9 57 | 33 33 |
| 30 | 8 45 | 29 35 | 8 55 | 30 9 | 9 5 | 30 43 | 9 15 | 31 17 | 9 25 | 31 51 | 9 35 | 32 25 | 9 45 | 32 59 | 9 54 | 33 33 |
| 32 | 8 43 | 29 35 | 8 53 | 30 9 | 9 3 | 30 43 | 9 13 | 31 17 | 9 23 | 31 51 | 9 33 | 32 25 | 9 43 | 32 59 | 9 52 | 33 33 |
| 34 | 8 42 | 29 35 | 8 51 | 30 9 | 9 1 | 30 43 | 9 11 | 31 17 | 9 21 | 31 51 | 9 31 | 32 25 | 9 41 | 32 59 | 9 50 | 33 33 |
| 36 | 8 40 | 29 35 | 8 49 | 30 9 | 8 59 | 30 44 | 9 9 | 31 18 | 9 19 | 31 52 | 9 29 | 32 26 | 9 39 | 33 0 | 9 48 | 33 34 |
| 38 | 8 38 | 29 36 | 8 48 | 30 10 | 8 57 | 30 44 | 9 7 | 31 18 | 9 17 | 31 52 | 9 27 | 32 26 | 9 37 | 33 0 | 9 46 | 33 34 |
| 40 | 8 36 | 29 36 | 8 46 | 30 10 | 8 56 | 30 44 | 9 5 | 31 18 | 9 15 | 31 52 | 9 25 | 32 26 | 9 34 | 33 0 | 9 44 | 33 34 |
| 42 | 8 34 | 29 36 | 8 44 | 30 10 | 8 54 | 30 44 | 9 3 | 31 18 | 9 13 | 31 52 | 9 23 | 32 26 | 9 32 | 33 0 | 9 42 | 33 34 |
| 44 | 8 32 | 29 36 | 8 42 | 30 10 | 8 52 | 30 44 | 9 1 | 31 18 | 9 11 | 31 52 | 9 21 | 32 26 | 9 30 | 33 0 | 9 40 | 33 34 |
| 46 | 8 31 | 29 36 | 8 40 | 30 10 | 8 50 | 30 44 | 9 0 | 31 18 | 9 9 | 31 52 | 9 19 | 32 26 | 9 28 | 33 1 | 9 38 | 33 35 |
| 48 | 8 29 | 29 36 | 8 38 | 30 11 | 8 48 | 30 45 | 8 58 | 31 19 | 9 7 | 31 53 | 9 17 | 32 27 | 9 26 | 33 1 | 9 36 | 33 35 |
| 50 | 8 27 | 29 37 | 8 36 | 30 11 | 8 46 | 30 45 | 8 56 | 31 19 | 9 5 | 31 53 | 9 15 | 32 27 | 9 24 | 33 1 | 9 34 | 33 35 |
| 52 | 8 25 | 29 37 | 8 35 | 30 11 | 8 44 | 30 45 | 8 54 | 31 19 | 9 3 | 31 53 | 9 13 | 32 27 | 9 22 | 33 1 | 9 32 | 33 35 |
| 54 | 8 23 | 29 37 | 8 33 | 30 11 | 8 42 | 30 45 | 8 52 | 31 19 | 9 1 | 31 53 | 9 11 | 32 27 | 9 20 | 33 1 | 9 30 | 33 35 |
| 56 | 8 21 | 29 37 | 8 31 | 30 11 | 8 40 | 30 45 | 8 50 | 31 19 | 8 59 | 31 53 | 9 9 | 32 27 | 9 18 | 33 1 | 9 28 | 33 36 |
| 58 | 8 20 | 29 37 | 8 29 | 30 11 | 8 38 | 30 45 | 8 48 | 31 20 | 8 57 | 31 54 | 9 7 | 32 28 | 9 16 | 33 2 | 9 26 | 33 36 |

| 81° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 8 18 | 29 37 | 8 27 | 30 12 | 8 37 | 30 46 | 8 46 | 31 20 | 8 55 | 31 54 | 9 5 | 32 28 | 9 14 | 33 2 | 9 24 | 33 36 |
| 2 | 8 16 | 29 38 | 8 25 | 30 12 | 8 35 | 30 46 | 8 44 | 31 20 | 8 53 | 31 54 | 9 3 | 32 28 | 9 12 | 33 2 | 9 22 | 33 36 |
| 4 | 8 14 | 29 38 | 8 23 | 30 12 | 8 33 | 30 46 | 8 42 | 31 20 | 8 51 | 31 54 | 9 1 | 32 28 | 9 10 | 33 2 | 9 19 | 33 36 |
| 6 | 8 12 | 29 38 | 8 22 | 30 12 | 8 31 | 30 46 | 8 40 | 31 20 | 8 49 | 31 54 | 8 59 | 32 28 | 9 8 | 33 2 | 9 17 | 33 36 |
| 8 | 8 10 | 29 38 | 8 20 | 30 12 | 8 29 | 30 46 | 8 38 | 31 20 | 8 47 | 31 54 | 8 57 | 32 28 | 9 6 | 33 3 | 9 15 | 33 37 |
| 10 | 8 9 | 29 38 | 8 18 | 30 12 | 8 27 | 30 46 | 8 36 | 31 20 | 8 45 | 31 55 | 8 55 | 32 29 | 9 4 | 33 3 | 9 13 | 33 37 |
| 12 | 8 7 | 29 38 | 8 16 | 30 12 | 8 25 | 30 47 | 8 34 | 31 21 | 8 44 | 31 55 | 8 53 | 32 29 | 9 2 | 33 3 | 9 11 | 33 37 |
| 14 | 8 5 | 29 39 | 8 14 | 30 13 | 8 23 | 30 47 | 8 32 | 31 21 | 8 42 | 31 55 | 8 51 | 32 29 | 9 0 | 33 3 | 9 9 | 33 37 |
| 16 | 8 3 | 29 39 | 8 12 | 30 13 | 8 21 | 30 47 | 8 30 | 31 21 | 8 40 | 31 55 | 8 49 | 32 29 | 8 58 | 33 3 | 9 7 | 33 37 |
| 18 | 8 1 | 29 39 | 8 10 | 30 13 | 8 19 | 30 47 | 8 29 | 31 21 | 8 38 | 31 55 | 8 47 | 32 29 | 8 56 | 33 3 | 9 5 | 33 38 |
| 20 | 7 59 | 29 39 | 8 8 | 30 13 | 8 17 | 30 47 | 8 27 | 31 21 | 8 36 | 31 55 | 8 45 | 32 29 | 8 54 | 33 4 | 9 3 | 33 38 |
| 22 | 7 58 | 29 39 | 8 7 | 30 13 | 8 16 | 30 47 | 8 25 | 31 21 | 8 34 | 31 56 | 8 43 | 32 30 | 8 52 | 33 4 | 9 1 | 33 38 |
| 24 | 7 56 | 29 39 | 8 5 | 30 13 | 8 14 | 30 48 | 8 23 | 31 22 | 8 32 | 31 56 | 8 41 | 32 30 | 8 50 | 33 4 | 8 59 | 33 38 |
| 26 | 7 54 | 29 39 | 8 3 | 30 14 | 8 12 | 30 48 | 8 21 | 31 22 | 8 30 | 31 56 | 8 39 | 32 30 | 8 48 | 33 4 | 8 57 | 33 38 |
| 28 | 7 52 | 29 40 | 8 1 | 30 14 | 8 10 | 30 48 | 8 19 | 31 22 | 8 28 | 31 56 | 8 37 | 32 30 | 8 46 | 33 4 | 8 55 | 33 38 |
| 30 | 7 50 | 29 40 | 7 59 | 30 14 | 8 8 | 30 48 | 8 17 | 31 22 | 8 26 | 31 56 | 8 35 | 32 30 | 8 43 | 33 4 | 8 52 | 33 39 |
| 32 | 7 48 | 29 40 | 7 57 | 30 14 | 8 6 | 30 48 | 8 15 | 31 22 | 8 24 | 31 56 | 8 33 | 32 30 | 8 41 | 33 5 | 8 50 | 33 39 |
| 34 | 7 47 | 29 40 | 7 55 | 30 14 | 8 4 | 30 48 | 8 13 | 31 22 | 8 22 | 31 57 | 8 31 | 32 31 | 8 39 | 33 5 | 8 48 | 33 39 |
| 36 | 7 45 | 29 40 | 7 54 | 30 14 | 8 2 | 30 48 | 8 11 | 31 23 | 8 20 | 31 57 | 8 29 | 32 31 | 8 37 | 33 5 | 8 46 | 33 39 |
| 38 | 7 43 | 29 40 | 7 52 | 30 14 | 8 0 | 30 49 | 8 9 | 31 23 | 8 18 | 31 57 | 8 27 | 32 31 | 8 35 | 33 5 | 8 44 | 33 39 |
| 40 | 7 41 | 29 40 | 7 50 | 30 15 | 7 58 | 30 49 | 8 7 | 31 23 | 8 16 | 31 57 | 8 25 | 32 31 | 8 33 | 33 5 | 8 42 | 33 39 |
| 42 | 7 39 | 29 41 | 7 48 | 30 15 | 7 57 | 30 49 | 8 5 | 31 23 | 8 14 | 31 57 | 8 23 | 32 31 | 8 31 | 33 5 | 8 40 | 33 40 |
| 44 | 7 37 | 29 41 | 7 46 | 30 15 | 7 55 | 30 49 | 8 3 | 31 23 | 8 12 | 31 57 | 8 21 | 32 31 | 8 29 | 33 6 | 8 38 | 33 40 |
| 46 | 7 36 | 29 41 | 7 44 | 30 15 | 7 53 | 30 49 | 8 1 | 31 23 | 8 10 | 31 58 | 8 19 | 32 32 | 8 27 | 33 6 | 8 36 | 33 40 |
| 48 | 7 34 | 29 41 | 7 42 | 30 15 | 7 51 | 30 49 | 7 59 | 31 24 | 8 8 | 31 58 | 8 17 | 32 32 | 8 25 | 33 6 | 8 34 | 33 40 |
| 50 | 7 32 | 29 41 | 7 40 | 30 15 | 7 49 | 30 50 | 7 58 | 31 24 | 8 6 | 31 58 | 8 15 | 32 32 | 8 23 | 33 6 | 8 32 | 33 40 |
| 52 | 7 30 | 29 41 | 7 39 | 30 16 | 7 47 | 30 50 | 7 56 | 31 24 | 8 4 | 31 58 | 8 13 | 32 32 | 8 21 | 33 6 | 8 30 | 33 40 |
| 54 | 7 28 | 29 42 | 7 37 | 30 16 | 7 45 | 30 50 | 7 54 | 31 24 | 8 2 | 31 58 | 8 11 | 32 32 | 8 19 | 33 6 | 8 28 | 33 41 |
| 56 | 7 26 | 29 42 | 7 35 | 30 16 | 7 43 | 30 50 | 7 52 | 31 24 | 8 0 | 31 58 | 8 9 | 32 33 | 8 17 | 33 7 | 8 25 | 33 41 |
| 58 | 7 25 | 29 42 | 7 33 | 30 16 | 7 41 | 30 50 | 7 50 | 31 24 | 7 58 | 31 59 | 8 7 | 32 33 | 8 15 | 33 7 | 8 23 | 33 41 |

| Seconds of H. P. | Corr. | A |
|---|---|---|
| ″ | ″ | ″ |
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 0 | 2 |
| 4 | 1 | 2 |
| 5 | 1 | 3 |
| 6 | 1 | 3 |
| 7 | 1 | 4 |
| 8 | 1 | 5 |
| 9 | 1 | 5 |
| 10 | 2 | 6 |
| 11 | 2 | 6 |
| 12 | 2 | 7 |
| 13 | 2 | 7 |
| 14 | 2 | 8 |
| 15 | 2 | 9 |
| 16 | 3 | 9 |
| 17 | 3 | 10 |
| 18 | 3 | 10 |
| 19 | 3 | 11 |
| 20 | 3 | 11 |
| 21 | 3 | 12 |
| 22 | 3 | 13 |
| 23 | 4 | 13 |
| 24 | 4 | 14 |
| 25 | 4 | 14 |
| 26 | 4 | 15 |
| 27 | 4 | 16 |
| 28 | 4 | 16 |
| 29 | 5 | 17 |
| 30 | 5 | 17 |
| 31 | 5 | 18 |
| 32 | 5 | 18 |
| 33 | 5 | 19 |
| 34 | 5 | 20 |
| 35 | 6 | 20 |
| 36 | 6 | 21 |
| 37 | 6 | 21 |
| 38 | 6 | 22 |
| 39 | 6 | 22 |
| 40 | 6 | 23 |
| 41 | 6 | 24 |
| 42 | 7 | 24 |
| 43 | 7 | 25 |
| 44 | 7 | 25 |
| 45 | 7 | 26 |
| 46 | 7 | 26 |
| 47 | 7 | 27 |
| 48 | 8 | 28 |
| 49 | 8 | 28 |
| 50 | 8 | 29 |
| 51 | 8 | 29 |
| 52 | 8 | 30 |
| 53 | 8 | 30 |
| 54 | 9 | 31 |
| 55 | 9 | 32 |
| 56 | 9 | 32 |
| 57 | 9 | 33 |
| 58 | 9 | 33 |
| 59 | 9 | 34 |

| Alt. ☉ | A ☉ | A ☾ |
|---|---|---|
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(82° and 83°) The Correction of the Moon's Altitude, and the Aux. Angle A. (W.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54 | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 82° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 7 23 | 29 42 | 7 31 | 30 16 | 7 39 | 30 50 | 7 48 | 31 25 | 7 56 | 31 59 | 8 5 | 32 33 | 8 13 | 33 7 | 8 21 | 33 41 |
| 2 | 7 21 | 29 42 | 7 29 | 30 16 | 7 38 | 30 51 | 7 46 | 31 25 | 7 54 | 31 59 | 8 3 | 32 33 | 8 11 | 33 7 | 8 19 | 33 41 |
| 4 | 7 19 | 29 42 | 7 27 | 30 17 | 7 36 | 30 51 | 7 44 | 31 25 | 7 52 | 31 59 | 8 1 | 32 33 | 8 9 | 33 7 | 8 17 | 33 42 |
| 6 | 7 17 | 29 43 | 7 26 | 30 17 | 7 34 | 30 51 | 7 42 | 31 25 | 7 50 | 31 59 | 7 59 | 32 33 | 8 7 | 33 7 | 8 15 | 33 42 |
| 8 | 7 15 | 29 43 | 7 24 | 30 17 | 7 32 | 30 51 | 7 40 | 31 25 | 7 48 | 31 59 | 7 57 | 32 33 | 8 5 | 33 8 | 8 13 | 33 42 |
| 10 | 7 14 | 29 43 | 7 22 | 30 17 | 7 30 | 30 51 | 7 38 | 31 25 | 7 46 | 31 59 | 7 55 | 32 34 | 8 3 | 33 8 | 8 11 | 33 42 |
| 12 | 7 12 | 29 43 | 7 20 | 30 17 | 7 28 | 30 51 | 7 36 | 31 25 | 7 44 | 32 0 | 7 53 | 32 34 | 8 1 | 33 8 | 8 9 | 33 42 |
| 14 | 7 10 | 29 43 | 7 18 | 30 17 | 7 26 | 30 51 | 7 34 | 31 26 | 7 42 | 32 0 | 7 50 | 32 34 | 7 59 | 33 8 | 8 7 | 33 42 |
| 16 | 7 8 | 29 43 | 7 16 | 30 17 | 7 24 | 30 52 | 7 32 | 31 26 | 7 40 | 32 0 | 7 49 | 32 34 | 7 57 | 33 8 | 8 5 | 33 42 |
| 18 | 7 6 | 29 43 | 7 14 | 30 18 | 7 22 | 30 52 | 7 30 | 31 26 | 7 38 | 32 0 | 7 47 | 32 34 | 7 55 | 33 8 | 8 3 | 33 43 |
| 20 | 7 4 | 29 43 | 7 12 | 30 18 | 7 20 | 30 52 | 7 28 | 31 26 | 7 36 | 32 0 | 7 44 | 32 34 | 7 52 | 33 9 | 8 0 | 33 43 |
| 22 | 7 3 | 29 44 | 7 11 | 30 18 | 7 18 | 30 52 | 7 26 | 31 26 | 7 35 | 32 0 | 7 42 | 32 35 | 7 50 | 33 9 | 7 58 | 33 43 |
| 24 | 7 1 | 29 44 | 7 9 | 30 18 | 7 17 | 30 52 | 7 25 | 31 26 | 7 33 | 32 0 | 7 40 | 32 35 | 7 48 | 33 9 | 7 56 | 33 43 |
| 26 | 6 59 | 29 44 | 7 7 | 30 18 | 7 15 | 30 52 | 7 23 | 31 27 | 7 31 | 32 1 | 7 38 | 32 35 | 7 46 | 33 9 | 7 54 | 33 43 |
| 28 | 6 57 | 29 44 | 7 5 | 30 18 | 7 13 | 30 53 | 7 21 | 31 27 | 7 29 | 32 1 | 7 36 | 32 35 | 7 44 | 33 9 | 7 52 | 33 43 |
| 30 | 6 55 | 29 44 | 7 3 | 30 18 | 7 11 | 30 53 | 7 19 | 31 27 | 7 27 | 32 1 | 7 34 | 32 35 | 7 42 | 33 9 | 7 50 | 33 44 |
| 32 | 6 53 | 29 44 | 7 1 | 30 18 | 7 9 | 30 53 | 7 17 | 31 27 | 7 25 | 32 1 | 7 32 | 32 35 | 7 40 | 33 10 | 7 48 | 33 44 |
| 34 | 6 52 | 29 44 | 6 59 | 30 19 | 7 7 | 30 53 | 7 15 | 31 27 | 7 23 | 32 1 | 7 30 | 32 35 | 7 38 | 33 10 | 7 46 | 33 44 |
| 36 | 6 50 | 29 45 | 6 58 | 30 19 | 7 5 | 30 53 | 7 13 | 31 27 | 7 21 | 32 1 | 7 28 | 32 36 | 7 36 | 33 10 | 7 44 | 33 44 |
| 38 | 6 48 | 29 45 | 6 56 | 30 19 | 7 3 | 30 53 | 7 11 | 31 27 | 7 19 | 32 2 | 7 26 | 32 36 | 7 34 | 33 10 | 7 42 | 33 44 |
| 40 | 6 46 | 29 45 | 6 54 | 30 19 | 7 1 | 30 53 | 7 9 | 31 27 | 7 17 | 32 2 | 7 24 | 32 36 | 7 32 | 33 10 | 7 40 | 33 44 |
| 42 | 6 44 | 29 45 | 6 52 | 30 19 | 6 59 | 30 53 | 7 7 | 31 28 | 7 15 | 32 2 | 7 22 | 32 36 | 7 30 | 33 10 | 7 38 | 33 45 |
| 44 | 6 42 | 29 45 | 6 50 | 30 19 | 6 58 | 30 54 | 7 5 | 31 28 | 7 13 | 32 2 | 7 20 | 32 36 | 7 28 | 33 11 | 7 36 | 33 45 |
| 46 | 6 41 | 29 45 | 6 48 | 30 19 | 6 56 | 30 54 | 7 3 | 31 28 | 7 11 | 32 2 | 7 18 | 32 36 | 7 26 | 33 11 | 7 34 | 33 45 |
| 48 | 6 39 | 29 45 | 6 46 | 30 20 | 6 54 | 30 54 | 7 1 | 31 28 | 7 9 | 32 2 | 7 16 | 32 37 | 7 24 | 33 11 | 7 31 | 33 45 |
| 50 | 6 37 | 29 45 | 6 44 | 30 20 | 6 52 | 30 54 | 6 59 | 31 28 | 7 7 | 32 2 | 7 14 | 32 37 | 7 22 | 33 11 | 7 29 | 33 45 |
| 52 | 6 35 | 29 46 | 6 43 | 30 20 | 6 50 | 30 54 | 6 57 | 31 28 | 7 5 | 32 3 | 7 12 | 32 37 | 7 20 | 33 11 | 7 27 | 33 45 |
| 54 | 6 33 | 29 46 | 6 41 | 30 20 | 6 48 | 30 54 | 6 56 | 31 29 | 7 3 | 32 3 | 7 10 | 32 37 | 7 18 | 33 11 | 7 25 | 33 46 |
| 56 | 6 31 | 29 46 | 6 39 | 30 20 | 6 46 | 30 54 | 6 54 | 31 29 | 7 1 | 32 3 | 7 8 | 32 37 | 7 16 | 33 11 | 7 23 | 33 46 |
| 58 | 6 30 | 29 46 | 6 37 | 30 20 | 6 44 | 30 55 | 6 52 | 31 29 | 6 59 | 32 3 | 7 6 | 32 37 | 7 14 | 33 12 | 7 21 | 33 46 |
| 83° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 6 28 | 29 46 | 6 35 | 30 20 | 6 42 | 30 55 | 6 50 | 31 29 | 6 57 | 32 3 | 7 4 | 32 38 | 7 12 | 33 12 | 7 19 | 33 46 |
| 2 | 6 26 | 29 46 | 6 33 | 30 21 | 6 40 | 30 55 | 6 48 | 31 29 | 6 55 | 32 3 | 7 2 | 32 38 | 7 10 | 33 12 | 7 17 | 33 46 |
| 4 | 6 24 | 29 46 | 6 31 | 30 21 | 6 39 | 30 55 | 6 46 | 31 29 | 6 53 | 32 4 | 7 0 | 32 38 | 7 7 | 33 12 | 7 15 | 33 46 |
| 6 | 6 22 | 29 47 | 6 29 | 30 21 | 6 37 | 30 55 | 6 44 | 31 29 | 6 51 | 32 4 | 6 58 | 32 38 | 7 5 | 33 12 | 7 13 | 33 47 |
| 8 | 6 20 | 29 47 | 6 28 | 30 21 | 6 35 | 30 55 | 6 42 | 31 30 | 6 49 | 32 4 | 6 56 | 32 38 | 7 3 | 33 12 | 7 11 | 33 47 |
| 10 | 6 19 | 29 47 | 6 26 | 30 21 | 6 33 | 30 55 | 6 40 | 31 30 | 6 47 | 32 4 | 6 54 | 32 38 | 7 1 | 33 12 | 7 8 | 33 47 |
| 12 | 6 17 | 29 47 | 6 24 | 30 21 | 6 31 | 30 56 | 6 38 | 31 30 | 6 45 | 32 4 | 6 52 | 32 38 | 6 59 | 33 13 | 7 6 | 33 47 |
| 14 | 6 15 | 29 47 | 6 22 | 30 21 | 6 29 | 30 56 | 6 36 | 31 30 | 6 43 | 32 4 | 6 50 | 32 39 | 6 57 | 33 13 | 7 4 | 33 47 |
| 16 | 6 13 | 29 47 | 6 20 | 30 22 | 6 27 | 30 56 | 6 34 | 31 30 | 6 41 | 32 4 | 6 48 | 32 39 | 6 55 | 33 13 | 7 2 | 33 47 |
| 18 | 6 11 | 29 47 | 6 18 | 30 22 | 6 25 | 30 56 | 6 32 | 31 30 | 6 39 | 32 4 | 6 46 | 32 39 | 6 53 | 33 13 | 7 0 | 33 47 |
| 20 | 6 9 | 29 47 | 6 16 | 30 22 | 6 23 | 30 56 | 6 30 | 31 30 | 6 37 | 32 5 | 6 44 | 32 39 | 6 51 | 33 13 | 6 58 | 33 47 |
| 22 | 6 8 | 29 48 | 6 14 | 30 22 | 6 21 | 30 56 | 6 28 | 31 31 | 6 35 | 32 5 | 6 42 | 32 39 | 6 49 | 33 13 | 6 56 | 33 48 |
| 24 | 6 6 | 29 48 | 6 13 | 30 22 | 6 19 | 30 56 | 6 26 | 31 31 | 6 33 | 32 5 | 6 40 | 32 39 | 6 47 | 33 13 | 6 54 | 33 48 |
| 26 | 6 4 | 29 48 | 6 11 | 30 22 | 6 18 | 30 56 | 6 24 | 31 31 | 6 31 | 32 5 | 6 38 | 32 39 | 6 45 | 33 14 | 6 52 | 33 48 |
| 28 | 6 2 | 29 48 | 6 9 | 30 22 | 6 16 | 30 57 | 6 22 | 31 31 | 6 29 | 32 5 | 6 36 | 32 39 | 6 43 | 33 14 | 6 50 | 33 48 |
| 30 | 6 0 | 29 48 | 6 7 | 30 22 | 6 14 | 30 57 | 6 20 | 31 31 | 6 27 | 32 5 | 6 34 | 32 40 | 6 41 | 33 14 | 6 48 | 33 48 |
| 32 | 5 58 | 29 48 | 6 5 | 30 23 | 6 12 | 30 57 | 6 19 | 31 31 | 6 25 | 32 5 | 6 32 | 32 40 | 6 39 | 33 14 | 6 46 | 33 48 |
| 34 | 5 57 | 29 48 | 6 3 | 30 23 | 6 10 | 30 57 | 6 17 | 31 31 | 6 23 | 32 6 | 6 30 | 32 40 | 6 37 | 33 14 | 6 44 | 33 48 |
| 36 | 5 55 | 29 49 | 6 1 | 30 23 | 6 8 | 30 57 | 6 15 | 31 31 | 6 21 | 32 6 | 6 28 | 32 40 | 6 35 | 33 14 | 6 41 | 33 49 |
| 38 | 5 53 | 29 49 | 5 59 | 30 23 | 6 6 | 30 57 | 6 13 | 31 32 | 6 19 | 32 6 | 6 26 | 32 40 | 6 33 | 33 14 | 6 39 | 33 49 |
| 40 | 5 51 | 29 49 | 5 58 | 30 23 | 6 4 | 30 57 | 6 11 | 31 32 | 6 17 | 32 6 | 6 24 | 32 40 | 6 31 | 33 15 | 6 37 | 33 49 |
| 42 | 5 49 | 29 49 | 5 56 | 30 23 | 6 2 | 30 58 | 6 9 | 31 32 | 6 15 | 32 6 | 6 22 | 32 40 | 6 29 | 33 15 | 6 35 | 33 49 |
| 44 | 5 47 | 29 49 | 5 54 | 30 23 | 6 0 | 30 58 | 6 7 | 31 32 | 6 13 | 32 6 | 6 20 | 32 41 | 6 27 | 33 15 | 6 33 | 33 49 |
| 46 | 5 46 | 29 49 | 5 52 | 30 24 | 5 58 | 30 58 | 6 5 | 31 32 | 6 12 | 32 6 | 6 18 | 32 41 | 6 25 | 33 15 | 6 31 | 33 49 |
| 48 | 5 44 | 29 49 | 5 50 | 30 24 | 5 57 | 30 58 | 6 3 | 31 32 | 6 10 | 32 7 | 6 16 | 32 41 | 6 22 | 33 15 | 6 29 | 33 49 |
| 50 | 5 42 | 29 49 | 5 48 | 30 24 | 5 55 | 30 58 | 6 1 | 31 32 | 6 8 | 32 7 | 6 14 | 32 41 | 6 20 | 33 15 | 6 27 | 33 50 |
| 52 | 5 40 | 29 50 | 5 46 | 30 24 | 5 53 | 30 58 | 5 59 | 31 33 | 6 6 | 32 7 | 6 12 | 32 41 | 6 18 | 33 15 | 6 25 | 33 50 |
| 54 | 5 38 | 29 50 | 5 45 | 30 24 | 5 51 | 30 58 | 5 57 | 31 33 | 6 4 | 32 7 | 6 10 | 32 41 | 6 16 | 33 16 | 6 23 | 33 50 |
| 56 | 5 36 | 29 50 | 5 43 | 30 24 | 5 49 | 30 59 | 5 55 | 31 33 | 6 2 | 32 7 | 6 8 | 32 41 | 6 14 | 33 16 | 6 21 | 33 50 |
| 58 | 5 35 | 29 50 | 5 41 | 30 24 | 5 47 | 30 59 | 5 53 | 31 33 | 6 0 | 32 7 | 6 6 | 32 42 | 6 12 | 33 16 | 6 19 | 33 50 |

Seconds of H. P.

| ″ | Cor. | A ′ |
|---|---|---|
| | ″ | |
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 0 | 2 |
| 4 | 0 | 2 |
| 5 | 1 | 3 |
| 6 | 1 | 3 |
| 7 | 1 | 4 |
| 8 | 1 | 5 |
| 9 | 1 | 5 |
| 10 | 1 | 6 |
| 11 | 1 | 6 |
| 12 | 1 | 7 |
| 13 | 2 | 7 |
| 14 | 2 | 8 |
| 15 | 2 | 9 |
| 16 | 2 | 9 |
| 17 | 2 | 10 |
| 18 | 2 | 10 |
| 19 | 2 | 11 |
| 20 | 2 | 11 |
| 21 | 3 | 12 |
| 22 | 3 | 13 |
| 23 | 3 | 13 |
| 24 | 3 | 14 |
| 25 | 3 | 14 |
| 26 | 3 | 15 |
| 27 | 3 | 16 |
| 28 | 3 | 16 |
| 29 | 4 | 17 |
| 30 | 4 | 17 |
| 31 | 4 | 18 |
| 32 | 4 | 18 |
| 33 | 4 | 19 |
| 34 | 4 | 20 |
| 35 | 4 | 20 |
| 36 | 4 | 21 |
| 37 | 5 | 21 |
| 38 | 5 | 22 |
| 39 | 5 | 22 |
| 40 | 5 | 23 |
| 41 | 5 | 24 |
| 42 | 5 | 24 |
| 43 | 5 | 25 |
| 44 | 5 | 25 |
| 45 | 6 | 26 |
| 46 | 6 | 26 |
| 47 | 6 | 27 |
| 48 | 6 | 28 |
| 49 | 6 | 28 |
| 50 | 6 | 29 |
| 51 | 6 | 29 |
| 52 | 6 | 30 |
| 53 | 7 | 30 |
| 54 | 7 | 31 |
| 55 | 7 | 32 |
| 56 | 7 | 32 |
| 57 | 7 | 33 |
| 58 | 7 | 33 |
| 59 | 7 | 34 |

| ☉ Alt. | ☽ A ′ | ☽ A ° |
|---|---|---|
| ° | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

## (w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (84° and 85°)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 84° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 5 33 | 29 50 | 5 39 | 30 24 | 5 45 | 30 59 | 5 51 | 31 33 | 5 58 | 32 7 | 6 5 | 32 42 | 6 10 | 33 16 | 6 17 | 33 50 |
| 2 | 5 31 | 29 50 | 5 37 | 30 25 | 5 43 | 30 59 | 5 50 | 31 33 | 5 56 | 32 7 | 6 2 | 32 42 | 6 8 | 33 16 | 6 15 | 33 50 |
| 4 | 5 29 | 29 50 | 5 35 | 30 25 | 5 41 | 30 59 | 5 48 | 31 33 | 5 54 | 32 8 | 6 0 | 32 42 | 6 6 | 33 16 | 6 12 | 33 51 |
| 6 | 5 27 | 29 50 | 5 33 | 30 25 | 5 39 | 30 59 | 5 46 | 31 33 | 5 52 | 32 8 | 5 58 | 32 42 | 6 4 | 33 16 | 6 10 | 33 51 |
| 8 | 5 25 | 29 51 | 5 31 | 30 25 | 5 38 | 30 59 | 5 44 | 31 33 | 5 50 | 32 8 | 5 56 | 32 42 | 6 2 | 33 16 | 6 8 | 33 51 |
| 10 | 5 23 | 29 51 | 5 30 | 30 25 | 5 36 | 30 59 | 5 42 | 31 34 | 5 48 | 32 8 | 5 54 | 32 42 | 6 0 | 33 16 | 6 6 | 33 51 |
| 12 | 5 22 | 29 51 | 5 28 | 30 25 | 5 34 | 30 59 | 5 40 | 31 34 | 5 46 | 32 8 | 5 52 | 32 42 | 5 58 | 33 17 | 6 4 | 33 51 |
| 14 | 5 20 | 29 51 | 5 26 | 30 25 | 5 32 | 30 59 | 5 38 | 31 34 | 5 44 | 32 8 | 5 50 | 32 42 | 5 56 | 33 17 | 6 2 | 33 51 |
| 16 | 5 18 | 29 51 | 5 24 | 30 25 | 5 30 | 31 0 | 5 36 | 31 34 | 5 42 | 32 8 | 5 48 | 32 42 | 5 54 | 33 17 | 6 0 | 33 51 |
| 18 | 5 16 | 29 51 | 5 22 | 30 25 | 5 28 | 31 0 | 5 34 | 31 34 | 5 40 | 32 8 | 5 46 | 32 43 | 5 52 | 33 17 | 5 58 | 33 51 |
| 20 | 5 14 | 29 51 | 5 20 | 30 25 | 5 26 | 31 0 | 5 32 | 31 34 | 5 38 | 32 8 | 5 44 | 32 43 | 5 50 | 33 17 | 5 56 | 33 51 |
| 22 | 5 12 | 29 51 | 5 18 | 30 26 | 5 24 | 31 0 | 5 30 | 31 34 | 5 36 | 32 9 | 5 42 | 32 43 | 5 48 | 33 17 | 5 54 | 33 52 |
| 24 | 5 11 | 29 51 | 5 16 | 30 26 | 5 22 | 31 0 | 5 28 | 31 34 | 5 34 | 32 9 | 5 40 | 32 43 | 5 46 | 33 17 | 5 52 | 33 52 |
| 26 | 5 9 | 29 51 | 5 14 | 30 26 | 5 20 | 31 0 | 5 26 | 31 34 | 5 32 | 32 9 | 5 38 | 32 43 | 5 44 | 33 17 | 5 49 | 33 52 |
| 28 | 5 7 | 29 52 | 5 13 | 30 26 | 5 18 | 31 0 | 5 24 | 31 35 | 5 30 | 32 9 | 5 36 | 32 43 | 5 42 | 33 17 | 5 47 | 33 52 |
| 30 | 5 5 | 29 52 | 5 11 | 30 26 | 5 17 | 31 0 | 5 22 | 31 35 | 5 28 | 32 9 | 5 34 | 32 43 | 5 40 | 33 18 | 5 45 | 33 52 |
| 32 | 5 3 | 29 52 | 5 9 | 30 26 | 5 15 | 31 0 | 5 20 | 31 35 | 5 26 | 32 9 | 5 32 | 32 43 | 5 37 | 33 18 | 5 43 | 33 52 |
| 34 | 5 1 | 29 52 | 5 7 | 30 26 | 5 13 | 31 1 | 5 18 | 31 35 | 5 24 | 32 9 | 5 30 | 32 43 | 5 35 | 33 18 | 5 41 | 33 52 |
| 36 | 4 59 | 29 52 | 5 5 | 30 26 | 5 11 | 31 1 | 5 16 | 31 35 | 5 22 | 32 9 | 5 28 | 32 44 | 5 33 | 33 18 | 5 39 | 33 52 |
| 38 | 4 58 | 29 52 | 5 3 | 30 26 | 5 9 | 31 1 | 5 15 | 31 35 | 5 20 | 32 9 | 5 26 | 32 44 | 5 31 | 33 18 | 5 37 | 33 52 |
| 40 | 4 56 | 29 52 | 5 1 | 30 26 | 5 7 | 31 1 | 5 13 | 31 35 | 5 18 | 32 9 | 5 24 | 32 44 | 5 29 | 33 18 | 5 35 | 33 52 |
| 42 | 4 54 | 29 52 | 5 0 | 30 27 | 5 5 | 31 1 | 5 11 | 31 35 | 5 16 | 32 10 | 5 22 | 32 44 | 5 27 | 33 18 | 5 33 | 33 53 |
| 44 | 4 52 | 29 52 | 4 58 | 30 27 | 5 3 | 31 1 | 5 9 | 31 35 | 5 14 | 32 10 | 5 20 | 32 44 | 5 25 | 33 18 | 5 31 | 33 53 |
| 46 | 4 50 | 29 52 | 4 56 | 30 27 | 5 1 | 31 1 | 5 7 | 31 35 | 5 12 | 32 10 | 5 18 | 32 44 | 5 23 | 33 19 | 5 29 | 33 53 |
| 48 | 4 48 | 29 53 | 4 54 | 30 27 | 4 59 | 31 1 | 5 5 | 31 36 | 5 10 | 32 10 | 5 16 | 32 44 | 5 21 | 33 19 | 5 27 | 33 53 |
| 50 | 4 47 | 29 53 | 4 52 | 30 27 | 4 57 | 31 1 | 5 3 | 31 36 | 5 8 | 32 10 | 5 14 | 32 44 | 5 19 | 33 19 | 5 24 | 33 53 |
| 52 | 4 45 | 29 53 | 4 50 | 30 27 | 4 56 | 31 1 | 5 1 | 31 36 | 5 6 | 32 10 | 5 12 | 32 44 | 5 17 | 33 19 | 5 22 | 33 53 |
| 54 | 4 43 | 29 53 | 4 48 | 30 27 | 4 54 | 31 2 | 4 59 | 31 36 | 5 4 | 32 10 | 5 10 | 32 45 | 5 15 | 33 19 | 5 20 | 33 53 |
| 56 | 4 41 | 29 53 | 4 46 | 30 27 | 4 52 | 31 2 | 4 57 | 31 36 | 5 2 | 32 10 | 5 8 | 32 45 | 5 13 | 33 19 | 5 18 | 33 53 |
| 58 | 4 39 | 29 53 | 4 44 | 30 27 | 4 50 | 31 2 | 4 55 | 31 36 | 5 0 | 32 10 | 5 6 | 32 45 | 5 11 | 33 19 | 5 16 | 33 53 |
| 85° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 4 37 | 29 53 | 4 43 | 30 28 | 4 48 | 31 2 | 4 53 | 31 36 | 4 58 | 32 11 | 5 3 | 32 45 | 5 9 | 33 19 | 5 14 | 33 54 |
| 2 | 4 36 | 29 53 | 4 41 | 30 28 | 4 46 | 31 2 | 4 51 | 31 36 | 4 56 | 32 11 | 5 1 | 32 45 | 5 7 | 33 19 | 5 12 | 33 54 |
| 4 | 4 34 | 29 53 | 4 39 | 30 28 | 4 44 | 31 2 | 4 49 | 31 36 | 4 54 | 32 11 | 4 59 | 32 45 | 5 5 | 33 19 | 5 10 | 33 54 |
| 6 | 4 32 | 29 53 | 4 37 | 30 28 | 4 42 | 31 2 | 4 47 | 31 36 | 4 52 | 32 11 | 4 57 | 32 45 | 5 3 | 33 20 | 5 8 | 33 54 |
| 8 | 4 30 | 29 54 | 4 35 | 30 28 | 4 40 | 31 2 | 4 45 | 31 37 | 4 50 | 32 11 | 4 55 | 32 45 | 5 1 | 33 20 | 5 6 | 33 54 |
| 10 | 4 28 | 29 54 | 4 33 | 30 28 | 4 38 | 31 2 | 4 43 | 31 37 | 4 48 | 32 11 | 4 53 | 32 45 | 4 58 | 33 20 | 5 4 | 33 54 |
| 12 | 4 26 | 29 54 | 4 31 | 30 28 | 4 36 | 31 2 | 4 41 | 31 37 | 4 46 | 32 11 | 4 51 | 32 45 | 4 56 | 33 20 | 5 1 | 33 54 |
| 14 | 4 24 | 29 54 | 4 29 | 30 28 | 4 34 | 31 2 | 4 39 | 31 37 | 4 44 | 32 11 | 4 49 | 32 46 | 4 54 | 33 20 | 4 59 | 33 54 |
| 16 | 4 23 | 29 54 | 4 28 | 30 28 | 4 33 | 31 3 | 4 37 | 31 37 | 4 42 | 32 11 | 4 47 | 32 46 | 4 52 | 33 20 | 4 57 | 33 54 |
| 18 | 4 21 | 29 54 | 4 26 | 30 28 | 4 31 | 31 3 | 4 36 | 31 37 | 4 40 | 32 11 | 4 45 | 32 46 | 4 50 | 33 20 | 4 55 | 33 54 |
| 20 | 4 19 | 29 54 | 4 24 | 30 28 | 4 29 | 31 3 | 4 34 | 31 37 | 4 38 | 32 11 | 4 43 | 32 46 | 4 48 | 33 20 | 4 53 | 33 54 |
| 22 | 4 17 | 29 54 | 4 22 | 30 28 | 4 27 | 31 3 | 4 32 | 31 37 | 4 36 | 32 11 | 4 41 | 32 46 | 4 46 | 33 20 | 4 51 | 33 55 |
| 24 | 4 15 | 29 54 | 4 20 | 30 29 | 4 25 | 31 3 | 4 30 | 31 37 | 4 34 | 32 12 | 4 39 | 32 46 | 4 44 | 33 20 | 4 49 | 33 55 |
| 26 | 4 13 | 29 54 | 4 18 | 30 29 | 4 23 | 31 3 | 4 28 | 31 37 | 4 32 | 32 12 | 4 37 | 32 46 | 4 42 | 33 20 | 4 47 | 33 55 |
| 28 | 4 12 | 29 54 | 4 16 | 30 29 | 4 21 | 31 3 | 4 26 | 31 37 | 4 30 | 32 12 | 4 35 | 32 46 | 4 40 | 33 20 | 4 45 | 33 55 |
| 30 | 4 10 | 29 54 | 4 14 | 30 29 | 4 19 | 31 3 | 4 24 | 31 37 | 4 28 | 32 12 | 4 33 | 32 46 | 4 38 | 33 20 | 4 43 | 33 55 |
| 32 | 4 8 | 29 54 | 4 13 | 30 29 | 4 17 | 31 3 | 4 22 | 31 38 | 4 27 | 32 12 | 4 31 | 32 46 | 4 36 | 33 21 | 4 41 | 33 55 |
| 34 | 4 6 | 29 54 | 4 11 | 30 29 | 4 15 | 31 3 | 4 20 | 31 38 | 4 25 | 32 12 | 4 29 | 32 46 | 4 34 | 33 21 | 4 38 | 33 55 |
| 36 | 4 4 | 29 55 | 4 9 | 30 29 | 4 13 | 31 3 | 4 18 | 31 38 | 4 23 | 32 12 | 4 27 | 32 46 | 4 32 | 33 21 | 4 36 | 33 55 |
| 38 | 4 2 | 29 55 | 4 7 | 30 29 | 4 12 | 31 3 | 4 16 | 31 38 | 4 21 | 32 12 | 4 25 | 32 47 | 4 30 | 33 21 | 4 34 | 33 55 |
| 40 | 4 0 | 29 55 | 4 5 | 30 29 | 4 10 | 31 3 | 4 14 | 31 38 | 4 19 | 32 12 | 4 23 | 32 47 | 4 28 | 33 21 | 4 32 | 33 55 |
| 42 | 3 59 | 29 55 | 4 3 | 30 29 | 4 8 | 31 3 | 4 12 | 31 38 | 4 17 | 32 12 | 4 21 | 32 47 | 4 26 | 33 21 | 4 30 | 33 56 |
| 44 | 3 57 | 29 55 | 4 1 | 30 29 | 4 6 | 31 4 | 4 10 | 31 38 | 4 15 | 32 12 | 4 19 | 32 47 | 4 24 | 33 21 | 4 28 | 33 55 |
| 46 | 3 55 | 29 55 | 3 59 | 30 29 | 4 4 | 31 4 | 4 8 | 31 38 | 4 13 | 32 12 | 4 17 | 32 47 | 4 22 | 33 21 | 4 26 | 33 56 |
| 48 | 3 53 | 29 55 | 3 57 | 30 29 | 4 2 | 31 4 | 4 6 | 31 38 | 4 11 | 32 13 | 4 15 | 32 47 | 4 19 | 33 21 | 4 24 | 33 56 |
| 50 | 3 51 | 29 55 | 3 56 | 30 29 | 4 0 | 31 4 | 4 4 | 31 38 | 4 9 | 32 13 | 4 13 | 32 47 | 4 17 | 33 21 | 4 22 | 33 56 |
| 52 | 3 49 | 29 55 | 3 54 | 30 30 | 3 58 | 31 4 | 4 2 | 31 38 | 4 7 | 32 13 | 4 11 | 32 47 | 4 15 | 33 21 | 4 20 | 33 56 |
| 54 | 3 48 | 29 55 | 3 52 | 30 30 | 3 56 | 31 4 | 4 0 | 31 38 | 4 5 | 32 13 | 4 9 | 32 47 | 4 13 | 33 22 | 4 18 | 33 56 |
| 56 | 3 46 | 29 55 | 3 50 | 30 30 | 3 54 | 31 4 | 3 58 | 31 39 | 4 3 | 32 13 | 4 7 | 32 47 | 4 11 | 33 22 | 4 15 | 33 56 |
| 58 | 3 44 | 29 55 | 3 48 | 30 30 | 3 52 | 31 4 | 3 57 | 31 39 | 4 1 | 32 13 | 4 5 | 32 47 | 4 9 | 33 22 | 4 13 | 33 56 |

### Seconds of H. P.

| ″ | Cor′ | A ″ |
|---|---|---|
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 0 | 2 |
| 4 | 0 | 2 |
| 5 | 0 | 3 |
| 6 | 1 | 3 |
| 7 | 1 | 4 |
| 8 | 1 | 5 |
| 9 | 1 | 5 |
| 10 | 1 | 6 |
| 11 | 1 | 6 |
| 12 | 1 | 7 |
| 13 | 1 | 7 |
| 14 | 1 | 8 |
| 15 | 1 | 9 |
| 16 | 1 | 9 |
| 17 | 2 | 10 |
| 18 | 2 | 10 |
| 19 | 2 | 11 |
| 20 | 2 | 11 |
| 21 | 2 | 12 |
| 22 | 2 | 13 |
| 23 | 2 | 13 |
| 24 | 2 | 14 |
| 25 | 2 | 14 |
| 26 | 2 | 15 |
| 27 | 2 | 16 |
| 28 | 3 | 16 |
| 29 | 3 | 17 |
| 30 | 3 | 17 |
| 31 | 3 | 18 |
| 32 | 3 | 18 |
| 33 | 3 | 19 |
| 34 | 3 | 20 |
| 35 | 3 | 20 |
| 36 | 3 | 21 |
| 37 | 3 | 21 |
| 38 | 3 | 22 |
| 39 | 4 | 22 |
| 40 | 4 | 23 |
| 41 | 4 | 24 |
| 42 | 4 | 24 |
| 43 | 4 | 25 |
| 44 | 4 | 25 |
| 45 | 4 | 26 |
| 46 | 4 | 26 |
| 47 | 4 | 27 |
| 48 | 4 | 28 |
| 49 | 4 | 28 |
| 50 | 5 | 29 |
| 51 | 5 | 29 |
| 52 | 5 | 30 |
| 53 | 5 | 30 |
| 54 | 5 | 31 |
| 55 | 5 | 32 |
| 56 | 5 | 32 |
| 57 | 5 | 33 |
| 58 | 5 | 33 |
| 59 | 5 | 34 |
| ″ | A | A |
| 0 | ⊙ | ● |
| 1 | ♈ | ♓ |
| 2 | ♉ | ♒ |
| 3 | ♊ | ♑ |
| 4 | ♋ | ♐ |
| 5 | ♌ | ♏ |
| 6 | ♍ | ♎ |
| 7 | ♎ | ♍ |
| 8 | ♏ | ♌ |
| 9 | ♐ | ♋ |
| 10 | ♑ | ♊ |
| 11 | ♒ | ♉ |
| 12 | ♓ | ♈ |
| 13 | ♈ | ♓ |
| 14 | ♉ | ♒ |
| 15 | ♊ | ♑ |
| 16 | ♋ | ♐ |
| 17 | ♌ | ♏ |
| 18 | ♍ | ♎ |
| 19 | ♎ | ♍ |
| 20 | ♏ | ♌ |
| 21 | ♐ | ♋ |
| 22 | ♑ | ♊ |
| 23 | ♒ | ♉ |
| 24 | ♓ | ♈ |
| 25 | ♈ | ♓ |
| 26 | ♉ | ♒ |
| 27 | ♊ | ♑ |
| 28 | ♋ | ♐ |
| 29 | ♌ | ♏ |
| 30 | ♍ | ♎ |
| 31 | ♎ | ♍ |
| 32 | ♏ | ♌ |
| 33 | ♐ | ♋ |
| 34 | ♑ | ♊ |
| 35 | ♒ | ♉ |
| 36 | ♓ | ♈ |
| 37 | ♈ | ♓ |
| 38 | ♉ | ♒ |
| 39 | ♊ | ♑ |
| 40 | ♋ | ♐ |
| 41 | ♌ | ♏ |
| 42 | ♍ | ♎ |
| 43 | ♎ | ♍ |
| 44 | ♏ | ♌ |
| 45 | ♐ | ♋ |
| 46 | ♑ | ♊ |
| 47 | ♒ | ♉ |
| 48 | ♓ | ♈ |
| 49 | ♈ | ♓ |
| 50 | ♉ | ♒ |
| 51 | ♊ | ♑ |
| 52 | ♋ | ♐ |
| 53 | ♌ | ♏ |
| 54 | ♍ | ♎ |
| 55 | ♎ | ♍ |
| 56 | ♏ | ♌ |
| 57 | ♐ | ♋ |
| 58 | ♑ | ♊ |
| 59 | ♒ | ♉ |
| 60 | ♓ | ♈ |

## (86° and 87°) The Correction of the Moon's Altitude, and the Aux. Angle A. (w.)

| App. Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 86° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 3 42 | 29 55 | 3 46 | 30 30 | 3 50 | 31 4 | 3 55 | 31 39 | 3 59 | 32 13 | 4 3 | 32 47 | 4 7 | 33 22 | 4 11 | 33 56 |
| 2 | 3 40 | 29 56 | 3 44 | 30 30 | 3 48 | 31 4 | 3 53 | 31 39 | 3 57 | 32 13 | 4 1 | 32 48 | 4 5 | 33 22 | 4 9 | 33 56 |
| 4 | 3 38 | 29 56 | 3 42 | 30 30 | 3 47 | 31 4 | 3 51 | 31 39 | 3 55 | 32 13 | 3 59 | 32 48 | 4 3 | 33 22 | 4 7 | 33 56 |
| 6 | 3 36 | 29 56 | 3 40 | 30 30 | 3 45 | 31 4 | 3 49 | 31 39 | 3 53 | 32 13 | 3 57 | 32 48 | 4 1 | 33 22 | 4 5 | 33 56 |
| 8 | 3 35 | 29 56 | 3 39 | 30 30 | 3 43 | 31 4 | 3 47 | 31 39 | 3 51 | 32 13 | 3 55 | 32 48 | 3 59 | 33 22 | 4 3 | 33 56 |
| 10 | 3 33 | 29 56 | 3 37 | 30 30 | 3 41 | 31 5 | 3 45 | 31 39 | 3 49 | 32 13 | 3 53 | 32 48 | 3 57 | 33 22 | 4 1 | 33 56 |
| 12 | 3 31 | 29 56 | 3 35 | 30 30 | 3 39 | 31 5 | 3 43 | 31 39 | 3 47 | 32 13 | 3 51 | 32 48 | 3 55 | 33 22 | 3 59 | 33 57 |
| 14 | 3 29 | 29 56 | 3 33 | 30 30 | 3 37 | 31 5 | 3 41 | 31 39 | 3 45 | 32 13 | 3 49 | 32 48 | 3 53 | 33 22 | 3 57 | 33 57 |
| 16 | 3 27 | 29 56 | 3 31 | 30 30 | 3 35 | 31 5 | 3 39 | 31 39 | 3 43 | 32 13 | 3 47 | 32 48 | 3 51 | 33 22 | 3 54 | 33 57 |
| 18 | 3 25 | 29 56 | 3 29 | 30 30 | 3 33 | 31 5 | 3 37 | 31 39 | 3 41 | 32 14 | 3 45 | 32 48 | 3 49 | 33 22 | 3 52 | 33 57 |
| 20 | 3 23 | 29 56 | 3 27 | 30 30 | 3 31 | 31 5 | 3 35 | 31 39 | 3 39 | 32 14 | 3 43 | 32 48 | 3 46 | 33 22 | 3 50 | 33 57 |
| 22 | 3 22 | 29 56 | 3 25 | 30 30 | 3 29 | 31 5 | 3 33 | 31 39 | 3 37 | 32 14 | 3 41 | 32 48 | 3 44 | 33 22 | 3 48 | 33 57 |
| 24 | 3 20 | 29 56 | 3 24 | 30 30 | 3 27 | 31 5 | 3 31 | 31 39 | 3 35 | 32 14 | 3 39 | 32 48 | 3 42 | 33 22 | 3 46 | 33 57 |
| 26 | 3 18 | 29 56 | 3 22 | 30 31 | 3 25 | 31 5 | 3 29 | 31 39 | 3 33 | 32 14 | 3 37 | 32 48 | 3 40 | 33 23 | 3 44 | 33 57 |
| 28 | 3 16 | 29 56 | 3 20 | 30 31 | 3 24 | 31 5 | 3 27 | 31 39 | 3 31 | 32 14 | 3 35 | 32 48 | 3 38 | 33 23 | 3 42 | 33 57 |
| 30 | 3 14 | 29 56 | 3 18 | 30 31 | 3 22 | 31 5 | 3 25 | 31 39 | 3 29 | 32 14 | 3 32 | 32 48 | 3 36 | 33 23 | 3 40 | 33 57 |
| 32 | 3 12 | 29 56 | 3 16 | 30 31 | 3 20 | 31 5 | 3 23 | 31 39 | 3 27 | 32 14 | 3 30 | 32 48 | 3 34 | 33 23 | 3 38 | 33 57 |
| 34 | 3 11 | 29 56 | 3 14 | 30 31 | 3 18 | 31 5 | 3 21 | 31 40 | 3 25 | 32 14 | 3 28 | 32 48 | 3 32 | 33 23 | 3 36 | 33 57 |
| 36 | 3 9 | 29 56 | 3 12 | 30 31 | 3 16 | 31 5 | 3 19 | 31 40 | 3 23 | 32 14 | 3 26 | 32 48 | 3 30 | 33 23 | 3 34 | 33 57 |
| 38 | 3 7 | 29 56 | 3 10 | 30 31 | 3 14 | 31 5 | 3 17 | 31 40 | 3 21 | 32 14 | 3 24 | 32 48 | 3 28 | 33 23 | 3 31 | 33 57 |
| 40 | 3 5 | 29 56 | 3 8 | 30 31 | 3 12 | 31 5 | 3 15 | 31 40 | 3 19 | 32 14 | 3 22 | 32 48 | 3 26 | 33 23 | 3 29 | 33 57 |
| 42 | 3 3 | 29 57 | 3 7 | 30 31 | 3 10 | 31 5 | 3 14 | 31 40 | 3 17 | 32 14 | 3 20 | 32 49 | 3 24 | 33 23 | 3 27 | 33 57 |
| 44 | 3 1 | 29 57 | 3 5 | 30 31 | 3 8 | 31 5 | 3 12 | 31 40 | 3 15 | 32 14 | 3 18 | 32 49 | 3 22 | 33 23 | 3 25 | 33 57 |
| 46 | 2 59 | 29 57 | 3 3 | 30 31 | 3 6 | 31 5 | 3 10 | 31 40 | 3 13 | 32 14 | 3 16 | 32 49 | 3 20 | 33 23 | 3 23 | 33 57 |
| 48 | 2 58 | 29 57 | 3 1 | 30 31 | 3 4 | 31 5 | 3 8 | 31 40 | 3 11 | 32 14 | 3 14 | 32 49 | 3 18 | 33 23 | 3 21 | 33 58 |
| 50 | 2 56 | 29 57 | 2 59 | 30 31 | 3 2 | 31 6 | 3 6 | 31 40 | 3 9 | 32 14 | 3 12 | 32 49 | 3 16 | 33 23 | 3 19 | 33 58 |
| 52 | 2 54 | 29 57 | 2 57 | 30 31 | 3 0 | 31 6 | 3 4 | 31 40 | 3 7 | 32 14 | 3 10 | 32 49 | 3 14 | 33 23 | 3 17 | 33 58 |
| 54 | 2 52 | 29 57 | 2 55 | 30 31 | 2 59 | 31 6 | 3 2 | 31 40 | 3 5 | 32 14 | 3 8 | 32 49 | 3 11 | 33 23 | 3 15 | 33 58 |
| 56 | 2 50 | 29 57 | 2 53 | 30 31 | 2 57 | 31 6 | 3 0 | 31 40 | 3 3 | 32 14 | 3 6 | 32 49 | 3 9 | 33 23 | 3 13 | 33 58 |
| 58 | 2 48 | 29 57 | 2 51 | 30 31 | 2 55 | 31 6 | 2 58 | 31 40 | 3 1 | 32 15 | 3 4 | 32 49 | 3 7 | 33 23 | 3 11 | 33 58 |
| 87° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 2 46 | 29 57 | 2 50 | 30 31 | 2 53 | 31 6 | 2 56 | 31 40 | 2 59 | 32 15 | 3 2 | 32 49 | 3 5 | 33 23 | 3 8 | 33 58 |
| 2 | 2 45 | 29 57 | 2 48 | 30 31 | 2 51 | 31 6 | 2 54 | 31 40 | 2 57 | 32 15 | 3 0 | 32 49 | 3 3 | 33 24 | 3 6 | 33 58 |
| 4 | 2 43 | 29 57 | 2 46 | 30 32 | 2 49 | 31 6 | 2 52 | 31 40 | 2 55 | 32 15 | 2 58 | 32 49 | 3 1 | 33 24 | 3 4 | 33 58 |
| 6 | 2 41 | 29 57 | 2 44 | 30 32 | 2 47 | 31 6 | 2 50 | 31 40 | 2 53 | 32 15 | 2 56 | 32 49 | 2 59 | 33 24 | 3 2 | 33 58 |
| 8 | 2 39 | 29 57 | 2 42 | 30 32 | 2 45 | 31 6 | 2 48 | 31 41 | 2 51 | 32 15 | 2 54 | 32 49 | 2 57 | 33 24 | 3 0 | 33 58 |
| 10 | 2 37 | 29 57 | 2 40 | 30 32 | 2 43 | 31 6 | 2 46 | 31 41 | 2 49 | 32 15 | 2 52 | 32 49 | 2 55 | 33 24 | 2 58 | 33 58 |
| 12 | 2 35 | 29 57 | 2 38 | 30 32 | 2 41 | 31 6 | 2 44 | 31 41 | 2 47 | 32 15 | 2 50 | 32 50 | 2 53 | 33 24 | 2 56 | 33 58 |
| 14 | 2 34 | 29 57 | 2 36 | 30 32 | 2 39 | 31 6 | 2 42 | 31 41 | 2 45 | 32 15 | 2 48 | 32 50 | 2 51 | 33 24 | 2 54 | 33 59 |
| 16 | 2 32 | 29 58 | 2 35 | 30 32 | 2 37 | 31 6 | 2 40 | 31 41 | 2 43 | 32 15 | 2 46 | 32 50 | 2 49 | 33 24 | 2 52 | 33 59 |
| 18 | 2 30 | 29 58 | 2 33 | 30 32 | 2 36 | 31 7 | 2 38 | 31 41 | 2 41 | 32 15 | 2 44 | 32 50 | 2 47 | 33 24 | 2 50 | 33 59 |
| 20 | 2 28 | 29 58 | 2 31 | 30 32 | 2 34 | 31 7 | 2 36 | 31 41 | 2 39 | 32 15 | 2 42 | 32 50 | 2 45 | 33 24 | 2 48 | 33 59 |
| 22 | 2 26 | 29 58 | 2 29 | 30 32 | 2 32 | 31 7 | 2 34 | 31 41 | 2 37 | 32 16 | 2 40 | 32 50 | 2 43 | 33 24 | 2 46 | 33 59 |
| 24 | 2 24 | 29 58 | 2 27 | 30 32 | 2 30 | 31 7 | 2 32 | 31 41 | 2 35 | 32 16 | 2 38 | 32 50 | 2 41 | 33 24 | 2 43 | 33 59 |
| 26 | 2 22 | 29 58 | 2 25 | 30 32 | 2 28 | 31 7 | 2 31 | 31 41 | 2 33 | 32 16 | 2 36 | 32 50 | 2 39 | 33 25 | 2 41 | 33 59 |
| 28 | 2 21 | 29 58 | 2 23 | 30 32 | 2 26 | 31 7 | 2 29 | 31 41 | 2 31 | 32 16 | 2 34 | 32 50 | 2 37 | 33 25 | 2 39 | 33 59 |
| 30 | 2 19 | 29 58 | 2 21 | 30 32 | 2 24 | 31 7 | 2 27 | 31 41 | 2 29 | 32 16 | 2 32 | 32 50 | 2 35 | 33 25 | 2 37 | 33 59 |
| 32 | 2 17 | 29 58 | 2 20 | 30 33 | 2 22 | 31 7 | 2 25 | 31 42 | 2 27 | 32 16 | 2 30 | 32 50 | 2 32 | 33 25 | 2 35 | 33 59 |
| 34 | 2 15 | 29 58 | 2 18 | 30 33 | 2 20 | 31 7 | 2 23 | 31 42 | 2 25 | 32 16 | 2 28 | 32 51 | 2 30 | 33 25 | 2 33 | 33 59 |
| 36 | 2 13 | 29 58 | 2 16 | 30 33 | 2 18 | 31 7 | 2 21 | 31 42 | 2 23 | 32 16 | 2 26 | 32 51 | 2 28 | 33 25 | 2 31 | 34 0 |
| 38 | 2 11 | 29 58 | 2 14 | 30 33 | 2 16 | 31 7 | 2 19 | 31 42 | 2 21 | 32 16 | 2 24 | 32 51 | 2 26 | 33 25 | 2 29 | 34 0 |
| 40 | 2 10 | 29 58 | 2 12 | 30 33 | 2 14 | 31 7 | 2 17 | 31 42 | 2 19 | 32 16 | 2 22 | 32 51 | 2 24 | 33 25 | 2 27 | 34 0 |
| 42 | 2 8 | 29 59 | 2 10 | 30 33 | 2 13 | 31 7 | 2 15 | 31 42 | 2 17 | 32 16 | 2 20 | 32 51 | 2 22 | 33 25 | 2 25 | 34 0 |
| 44 | 2 6 | 29 59 | 2 8 | 30 33 | 2 11 | 31 8 | 2 13 | 31 42 | 2 15 | 32 16 | 2 18 | 32 51 | 2 20 | 33 25 | 2 23 | 34 0 |
| 46 | 2 4 | 29 59 | 2 6 | 30 33 | 2 9 | 31 8 | 2 11 | 31 42 | 2 13 | 32 17 | 2 16 | 32 51 | 2 18 | 33 25 | 2 20 | 34 0 |
| 48 | 2 2 | 29 59 | 2 4 | 30 33 | 2 7 | 31 8 | 2 9 | 31 42 | 2 11 | 32 17 | 2 14 | 32 51 | 2 16 | 33 26 | 2 18 | 34 0 |
| 50 | 2 0 | 29 59 | 2 3 | 30 33 | 2 5 | 31 8 | 2 7 | 31 42 | 2 9 | 32 17 | 2 12 | 32 51 | 2 14 | 33 26 | 2 16 | 34 0 |
| 52 | 1 58 | 29 59 | 2 1 | 30 33 | 2 3 | 31 8 | 2 5 | 31 42 | 2 7 | 32 17 | 2 10 | 32 51 | 2 12 | 33 26 | 2 14 | 34 0 |
| 54 | 1 57 | 29 59 | 1 59 | 30 34 | 2 1 | 31 9 | 2 3 | 31 43 | 2 5 | 32 17 | 2 8 | 32 51 | 2 10 | 33 26 | 2 12 | 34 0 |
| 56 | 1 55 | 29 59 | 1 57 | 30 34 | 1 59 | 31 8 | 2 1 | 31 43 | 2 3 | 32 17 | 2 6 | 32 52 | 2 8 | 33 26 | 2 10 | 34 0 |
| 58 | 1 53 | 29 59 | 1 55 | 30 34 | 1 57 | 31 8 | 1 59 | 31 43 | 2 1 | 32 17 | 2 4 | 32 52 | 2 6 | 33 26 | 2 8 | 34 1 |

| Seconds of H. P. | | |
|---|---|---|
| | ″ Cor. | A ″ |
| 1 | 0 | 1 |
| 2 | 0 | 1 |
| 3 | 0 | 2 |
| 4 | 0 | 2 |
| 5 | 0 | 3 |
| 6 | 0 | 3 |
| 7 | 0 | 4 |
| 8 | 0 | 5 |
| 9 | 1 | 5 |
| 10 | 1 | 6 |
| 11 | 1 | 6 |
| 12 | 1 | 7 |
| 13 | 1 | 7 |
| 14 | 1 | 8 |
| 15 | 1 | 9 |
| 16 | 1 | 9 |
| 17 | 1 | 10 |
| 18 | 1 | 10 |
| 19 | 1 | 11 |
| 20 | 1 | 11 |
| 21 | 1 | 12 |
| 22 | 1 | 13 |
| 23 | 1 | 13 |
| 24 | 1 | 14 |
| 25 | 1 | 14 |
| 26 | 2 | 15 |
| 27 | 2 | 16 |
| 28 | 2 | 16 |
| 29 | 2 | 17 |
| 30 | 2 | 17 |
| 31 | 2 | 18 |
| 32 | 2 | 18 |
| 33 | 2 | 19 |
| 34 | 2 | 20 |
| 35 | 2 | 20 |
| 36 | 2 | 21 |
| 37 | 2 | 21 |
| 38 | 2 | 22 |
| 39 | 2 | 22 |
| 40 | 2 | 23 |
| 41 | 2 | 24 |
| 42 | 2 | 24 |
| 43 | 2 | 25 |
| 44 | 3 | 25 |
| 45 | 3 | 26 |
| 46 | 3 | 26 |
| 47 | 3 | 27 |
| 48 | 3 | 28 |
| 49 | 3 | 28 |
| 50 | 3 | 29 |
| 51 | 3 | 29 |
| 52 | 3 | 30 |
| 53 | 3 | 30 |
| 54 | 3 | 31 |
| 55 | 3 | 32 |
| 56 | 3 | 32 |
| 57 | 3 | 33 |
| 58 | 3 | 33 |
| 59 | 3 | 34 |
| ⊙ Alt. | ″ Cor. | A ″ |
| 3 | 8 | 8 |
| 4 | 6 | 5 |
| 5 | 4 | 4 |
| 6 | 3 | 3 |
| 7 | 3 | 2 |
| 8 | 2 | 2 |
| 9 | 2 | 1 |
| 10 | 2 | 1 |
| 20 | 2 | 0 |
| 30 | 3 | 0 |
| 40 | 3 | 0 |
| 50 | 4 | 0 |
| 60 | 4 | 0 |
| 70 | 5 | 0 |
| 90 | 5 | 0 |

(w.) The Correction of the Moon's Altitude, and the Aux. Angle A. (88° and 89°)

| App Alt. | Minutes of Moon's Hor. Parallax. 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 88 | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° | Corr. + | A 60° |
| | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ | ′ ″ |
| 0′ | 1 51 | 29 59 | 1 53 | 30 34 | 1 55 | 31 8 | 1 57 | 31 43 | 1 59 | 32 17 | 2 2 | 32 52 | 2 4 | 33 26 | 2 6 | 34 1 |
| 2 | 1 49 | 29 59 | 1 51 | 30 34 | 1 53 | 31 8 | 1 55 | 31 43 | 1 58 | 32 17 | 2 0 | 32 52 | 2 2 | 33 26 | 2 4 | 34 1 |
| 4 | 1 47 | 29 59 | 1 49 | 30 34 | 1 51 | 31 8 | 1 53 | 31 43 | 1 56 | 32 17 | 1 58 | 32 52 | 2 0 | 33 26 | 2 2 | 34 1 |
| 6 | 1 46 | 29 59 | 1 48 | 30 34 | 1 50 | 31 8 | 1 52 | 31 43 | 1 53 | 32 17 | 1 56 | 32 52 | 1 58 | 33 26 | 1 59 | 34 1 |
| 8 | 1 44 | 29 59 | 1 46 | 30 34 | 1 48 | 31 8 | 1 50 | 31 43 | 1 52 | 32 17 | 1 53 | 32 52 | 1 55 | 33 26 | 1 57 | 34 1 |
| 10 | 1 42 | 29 59 | 1 44 | 30 34 | 1 46 | 31 8 | 1 48 | 31 43 | 1 50 | 32 17 | 1 51 | 32 52 | 1 53 | 33 26 | 1 55 | 34 1 |
| 12 | 1 40 | 29 59 | 1 42 | 30 34 | 1 44 | 31 8 | 1 46 | 31 43 | 1 48 | 32 17 | 1 49 | 32 52 | 1 51 | 33 26 | 1 53 | 34 1 |
| 14 | 1 38 | 29 59 | 1 40 | 30 34 | 1 42 | 31 9 | 1 44 | 31 43 | 1 46 | 32 17 | 1 47 | 32 52 | 1 49 | 33 27 | 1 51 | 34 1 |
| 16 | 1 36 | 29 59 | 1 38 | 30 34 | 1 40 | 31 9 | 1 42 | 31 43 | 1 44 | 32 18 | 1 45 | 32 52 | 1 47 | 33 27 | 1 49 | 34 1 |
| 18 | 1 34 | 29 59 | 1 36 | 30 34 | 1 38 | 31 9 | 1 40 | 31 43 | 1 42 | 32 18 | 1 43 | 32 52 | 1 45 | 33 27 | 1 47 | 34 1 |
| 20 | 1 33 | 29 59 | 1 34 | 30 34 | 1 36 | 31 9 | 1 38 | 31 43 | 1 40 | 32 18 | 1 41 | 32 52 | 1 43 | 33 27 | 1 45 | 34 1 |
| 22 | 1 31 | 30 0 | 1 32 | 30 34 | 1 34 | 31 9 | 1 36 | 31 43 | 1 38 | 32 18 | 1 39 | 32 52 | 1 41 | 33 27 | 1 43 | 34 1 |
| 24 | 1 29 | 30 0 | 1 31 | 30 34 | 1 32 | 31 9 | 1 34 | 31 43 | 1 36 | 32 18 | 1 37 | 32 52 | 1 39 | 33 27 | 1 41 | 34 1 |
| 26 | 1 27 | 30 0 | 1 29 | 30 34 | 1 30 | 31 9 | 1 32 | 31 43 | 1 34 | 32 18 | 1 35 | 32 52 | 1 37 | 33 27 | 1 39 | 34 1 |
| 28 | 1 25 | 30 0 | 1 27 | 30 34 | 1 28 | 31 9 | 1 30 | 31 43 | 1 32 | 32 18 | 1 33 | 32 52 | 1 35 | 33 27 | 1 36 | 34 1 |
| 30 | 1 23 | 30 0 | 1 25 | 30 34 | 1 26 | 31 9 | 1 28 | 31 43 | 1 30 | 32 18 | 1 31 | 32 52 | 1 33 | 33 27 | 1 34 | 34 1 |
| 32 | 1 21 | 30 0 | 1 23 | 30 34 | 1 25 | 31 9 | 1 26 | 31 43 | 1 28 | 32 18 | 1 29 | 32 52 | 1 31 | 33 27 | 1 32 | 34 2 |
| 34 | 1 20 | 30 0 | 1 21 | 30 34 | 1 23 | 31 9 | 1 24 | 31 43 | 1 26 | 32 18 | 1 27 | 32 52 | 1 29 | 33 27 | 1 30 | 34 2 |
| 36 | 1 18 | 30 0 | 1 19 | 30 34 | 1 21 | 31 9 | 1 22 | 31 43 | 1 24 | 32 18 | 1 25 | 32 52 | 1 27 | 33 27 | 1 28 | 34 2 |
| 38 | 1 16 | 30 0 | 1 17 | 30 34 | 1 19 | 31 9 | 1 20 | 31 43 | 1 22 | 32 18 | 1 23 | 32 53 | 1 25 | 33 27 | 1 26 | 34 2 |
| 40 | 1 14 | 30 0 | 1 15 | 30 34 | 1 17 | 31 9 | 1 18 | 31 43 | 1 20 | 32 18 | 1 21 | 32 53 | 1 22 | 33 27 | 1 24 | 34 2 |
| 42 | 1 12 | 30 0 | 1 14 | 30 34 | 1 15 | 31 9 | 1 16 | 31 44 | 1 18 | 32 18 | 1 19 | 32 53 | 1 20 | 33 27 | 1 22 | 34 2 |
| 44 | 1 10 | 30 0 | 1 12 | 30 34 | 1 13 | 31 9 | 1 14 | 31 44 | 1 16 | 32 18 | 1 17 | 32 53 | 1 18 | 33 27 | 1 20 | 34 2 |
| 46 | 1 9 | 30 0 | 1 10 | 30 34 | 1 11 | 31 9 | 1 12 | 31 44 | 1 14 | 32 18 | 1 15 | 32 53 | 1 16 | 33 27 | 1 18 | 34 2 |
| 48 | 1 7 | 30 0 | 1 8 | 30 34 | 1 9 | 31 9 | 1 10 | 31 44 | 1 12 | 32 18 | 1 13 | 32 53 | 1 14 | 33 27 | 1 15 | 34 2 |
| 50 | 1 5 | 30 0 | 1 6 | 30 34 | 1 7 | 31 9 | 1 8 | 31 44 | 1 10 | 32 18 | 1 11 | 32 53 | 1 12 | 33 27 | 1 13 | 34 2 |
| 52 | 1 3 | 30 0 | 1 4 | 30 34 | 1 5 | 31 9 | 1 7 | 31 44 | 1 8 | 32 18 | 1 9 | 32 53 | 1 10 | 33 28 | 1 11 | 34 2 |
| 54 | 1 1 | 30 0 | 1 2 | 30 34 | 1 3 | 31 9 | 1 5 | 31 44 | 1 6 | 32 18 | 1 7 | 32 53 | 1 8 | 33 28 | 1 9 | 34 2 |
| 56 | 0 59 | 30 0 | 1 0 | 30 34 | 1 2 | 31 9 | 1 3 | 31 44 | 1 4 | 32 18 | 1 5 | 32 53 | 1 6 | 33 28 | 1 7 | 34 2 |
| 58 | 0 57 | 30 0 | 0 58 | 30 34 | 1 0 | 31 9 | 1 1 | 31 44 | 1 2 | 32 18 | 1 3 | 32 53 | 1 4 | 33 28 | 1 5 | 34 2 |
| 89° | 54′ | | 55′ | | 56′ | | 57′ | | 58′ | | 59′ | | 60′ | | 61′ | |
| 0′ | 0 56 | 30 0 | 0 57 | 30 34 | 0 58 | 31 9 | 0 59 | 31 44 | 1 0 | 32 18 | 1 1 | 32 53 | 1 2 | 33 28 | 1 3 | 34 2 |
| 2 | 0 54 | 30 0 | 0 55 | 30 34 | 0 56 | 31 9 | 0 57 | 31 44 | 0 58 | 32 18 | 0 59 | 32 53 | 1 0 | 33 28 | 1 1 | 34 2 |
| 4 | 0 52 | 30 0 | 0 53 | 30 34 | 0 54 | 31 9 | 0 55 | 31 44 | 0 56 | 32 18 | 0 57 | 32 53 | 0 58 | 33 28 | 0 59 | 34 2 |
| 6 | 0 50 | 30 0 | 0 51 | 30 34 | 0 52 | 31 9 | 0 53 | 31 44 | 0 54 | 32 19 | 0 55 | 32 53 | 0 56 | 33 28 | 0 57 | 34 2 |
| 8 | 0 48 | 30 0 | 0 49 | 30 34 | 0 50 | 31 9 | 0 51 | 31 44 | 0 52 | 32 19 | 0 53 | 32 53 | 0 54 | 33 28 | 0 54 | 34 2 |
| 10 | 0 47 | 30 0 | 0 47 | 30 34 | 0 48 | 31 9 | 0 49 | 31 44 | 0 50 | 32 19 | 0 51 | 32 53 | 0 52 | 33 28 | 0 52 | 34 3 |
| 12 | 0 45 | 30 0 | 0 46 | 30 34 | 0 46 | 31 9 | 0 47 | 31 44 | 0 48 | 32 19 | 0 49 | 32 53 | 0 50 | 33 28 | 0 50 | 34 3 |
| 14 | 0 43 | 30 0 | 0 44 | 30 35 | 0 45 | 31 9 | 0 45 | 31 44 | 0 46 | 32 19 | 0 47 | 32 53 | 0 47 | 33 28 | 0 48 | 34 3 |
| 16 | 0 41 | 30 0 | 0 42 | 30 35 | 0 43 | 31 9 | 0 43 | 31 44 | 0 44 | 32 19 | 0 45 | 32 53 | 0 45 | 33 28 | 0 46 | 34 3 |
| 18 | 0 39 | 30 0 | 0 40 | 30 35 | 0 41 | 31 9 | 0 41 | 31 44 | 0 42 | 32 19 | 0 43 | 32 53 | 0 43 | 33 28 | 0 44 | 34 3 |
| 20 | 0 38 | 30 0 | 0 38 | 30 35 | 0 39 | 31 9 | 0 39 | 31 44 | 0 40 | 32 19 | 0 41 | 32 53 | 0 41 | 33 28 | 0 42 | 34 3 |
| 22 | 0 36 | 30 0 | 0 36 | 30 35 | 0 37 | 31 9 | 0 38 | 31 44 | 0 38 | 32 19 | 0 39 | 32 54 | 0 39 | 33 28 | 0 40 | 34 3 |
| 24 | 0 34 | 30 0 | 0 35 | 30 35 | 0 35 | 31 9 | 0 36 | 31 44 | 0 36 | 32 19 | 0 37 | 32 54 | 0 37 | 33 28 | 0 38 | 34 3 |
| 26 | 0 32 | 30 0 | 0 33 | 30 35 | 0 33 | 31 9 | 0 34 | 31 44 | 0 34 | 32 19 | 0 35 | 32 54 | 0 35 | 33 28 | 0 36 | 34 3 |
| 28 | 0 31 | 30 0 | 0 31 | 30 35 | 0 31 | 31 10 | 0 32 | 31 44 | 0 32 | 32 19 | 0 33 | 32 54 | 0 33 | 33 28 | 0 34 | 34 3 |
| 30 | 0 29 | 30 0 | 0 29 | 30 35 | 0 30 | 31 10 | 0 30 | 31 44 | 0 30 | 32 19 | 0 31 | 32 54 | 0 31 | 33 28 | 0 31 | 34 3 |
| 32 | 0 27 | 30 0 | 0 27 | 30 35 | 0 28 | 31 10 | 0 28 | 31 44 | 0 28 | 32 19 | 0 29 | 32 54 | 0 29 | 33 28 | 0 29 | 34 3 |
| 34 | 0 25 | 30 0 | 0 26 | 30 35 | 0 26 | 31 10 | 0 26 | 31 44 | 0 26 | 32 19 | 0 27 | 32 54 | 0 27 | 33 29 | 0 27 | 34 3 |
| 36 | 0 23 | 30 0 | 0 24 | 30 35 | 0 24 | 31 10 | 0 24 | 31 44 | 0 24 | 32 19 | 0 25 | 32 54 | 0 25 | 33 29 | 0 25 | 34 3 |
| 38 | 0 22 | 30 0 | 0 22 | 30 35 | 0 22 | 31 10 | 0 22 | 31 44 | 0 22 | 32 19 | 0 23 | 32 54 | 0 23 | 33 29 | 0 23 | 34 3 |
| 40 | 0 20 | 30 0 | 0 20 | 30 35 | 0 20 | 31 10 | 0 20 | 31 44 | 0 20 | 32 19 | 0 21 | 32 54 | 0 21 | 33 29 | 0 21 | 34 3 |
| 42 | 0 18 | 30 0 | 0 18 | 30 35 | 0 18 | 31 10 | 0 18 | 31 44 | 0 19 | 32 19 | 0 19 | 32 54 | 0 19 | 33 29 | 0 19 | 34 3 |
| 44 | 0 16 | 30 0 | 0 16 | 30 35 | 0 16 | 31 10 | 0 17 | 31 44 | 0 17 | 32 19 | 0 17 | 32 54 | 0 17 | 33 29 | 0 17 | 34 3 |
| 46 | 0 15 | 30 0 | 0 15 | 30 35 | 0 15 | 31 10 | 0 15 | 31 45 | 0 15 | 32 19 | 0 15 | 32 54 | 0 15 | 33 29 | 0 15 | 34 4 |
| 48 | 0 13 | 30 0 | 0 13 | 30 35 | 0 13 | 31 10 | 0 13 | 31 45 | 0 13 | 32 19 | 0 13 | 32 54 | 0 13 | 33 29 | 0 13 | 34 4 |
| 50 | 0 11 | 30 0 | 0 11 | 30 35 | 0 11 | 31 10 | 0 11 | 31 45 | 0 11 | 32 19 | 0 11 | 32 54 | 0 11 | 33 29 | 0 10 | 34 4 |
| 52 | 0 9 | 30 0 | 0 9 | 30 35 | 0 9 | 31 10 | 0 9 | 31 45 | 0 9 | 32 19 | 0 9 | 32 54 | 0 8 | 33 29 | 0 8 | 34 4 |
| 54 | 0 7 | 30 0 | 0 7 | 30 35 | 0 7 | 31 10 | 0 7 | 31 45 | 0 7 | 32 19 | 0 7 | 32 54 | 0 6 | 33 29 | 0 6 | 34 4 |
| 56 | 0 6 | 30 0 | 0 5 | 30 35 | 0 5 | 31 10 | 0 5 | 31 45 | 0 5 | 32 20 | 0 5 | 32 54 | 0 4 | 33 29 | 0 4 | 34 4 |
| 58 | 0 4 | 30 0 | 0 4 | 30 35 | 0 3 | 31 10 | 0 3 | 31 45 | 0 3 | 32 20 | 0 3 | 32 54 | 0 2 | 33 29 | 0 2 | 34 4 |

Seconds of H. F.

| ″ | Corr. + | A ″ |
|---|---|---|
| | ″ | ″ |
| 1 | 0 | 1 |
| 2 | 0 | 2 |
| 3 | 0 | 2 |
| 4 | 0 | 2 |
| 5 | 0 | 3 |
| 6 | 0 | 3 |
| 7 | 0 | 4 |
| 8 | 0 | 5 |
| 9 | 0 | 5 |
| 10 | 0 | 6 |
| 11 | 0 | 6 |
| 12 | 0 | 7 |
| 13 | 0 | 7 |
| 14 | 0 | 8 |
| 15 | 0 | 9 |
| 16 | 0 | 9 |
| 17 | 0 | 10 |
| 18 | 0 | 10 |
| 19 | 0 | 11 |
| 20 | 0 | 11 |
| 21 | 0 | 12 |
| 22 | 0 | 13 |
| 23 | 0 | 13 |
| 24 | 0 | 14 |
| 25 | 0 | 14 |
| 26 | 0 | 15 |
| 27 | 0 | 16 |
| 28 | 0 | 16 |
| 29 | 0 | 17 |
| 30 | 1 | 17 |
| 31 | 1 | 18 |
| 32 | 1 | 18 |
| 33 | 1 | 19 |
| 34 | 1 | 20 |
| 35 | 1 | 20 |
| 36 | 1 | 21 |
| 37 | 1 | 21 |
| 38 | 1 | 22 |
| 39 | 1 | 22 |
| 40 | 1 | 23 |
| 41 | 1 | 24 |
| 42 | 1 | 24 |
| 43 | 1 | 25 |
| 44 | 1 | 25 |
| 45 | 1 | 26 |
| 46 | 1 | 26 |
| 47 | 1 | 27 |
| 48 | 1 | 28 |
| 49 | 1 | 28 |
| 50 | 1 | 29 |
| 51 | 1 | 29 |
| 52 | 1 | 30 |
| 53 | 1 | 30 |
| 54 | 1 | 31 |
| 55 | 1 | 32 |
| 56 | 1 | 32 |
| 57 | 1 | 33 |
| 58 | 1 | 33 |
| 59 | 1 | 34 |
| 60 | 1 | 34 |

| | A ☽ | A ♈ |
|---|---|---|
| | ″ | ″ |
| 1° | 2 | 2 |
| 2 | 4 | 4 |
| 3 | 6 | 6 |
| 4 | 8 | 8 |
| 5 | 10 | 10 |
| 6 | 12 | 12 |
| 7 | 14 | 14 |
| 8 | 16 | 16 |
| 9 | 18 | 18 |
| 10 | 20 | 20 |
| 11 | 22 | 22 |
| 12 | 24 | 24 |
| 13 | 26 | 26 |
| 14 | 28 | 28 |
| 15 | 30 | 30 |
| 16 | 32 | 32 |
| 17 | 34 | 34 |
| 18 | 36 | 36 |
| 19 | 38 | 38 |
| 20 | 40 | 40 |
| 21 | 42 | 42 |
| 22 | 44 | 44 |
| 23 | 46 | 46 |
| 24 | 48 | 48 |
| 25 | 50 | 50 |
| 26 | 52 | 52 |
| 27 | 54 | 54 |
| 28 | 56 | 56 |
| 29 | 58 | 58 |
| 30 | 60 | 60 |

## Traverse Table. (x.)

| Distance. | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 01.0 | 00.0 | 02.0 | 00.1 | 03.0 | 00.1 | 04.0 | 00.2 | 05.0 | 00.2 | 06.0 | 00.3 | 07.0 | 00.3 | 08.0 | 00.4 | 7¾ |
| ½ | 01.0 | 00.1 | 02.0 | 00.2 | 03.0 | 00.3 | 04.0 | 00.4 | 05.0 | 00.5 | 06.0 | 00.6 | 07.0 | 00.7 | 08.0 | 00.8 | 7½ |
| ¾ | 01.0 | 00.1 | 02.0 | 00.3 | 03.0 | 00.4 | 04.0 | 00.6 | 04.9 | 00.7 | 05.9 | 00.9 | 06.9 | 01.0 | 07.9 | 01.2 | 7¼ |
| 1 | 01.0 | 00.2 | 02.0 | 00.4 | 02.9 | 00.6 | 03.9 | 00.8 | 04.9 | 01.0 | 05.9 | 01.2 | 06.9 | 01.4 | 07.8 | 01.6 | 7 |
| ¼ | 01.0 | 00.2 | 01.9 | 00.5 | 02.9 | 00.7 | 03.9 | 01.0 | 04.9 | 01.2 | 05.8 | 01.5 | 06.8 | 01.7 | 07.8 | 01.9 | ¾ |
| ½ | 01.0 | 00.3 | 01.9 | 00.6 | 02.9 | 00.9 | 03.8 | 01.2 | 04.8 | 01.5 | 05.7 | 01.7 | 06.7 | 02.0 | 07.7 | 02.3 | ½ |
| ¾ | 00.9 | 00.3 | 01.9 | 00.7 | 02.8 | 01.0 | 03.8 | 01.3 | 04.7 | 01.7 | 05.6 | 02.0 | 06.6 | 02.4 | 07.5 | 02.7 | ¼ |
| 2 | 00.9 | 00.4 | 01.8 | 00.8 | 02.8 | 01.1 | 03.7 | 01.5 | 04.6 | 01.9 | 05.5 | 02.3 | 06.5 | 02 7 | 07.4 | 03.1 | 6 |
| ¼ | 00.9 | 00.4 | 01.8 | 00.9 | 02.7 | 01.3 | 03.6 | 01.7 | 04.5 | 02.1 | 05.4 | 02.6 | 06.3 | 03.0 | 07.2 | 03.4 | ¾ |
| ½ | 00.9 | 00.5 | 01.8 | 00.9 | 02.6 | 01.4 | 03.5 | 01.9 | 04.4 | 02.4 | 05.3 | 02.8 | 06.2 | 03.3 | 07.1 | 03.8 | ½ |
| ¾ | 00.9 | 00.5 | 01.7 | 01.0 | 02.6 | 01.5 | 03.4 | 02.1 | 04.3 | 02.6 | 05.1 | 03.1 | 06.0 | 03.6 | 06.9 | 04.1 | ¼ |
| 3 | 00.8 | 00.6 | 01.7 | 01.1 | 02.5 | 01.7 | 03.3 | 02.2 | 04.2 | 02.8 | 05.0 | 03.3 | 05.8 | 03.9 | 06.7 | 04.4 | 5 |
| ¼ | 00.8 | 00.6 | 01.6 | 01.2 | 02.4 | 01.8 | 03.2 | 02.4 | 04.0 | 03.0 | 04.8 | 03.6 | 05.6 | 04.2 | 06.4 | 04.8 | ¾ |
| ½ | 00.8 | 00.6 | 01.5 | 01.3 | 02.3 | 01.9 | 03.1 | 02.5 | 03.9 | 03.2 | 04.6 | 03.8 | 05.4 | 04.4 | 06.2 | 05.1 | ½ |
| ¾ | 00.7 | 00.7 | 01.5 | 01.3 | 02.2 | 02.0 | 03.0 | 02.7 | 03.7 | 03.4 | 04.4 | 04.0 | 05.2 | 04.7 | 05.9 | 05.4 | ¼ |
| 4 | 00.7 | 00.7 | 01.4 | 01.4 | 02.1 | 02.1 | 02.8 | 02.8 | 03.5 | 03.5 | 04.2 | 04.2 | 04.9 | 04.9 | 05.7 | 05.7 | 4 |
| 1° | 01.0 | 00.0 | 02.0 | 00.0 | 03.0 | 00.1 | 04.0 | 00.1 | 05.0 | 00.1 | 06.0 | 00.1 | 07.0 | 00.1 | 08.0 | 00.1 | 89° |
| 2 | 01.0 | 00.0 | 02.0 | 00.1 | 03.0 | 00.1 | 04.0 | 00.1 | 05.0 | 00.2 | 06.0 | 00.2 | 07.0 | 00.2 | 08.0 | 00.3 | 88 |
| 3 | 01.0 | 00.1 | 02.0 | 00.1 | 03.0 | 00.2 | 04.0 | 00.2 | 05.0 | 00.3 | 06.0 | 00.3 | 07.0 | 00.4 | 08.0 | 00.4 | 87 |
| 4 | 01.0 | 00.1 | 02.0 | 00.1 | 03.0 | 00.2 | 04.0 | 00.3 | 05.0 | 00.3 | 06.0 | 00.4 | 07.0 | 00.5 | 08.0 | 00.6 | 86 |
| 5 | 01.0 | 00.1 | 02.0 | 00.2 | 03.0 | 00.3 | 04.0 | 00.3 | 05.0 | 00.4 | 06.0 | 00.5 | 07.0 | 00.6 | 08.0 | 00.7 | 85 |
| 6 | 01.0 | 00.1 | 02.0 | 00.2 | 03.0 | 00.3 | 04.0 | 00.4 | 05.0 | 00.5 | 06.0 | 00.6 | 07.0 | 00.7 | 08.0 | 00.8 | 84 |
| 7 | 01.0 | 00.1 | 02.0 | 00.2 | 03.0 | 00.4 | 04.0 | 00.5 | 05.0 | 00.6 | 06.0 | 00.7 | 06.9 | 00.9 | 07.9 | 01.0 | 83 |
| 8 | 01.0 | 00.1 | 02.0 | 00.3 | 03.0 | 00.4 | 04.0 | 00.6 | 05.0 | 00.7 | 05.9 | 00.8 | 06.9 | 01.0 | 07.9 | 01.1 | 82 |
| 9 | 01.0 | 00.2 | 02.0 | 00.3 | 03.0 | 00.5 | 04.0 | 00.6 | 04.9 | 00.8 | 05.9 | 00.9 | 06.9 | 01.1 | 07.9 | 01.3 | 81 |
| 10 | 01.0 | 00.2 | 02.0 | 00.3 | 03.0 | 00.5 | 03.9 | 00.7 | 04.9 | 00.9 | 05.9 | 01.0 | 06.9 | 01.2 | 07.9 | 01.4 | 80 |
| 11 | 01.0 | 00 2 | 02.0 | 00.4 | 02.9 | 00 6 | 03.9 | 00.8 | 04.9 | 01.0 | 05.9 | 01.1 | 06.9 | 01.3 | 07.9 | 01.5 | 79 |
| 12 | 01.0 | 00.2 | 02.0 | 00.4 | 02.9 | 00.6 | 03.9 | 00.8 | 04.9 | 01.0 | 05.9 | 01.2 | 06.8 | 01.5 | 07.8 | 01.7 | 78 |
| 13 | 01.0 | 00.2 | 01.9 | 00.4 | 02.9 | 00.7 | 03.9 | 00.9 | 04.9 | 01.1 | 05.8 | 01.3 | 06.8 | 01.6 | 07.8 | 01.8 | 77 |
| 14 | 01.0 | 00.2 | 01.9 | 00.5 | 02.9 | 00.7 | 03.9 | 01.0 | 04.9 | 01.2 | 05.8 | 01.5 | 06.8 | 01.7 | 07.8 | 01.9 | 76 |
| 15 | 01.0 | 00.3 | 01.9 | 00.5 | 02.9 | 00.8 | 03.9 | 01.0 | 04.8 | 01.3 | 05.8 | 01.6 | 06.8 | 01.8 | 07.7 | 02.1 | 75 |
| 16 | 01.0 | 00.3 | 01.9 | 00.6 | 02.9 | 00.8 | 03.8 | 01.1 | 04.8 | 01.4 | 05.8 | 01.7 | 06.7 | 01.9 | 07.7 | 02.2 | 74 |
| 17 | 01.0 | 00.3 | 01.9 | 00.6 | 02.9 | 00.9 | 03.8 | 01.2 | 04.8 | 01.5 | 05.7 | 01.8 | 06.7 | 02.0 | 07.7 | 02.3 | 73 |
| 18 | 01.0 | 00.3 | 01.9 | 00.6 | 02.9 | 00.9 | 03.8 | 01.2 | 04.8 | 01.5 | 05.7 | 01.9 | 06.7 | 02.2 | 07.6 | 02.5 | 72 |
| 19 | 00.9 | 00.3 | 01.9 | 00.7 | 02.8 | 01.0 | 03.8 | 01.3 | 04.7 | 01.6 | 05.7 | 02.0 | 06.6 | 02.3 | 07.6 | 02.6 | 71 |
| 20 | 00.9 | 00.3 | 01.9 | 00.7 | 02.8 | 01.0 | 03.8 | 01.4 | 04.7 | 01.7 | 05.6 | 02.1 | 06.6 | 02.4 | 07.5 | 02.7 | 70 |
| 21 | 00.9 | 00.4 | 01.9 | 00.7 | 02.8 | 01.1 | 03.7 | 01.4 | 04.7 | 01.8 | 05.6 | 02.2 | 06.5 | 02.5 | 07.5 | 02.9 | 69 |
| 22 | 00.9 | 00.4 | 01.9 | 00.7 | 02.8 | 01.1 | 03.7 | 01.5 | 04.6 | 01.9 | 05.6 | 02.2 | 06.5 | 02.6 | 07.4 | 03.0 | 68 |
| 23 | 00.9 | 00.4 | 01.8 | 00.8 | 02.8 | 01.2 | 03.7 | 01.6 | 04.6 | 02.0 | 05.5 | 02.3 | 06.4 | 02.7 | 07.4 | 03.1 | 67 |
| 24 | 00.9 | 00.4 | 01.8 | 00.8 | 02.7 | 01.2 | 03.7 | 01.6 | 04.6 | 02.0 | 05.5 | 02.4 | 06.4 | 02.8 | 07.3 | 03.3 | 66 |
| 25 | 00.9 | 00.4 | 01.8 | 00.8 | 02.7 | 01.3 | 03.6 | 01.7 | 04.5 | 02.1 | 05.4 | 02.5 | 06.3 | 03.0 | 07.3 | 03.4 | 65 |
| 26 | 00.9 | 00.4 | 01.8 | 00.9 | 02.7 | 01.3 | 03.6 | 01.8 | 04.5 | 02.2 | 05.4 | 02.6 | 06.3 | 03.1 | 07.2 | 03.5 | 64 |
| 27 | 00.9 | 00.5 | 01.8 | 00.9 | 02.7 | 01.4 | 03.6 | 01.8 | 04.5 | 02.3 | 05.3 | 02.7 | 06.2 | 03.2 | 07.1 | 03.6 | 63 |
| 28 | 00.9 | 00.5 | 01.8 | 00.9 | 02.6 | 01 4 | 03.5 | 01.9 | 04.4 | 02.3 | 05.3 | 02.8 | 06.2 | 03.3 | 07.1 | 03.8 | 62 |
| 29 | 00.9 | 00.5 | 01.7 | 01.0 | 02.6 | 01.5 | 03.5 | 01.9 | 04.4 | 02.4 | 05.2 | 02.9 | 06.1 | 03.4 | 07.0 | 03.9 | 61 |
| 30 | 00.9 | 00.5 | 01.7 | 01.0 | 02.6 | 01.5 | 03.5 | 02.0 | 04.3 | 02.5 | 05.2 | 03.0 | 06.1 | 03.5 | 06.9 | 04.0 | 60 |
| 31 | 00.9 | 00.5 | 01.7 | 01.0 | 02.6 | 01.5 | 03.4 | 02.1 | 04.3 | 02.6 | 05.1 | 03.1 | 06.0 | 03.6 | 06.9 | 04.1 | 59 |
| 32 | 00.8 | 00.5 | 01.7 | 01.1 | 02.5 | 01.6 | 03.4 | 02.1 | 04.2 | 02.6 | 05.1 | 03.2 | 05.9 | 03.7 | 06.8 | 04.2 | 58 |
| 33 | 00.8 | 00.5 | 01.7 | 01.1 | 02.5 | 01.6 | 03.4 | 02.2 | 04.2 | 02.7 | 05.0 | 03.3 | 05.9 | 03.8 | 06.7 | 04.4 | 57 |
| 34 | 00.8 | 00.6 | 01.7 | 01.1 | 02.5 | 01.7 | 03.3 | 02.2 | 04.1 | 02.8 | 05.0 | 03.4 | 05.8 | 03.9 | 06.6 | 04.5 | 56 |
| 35 | 00.8 | 00.6 | 01.6 | 01.1 | 02.5 | 01.7 | 03.3 | 02.3 | 04.1 | 02.9 | 04.9 | 03.4 | 05.7 | 04.0 | 06.6 | 04.6 | 55 |
| 36 | 00.8 | 00.6 | 01.6 | 01.2 | 02.4 | 01.8 | 03.2 | 02.4 | 04.0 | 02.9 | 04.9 | 03.5 | 05.7 | 04.1 | 06.5 | 04.7 | 54 |
| 37 | 00.8 | 00.6 | 01.6 | 01.2 | 02.4 | 01.8 | 03.2 | 02.4 | 04.0 | 03.0 | 04.8 | 03.6 | 05.6 | 04.2 | 06.4 | 04.8 | 53 |
| 38 | 00.8 | 00.6 | 01.6 | 01.2 | 02.4 | 01.8 | 03.2 | 02.5 | 03.9 | 03.1 | 04.7 | 03.7 | 05.5 | 04.3 | 06.3 | 04.9 | 52 |
| 39 | 00.8 | 00.6 | 01.6 | 01.3 | 02.3 | 01.9 | 03.1 | 02.5 | 03.9 | 03.1 | 04.7 | 03.8 | 05.4 | 04.4 | 06.2 | 05.0 | 51 |
| 40 | 00.8 | 00.6 | 01.5 | 01.3 | 02.3 | 01.9 | 03.1 | 02.6 | 03.8 | 03.2 | 04.6 | 03.9 | 05.4 | 04.5 | 06.1 | 05.1 | 50 |
| 41 | 00.8 | 00.7 | 01.5 | 01.3 | 02.3 | 02.0 | 03.0 | 02.6 | 03.8 | 03.3 | 04.5 | 03.9 | 05.3 | 04 6 | 06.0 | 05.2 | 49 |
| 42 | 00.7 | 00.7 | 01.5 | 01.3 | 02.2 | 02.0 | 03.0 | 02.7 | 03.7 | 03.3 | 04.5 | 04.0 | 05.2 | 04.7 | 05.9 | 05.4 | 48 |
| 43 | 00.7 | 00.7 | 01.5 | 01.4 | 02.2 | 02.0 | 02.9 | 02.7 | 03.7 | 03.4 | 04.4 | 04.1 | 05.1 | 04.8 | 05.9 | 05.5 | 47 |
| 44 | 00.7 | 00.7 | 01.4 | 01.4 | 02.2 | 02.1 | 02.9 | 02.8 | 03 6 | 03.5 | 04.3 | 04.2 | 05.0 | 04.9 | 05.8 | 05.6 | 46 |
| 45 | 00.7 | 00.7 | 01 4 | 01.4 | 02.1 | 02.1 | 02.8 | 02.8 | 03.5 | 03.5 | 04.2 | 04.2 | 04.9 | 04.9 | 05.7 | 05.7 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 9 | | 10 | | 11 | | 12 | | 13 | | 14 | | 15 | | 16 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Course. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 09.0 | 00.4 | 10.0 | 00.5 | 11.0 | 00.5 | 12.0 | 00.6 | 13.0 | 00.6 | 14.0 | 00.7 | 15.0 | 00.7 | 16.0 | 00.8 | 7¾ |
| ½ | 09.0 | 00.9 | 10.0 | 01.0 | 10.9 | 01.1 | 11.9 | 01.2 | 12.9 | 01.3 | 13.9 | 01.4 | 14.9 | 01.5 | 15 9 | 01.6 | ½ |
| ¾ | 08.9 | 01.3 | 09.9 | 01.5 | 10.9 | 01.6 | 11.9 | 01.8 | 12.9 | 01.9 | 13.8 | 02.1 | 14.8 | 02.2 | 15.8 | 02.3 | ¼ |
| 1 | 08.8 | 01.8 | 09.8 | 02.0 | 10.8 | 02.1 | 11.8 | 02.3 | 12.7 | 02.5 | 13.7 | 02.7 | 14.7 | 02.9 | 15.7 | 03.1 | 7 |
| ¼ | 08.7 | 02.2 | 09.7 | 02.4 | 10.7 | 02.7 | 11.6 | 02.9 | 12.6 | 03.2 | 13.6 | 03.4 | 14.6 | 03.6 | 15.5 | 03.9 | ¾ |
| ½ | 08.6 | 02.6 | 09.6 | 02.9 | 10.5 | 03.2 | 11.5 | 03.5 | 12.4 | 03.8 | 13.4 | 04.1 | 14.4 | 04.4 | 15.3 | 04.6 | ½ |
| ¾ | 08.5 | 03.0 | 09.4 | 03.4 | 10.4 | 03.7 | 11.3 | 04.0 | 12.2 | 04.4 | 13.2 | 04.7 | 14.1 | 05.1 | 15.1 | 05.4 | ¼ |
| 2 | 08.3 | 03.4 | 09.2 | 03.8 | 10.2 | 04.2 | 11.1 | 04.6 | 12.0 | 05.0 | 12.9 | 05 4 | 13.9 | 05.7 | 14.8 | 06.1 | 5 |
| ¼ | 08.1 | 03.8 | 09.0 | 04.3 | 09.9 | 04.7 | 10.8 | 05.1 | 11.8 | 05.6 | 12.7 | 06.0 | 13.6 | 06.4 | 14.5 | 06.8 | ¾ |
| ½ | 07.9 | 04 2 | 08.8 | 04.7 | 09.7 | 05.2 | 10.6 | 05.7 | 11.5 | 06.1 | 12.3 | 06.6 | 13.2 | 07.1 | 14.1 | 07.5 | ½ |
| ¾ | 07.7 | 04.6 | 08.6 | 05.1 | 09.4 | 05.7 | 10.3 | 06.2 | 11.2 | 06.7 | 12.0 | 07.2 | 12.9 | 07.7 | 13.7 | 08.2 | ¼ |
| 3 | 07.5 | 05.0 | 08.3 | 05.6 | 09.1 | 06.1 | 10.0 | 06.7 | 10.8 | 07.2 | 11.6 | 07.8 | 12.5 | 08.3 | 13.3 | 08.9 | 5 |
| ¼ | 07.2 | 05.4 | 08.0 | 06.0 | 08.8 | 06.6 | 09.6 | 07.1 | 10.4 | 07.7 | 11.2 | 08.3 | 12.0 | 08.9 | 12.8 | 09.5 | ¾ |
| ½ | 07.0 | 05.7 | 07·7 | 06.3 | 08.5 | 07.0 | 09.3 | 07.6 | 10.1 | 08.2 | 10.8 | 08.9 | 11.6 | 09.5 | 12.4 | 10.1 | ½ |
| ¾ | 06.7 | 06.0 | 07.4 | 06.7 | 08.2 | 07.4 | 08.9 | 08.1 | 09.6 | 08.7 | 10.4 | 09.4 | 11.1 | 10.1 | 11.9 | 10.7 | ¼ |
| 4 | 06.4 | 06.4 | 07.1 | 07.1 | 07.8 | 07.8 | 08.5 | 08.5 | 09.2 | 09.2 | 09.9 | 09.9 | 10.6 | 10.6 | 11.3 | 11.3 | 4 |
| 1° | 09.0 | 00.2 | 10.0 | 00.2 | 11.0 | 00.2 | 12.0 | 00.2 | 13.0 | 00.2 | 14.0 | 00.2 | 15.0 | 00.3 | 16.0 | 00.3 | 89° |
| 2 | 09.0 | 00.3 | 10.0 | 00.3 | 11.0 | 00.4 | 12.0 | 00.4 | 13.0 | 00.5 | 14.0 | 00.5 | 15.0 | 00.5 | 16.0 | 00.6 | 88 |
| 3 | 09.0 | 00.5 | 10.0 | 00.5 | 11.0 | 00.6 | 12.0 | 00.6 | 13.0 | 00.7 | 14.0 | 00.7 | 15.0 | 00.8 | 16.0 | 00.8 | 87 |
| 4 | 09.0 | 00.6 | 10.0 | 00.7 | 11.0 | 00.8 | 12.0 | 00.8 | 13.0 | 00.9 | 14.0 | 01.0 | 15.0 | 01.0 | 16.0 | 01.1 | 86 |
| 5 | 09.0 | 00.8 | 10.0 | 00.9 | 11.0 | 01.0 | 12.0 | 01.0 | 13.0 | 01.1 | 13.9 | 01.2 | 14.9 | 01.3 | 15.9 | 01.4 | 85 |
| 6 | 09.0 | 00.9 | 09.9 | 01.0 | 10.9 | 01.1 | 11.9 | 01.3 | 12.9 | 01.4 | 13 9 | 01.5 | 14.9 | 01.6 | 15.9 | 01.7 | 84 |
| 7 | 08.9 | 01.1 | 09.9 | 01.2 | 10.9 | 01.3 | 11.9 | 01.5 | 12.9 | 01.6 | 13.9 | 01.7 | 14.9 | 01.8 | 15.9 | 01.9 | 83 |
| 8 | 08.9 | 01.3 | 09.9 | 01.4 | 10.9 | 01.5 | 11.9 | 01.7 | 12.9 | 01.8 | 13.9 | 01.9 | 14.9 | 02.1 | 15.8 | 02.2 | 82 |
| 9 | 08.9 | 01.4 | 09.9 | 01.6 | 10.9 | 01.7 | 11.9 | 01.9 | 12.8 | 02.0 | 13.8 | 02.2 | 14.8 | 02.3 | 15.8 | 02.5 | 81 |
| 10 | 08.9 | 01.6 | 09.8 | 01.7 | 10.8 | 01.9 | 11.8 | 02.1 | 12.8 | 02.3 | 13.8 | 02.4 | 14.8 | 02.6 | 15.8 | 02.8 | 80 |
| 11 | 08.8 | 01.7 | 09.8 | 01.9 | 10.8 | 02.1 | 11.8 | 02.3 | 12.8 | 02.5 | 13.7 | 02.7 | 14.7 | 02.9 | 15.7 | 03.1 | 79 |
| 12 | 08.8 | 01.9 | 09.8 | 02.1 | 10.8 | 02.3 | 11.7 | 02.5 | 12.7 | 02.7 | 13.7 | 02.9 | 14.7 | 03.1 | 15.7 | 03.3 | 78 |
| 13 | 08.8 | 02.0 | 09.7 | 02.2 | 10.7 | 02.5 | 11.7 | 02.7 | 12.7 | 02.9 | 13.6 | 03.1 | 14.6 | 03.4 | 15.6 | 03.6 | 77 |
| 14 | 08.7 | 02.2 | 09.7 | 02.4 | 10.7 | 02.7 | 11.6 | 02.9 | 12.6 | 03.1 | 13.6 | 03.4 | 14.6 | 03.6 | 15.5 | 03.9 | 76 |
| 15 | 08.7 | 02.3 | 09.7 | 02.6 | 10.6 | 02.8 | 11.6 | 03.1 | 12.6 | 03.4 | 13.5 | 03.6 | 14.5 | 03.9 | 15.5 | 04.1 | 75 |
| 16 | 08.7 | 02.5 | 09.6 | 02.8 | 10.6 | 03.0 | 11.5 | 03.3 | 12.5 | 03.6 | 13.5 | 03.9 | 14.4 | 04.1 | 15.4 | 04.4 | 74 |
| 17 | 08.6 | 02.6 | 09.6 | 02.9 | 10.5 | 03.2 | 11.5 | 03.5 | 12.4 | 03.8 | 13.4 | 04.1 | 14.3 | 04.4 | 15.3 | 04.7 | 73 |
| 18 | 08.6 | 02.8 | 09.5 | 03 1 | 10.5 | 03.4 | 11.4 | 03.7 | 12.4 | 04.0 | 13.3 | 04.3 | 14.3 | 04.6 | 15.2 | 04.9 | 72 |
| 19 | 08.5 | 02.9 | 09.5 | 03 3 | 10.4 | 03.6 | 11.3 | 03.9 | 12.3 | 04.2 | 13.2 | 04.6 | 14.2 | 04.9 | 15.1 | 05.2 | 71 |
| 20 | 08.5 | 03.1 | 09.4 | 03.4 | 10.3 | 03.8 | 11.3 | 04.1 | 12.2 | 04.4 | 13.2 | 04.8 | 14.1 | 05.1 | 15.0 | 05.5 | 70 |
| 21 | 08.4 | 03.2 | 09.3 | 03.6 | 10.3 | 03.9 | 11.2 | 04.3 | 12.1 | 04.7 | 13.1 | 05.0 | 14.0 | 05.4 | 14.9 | 05.7 | 69 |
| 22 | 08 3 | 03.4 | 09.3 | 03.7 | 10.2 | 04.1 | 11.1 | 04.5 | 12.1 | 04.9 | 13.0 | 05.2 | 13.9 | 05.6 | 14.8 | 06.0 | 68 |
| 23 | 08.3 | 03.5 | 09.2 | 03.9 | 10.1 | 04.3 | 11.0 | 04.7 | 12.0 | 05.1 | 12.9 | 05.5 | 13.8 | 05.9 | 14.7 | 06.3 | 67 |
| 24 | 08.2 | 03.7 | 09.1 | 04.1 | 10.0 | 04.5 | 11.0 | 04.9 | 11.9 | 05.3 | 12.8 | 05.7 | 13.7 | 06.1 | 14.6 | 06.5 | 66 |
| 25 | 08.2 | 03.8 | 09.1 | 04.2 | 10.0 | 04.6 | 10 9 | 05.1 | 11.8 | 05.5 | 12.7 | 05.9 | 13.6 | 06.3 | 14.5 | 06.8 | 65 |
| 26 | 08.1 | 03.9 | 09.0 | 04.4 | 09.9 | 04.8 | 10 8 | 05 3 | 11.7 | 05.7 | 12.6 | 06.1 | 13.5 | 06.6 | 14.4 | 07.0 | 64 |
| 27 | 08.0 | 04.1 | 08.9 | 04.5 | 09.8 | 05.0 | 10.7 | 05.4 | 11.6 | 05.9 | 12.5 | 06.4 | 13.4 | 06.8 | 14.3 | 07.3 | 63 |
| 28 | 07.9 | 04.2 | 08.8 | 04.7 | 09.7 | 05 2 | 10.6 | 05.6 | 11.5 | 06.1 | 12.4 | 06.6 | 13.2 | 07.0 | 14.1 | 07.5 | 62 |
| 29 | 07.9 | 04.4 | 08.7 | 04.8 | 09.6 | 05.3 | 10.5 | 05.8 | 11.4 | 06.3 | 12.2 | 06.8 | 13.1 | 07.3 | 14.0 | 07.8 | 61 |
| 30 | 07.8 | 04.5 | 08.7 | 05.0 | 09.5 | 05.5 | 10.4 | 06.0 | 11.3 | 06.5 | 12.1 | 07.0 | 13.0 | 07.5 | 13.9 | 08.0 | 60 |
| 31 | 07.7 | 04.6 | 08.6 | 05.2 | 09.4 | 05.7 | 10.3 | 06.2 | 11.1 | 06.7 | 12.0 | 07.2 | 12.9 | 07.7 | 13.7 | 08.2 | 59 |
| 32 | 07.6 | 04.8 | 08.5 | 05.3 | 09.3 | 05.8 | 10.2 | 06.4 | 11.0 | 06.9 | 11.9 | 07.4 | 12.7 | 07.9 | 13.6 | 08.5 | 58 |
| 33 | 07.5 | 04 9 | 08.4 | 05.4 | 09.2 | 06.0 | 10.1 | 06.5 | 10.9 | 07.1 | 11.7 | 07.6 | 12.6 | 08.2 | 18.4 | 08.7 | 57 |
| 34 | 07.5 | 05.0 | 08.3 | 05.6 | 09.1 | 06.2 | 09.9 | 06.7 | 10.8 | 07.3 | 11.6 | 07.8 | 12.4 | 08.4 | 13.3 | 08.9 | 56 |
| 35 | 07.4 | 05.2 | 08.2 | 05.7 | 09.0 | 06.3 | 09.8 | 06.9 | 10.6 | 07.5 | 11.5 | 08.0 | 12.3 | 08.6 | 13.1 | 09.2 | 55 |
| 36 | 07.3 | 05.3 | 08.1 | 05.9 | 08.9 | 06.5 | 09.7 | 07.1 | 10.5 | 07.6 | 11.3 | 08.2 | 12.1 | 08.8 | 12.9 | 09.4 | 54 |
| 37 | 07.2 | 05.4 | 08.0 | 06.0 | 08.8 | 06.6 | 09.6 | 07.2 | 10.4 | 07 8 | 11.2 | 08.4 | 12.0 | 09.0 | 12.8 | 39.6 | 53 |
| 38 | 07.1 | 05.5 | 07.9 | 06.2 | 08.7 | 06.8 | 09.5 | 07.4 | 10.2 | 08 0 | 11.0 | 08.6 | 11.8 | 09.2 | 12.6 | 09.9 | 52 |
| 39 | 07.0 | 05.7 | 07.8 | 06.3 | 08 5 | 06.9 | 09.3 | 07.6 | 10.1 | 08.2 | 10.9 | 08.8 | 11.7 | 09.4 | 12.4 | 10.1 | 51 |
| 40 | 06.9 | 05.8 | 07.7 | 06.4 | 08.4 | 07.1 | 09.2 | 07.7 | 10.0 | 08.4 | 10.7 | 09.0 | 11.5 | 09.6 | 12.3 | 10.3 | 50 |
| 41 | 06.8 | 05.9 | 07.5 | 06.6 | 08.3 | 07.2 | 09.1 | 07.9 | 09.8 | 08.5 | 10.6 | 09.2 | 11.3 | 09.8 | 12.1 | 10.5 | 49 |
| 42 | 06.7 | 06.0 | 07 4 | 06.7 | 08.2 | 07.4 | 08.9 | 08.0 | 09.7 | 08.7 | 10.4 | 09.4 | 11.1 | 10.0 | 11.9 | 10.7 | 48 |
| 43 | 06.6 | 06.1 | 07.3 | 06.8 | 08.0 | 07.5 | 08.8 | 08.2 | 09.5 | 08.9 | 10.2 | 09.5 | 11.0 | 10.2 | 11.7 | 10.9 | 47 |
| 44 | 06.5 | 06.3 | 07.2 | 06.9 | 07.9 | 07.6 | 08.6 | 08.3 | 09.4 | 09.0 | 10.1 | 09.7 | 10.8 | 10.4 | 11.5 | 11.1 | 46 |
| 45 | 06.4 | 06 4 | 07.1 | 07.1 | 07.8 | 07.8 | 08.5 | 08.5 | 09.2 | 09.2 | 09.9 | 09.9 | 10.6 | 10.6 | 11.3 | 11.3 | 45 |
| Course. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Course. |

## Traverse Table. (x.)

| Distance. | 17 | | 18 | | 19 | | 20 | | 21 | | 22 | | 23 | | 24 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cres. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Cres. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 17.0 | 00.8 | 18.0 | 00.9 | 19 0 | 00.9 | 20.0 | 01.0 | 21.0 | 01.0 | 22.0 | 01.1 | 23.0 | 01.1 | 24.0 | 01.2 | 7¼ |
| ½ | 16.9 | 01.7 | 17.9 | 01.8 | 18.9 | 01.9 | 19.9 | 02.0 | 20.9 | 02.1 | 21.9 | 02.2 | 22.9 | 02.3 | 23.9 | 02.4 | ½ |
| ¾ | 16.8 | 02.5 | 17.8 | 02.6 | 18.8 | 02.8 | 19.8 | 02.9 | 20.8 | 03.1 | 21.8 | 03.2 | 22.7 | 03.4 | 23.7 | 33.5 | ¾ |
| 1 | 16.7 | 03.3 | 17.7 | 03.5 | 18.6 | 03.7 | 19.6 | 03.9 | 20:6 | 04.1 | 21.6 | 04.3 | 22.6 | 04.5 | 23.5 | 04.7 | 7 |
| ¼ | 16.5 | 04.1 | 17.5 | 04.4 | 18.4 | 04.6 | 19.4 | 04.9 | 20.4 | 05.1 | 21.3 | 05.3 | 22.3 | 05.6 | 23.3 | 05.8 | ¼ |
| ½ | 16.3 | 04.9 | 17.2 | 05.2 | 18.2 | 05.5 | 19.1 | 05.8 | 20.1 | 06.1 | 21.1 | 06.4 | 22.0 | 06.7 | 23.0 | 07.0 | ½ |
| ¾ | 16.0 | 05.7 | 17.0 | 06.1 | 17.9 | 06.4 | 18.8 | 06.7 | 19.8 | 07.1 | 20.7 | 07.4 | 21.7 | 07.7 | 22.6 | 08.1 | ¾ |
| 2 | 15.7 | 06.5 | 16.6 | 06.9 | 17.6 | 07.3 | 18.5 | 07.7 | 19.4 | 08.0 | 20.3 | 08.4 | 21.3 | 08.8 | 22.2 | 09.2 | 6 |
| ¼ | 15.4 | 07.3 | 16.3 | 07.7 | 17.2 | 08.1 | 18.1 | 08.6 | 19.0 | 09.0 | 19.9 | 09.4 | 20.8 | 09.8 | 21.7 | 10.3 | ¼ |
| ½ | 15.0 | 08.0 | 15.9 | 08.5 | 16.8 | 09.0 | 17.6 | 09.4 | 18.5 | 09.9 | 19.4 | 10.4 | 20.3 | 10.8 | 21.2 | 11.3 | ½ |
| ¾ | 14.6 | 08.7 | 15.4 | 09.3 | 16.3 | 09.8 | 17.2 | 10.3 | 18.0 | 10.8 | 18.9 | 11.3 | 19.7 | 11.8 | 20.6 | 12.3 | ¾ |
| 3 | 14.1 | 09.4 | 15.0 | 10.0 | 15.8 | 10.6 | 16.6 | 11.1 | 17.5 | 11.7 | 18.3 | 12.2 | 19.1 | 12.8 | 20.0 | 13.3 | 5 |
| ¼ | 13.7 | 10.1 | 14.5 | 10.7 | 15.3 | 11.3 | 16.1 | 11.9 | 16.9 | 12.5 | 17.7 | 13.1 | 18.5 | 13.7 | 19.3 | 14.3 | ¼ |
| ½ | 13.1 | 10.8 | 13.9 | 11.4 | 14.7 | 12.0 | 15.5 | 12.7 | 16.2 | 13.3 | 17.0 | 14.0 | 17.8 | 14.6 | 18.5 | 15.2 | ½ |
| ¾ | 12.6 | 11.4 | 13.3 | 12.1 | 14.1 | 12.8 | 14.8 | 13.4 | 15.6 | 14.1 | 16.3 | 14.8 | 17.0 | 15.4 | 17.8 | 16.1 | ¾ |
| 4 | 12.0 | 12.0 | 12.7 | 12.7 | 13.4 | 13.4 | 14.1 | 14.1 | 14.8 | 14.8 | 15.6 | 15.6 | 16.3 | 16.3 | 17.0 | 17.0 | 4 |
| 1° | 17.0 | 00.3 | 18.0 | 00.3 | 19.0 | 00.3 | 20.0 | 00.3 | 21.0 | 00.4 | 22.0 | 00.4 | 23.0 | 00.4 | 24.0 | 00.4 | 89° |
| 2 | 17.0 | 00.6 | 18.0 | 00.6 | 19.0 | 00.7 | 20.0 | 00.7 | 21.0 | 00.7 | 22.0 | 00.8 | 23.0 | 00.8 | 24.0 | 00.8 | 88 |
| 3 | 17.0 | 00.9 | 18.0 | 00.9 | 19.0 | 01.0 | 20.0 | 01.0 | 21.0 | 01.1 | 22.0 | 01.2 | 23.0 | 01.2 | 24.0 | 01.3 | 87 |
| 4 | 17.0 | 01.2 | 18.0 | 01.3 | 19.0 | 01.3 | 20.0 | 01.4 | 20.9 | 01.5 | 21.9 | 01.5 | 22.9 | 01.6 | 23.9 | 01.7 | 86 |
| 5 | 16.9 | 01.5 | 17.9 | 01.6 | 18.9 | 01.7 | 19.9 | 01.7 | 20.9 | 01.8 | 21.9 | 01.9 | 22.9 | 02.0 | 23.9 | 02.1 | 85 |
| 6 | 16.9 | 01.8 | 17.9 | 01.9 | 18.9 | 02.0 | 19.9 | 02.1 | 20.9 | 02.2 | 21.9 | 02.3 | 22.9 | 02.4 | 23.9 | 02.5 | 84 |
| 7 | 16.9 | 02.1 | 17.9 | 02.2 | 18.9 | 02.3 | 19.9 | 02.4 | 20.8 | 02.6 | 21.8 | 02.7 | 22.8 | 02.8 | 23.8 | 02.9 | 83 |
| 8 | 16.8 | 02.4 | 17.8 | 02.5 | 18.8 | 02.6 | 19.8 | 02.8 | 20.8 | 02.9 | 21.8 | 03.1 | 22.8 | 03.2 | 23.8 | 03.3 | 82 |
| 9 | 16.8 | 02.7 | 17.8 | 02.8 | 18.8 | 03.0 | 19.8 | 03.1 | 20.7 | 03.3 | 21.7 | 03.4 | 22.7 | 03.6 | 23.7 | 03.8 | 81 |
| 10 | 16.7 | 03.0 | 17.7 | 03.1 | 18.7 | 03.3 | 19.7 | 03.5 | 20.7 | 03.6 | 21.7 | 03.8 | 22.7 | 04.0 | 23.6 | 04.2 | 80 |
| 11 | 16.7 | 03.2 | 17.7 | 03.4 | 18.7 | 03.6 | 19.6 | 03.8 | 20.6 | 04.0 | 21.6 | 04.2 | 22.6 | 04.4 | 23.6 | 04.6 | 79 |
| 12 | 16.6 | 03.5 | 17.6 | 03.7 | 18.6 | 04.0 | 19.6 | 04.2 | 20.5 | 04.4 | 21.5 | 04.6 | 22.5 | 04.8 | 23.5 | 05.0 | 78 |
| 13 | 16.6 | 03.8 | 17.5 | 04.0 | 18.5 | 04.3 | 19.5 | 04.5 | 20.5 | 04.7 | 21.4 | 04.9 | 22.4 | 05.2 | 23.4 | 05.4 | 77 |
| 14 | 16.5 | 04.1 | 17.5 | 04.4 | 18.4 | 04.6 | 19.4 | 04.8 | 20.4 | 05.1 | 21.3 | 05.3 | 22.3 | 05.6 | 23.3 | 05.8 | 76 |
| 15 | 16.4 | 04.4 | 17.4 | 04.7 | 18.4 | 04.9 | 19.3 | 05.2 | 20.3 | 05.4 | 21.3 | 05.7 | 22.2 | 06.0 | 23.2 | 06.2 | 75 |
| 16 | 16.3 | 04.7 | 17.3 | 05.0 | 18.3 | 05.2 | 19.2 | 05.5 | 20.2 | 05.8 | 21.1 | 06.1 | 22.1 | 06.3 | 23.1 | 06.6 | 74 |
| 17 | 16.3 | 05.0 | 17.2 | 05.3 | 18.2 | 05.6 | 19.1 | 05.8 | 20.1 | 06.1 | 21.0 | 06.4 | 22.0 | 06.7 | 23.0 | 07.0 | 73 |
| 18 | 16.2 | 05.3 | 17.1 | 05.6 | 18.1 | 05.9 | 19.0 | 06.2 | 20.0 | 06.5 | 20.9 | 06.8 | 21.9 | 07.1 | 22.8 | 07.4 | 72 |
| 19 | 16.1 | 05.5 | 17.0 | 05.9 | 18.0 | 06.2 | 18.9 | 06.5 | 19.9 | 06.8 | 20.8 | 07.2 | 21.7 | 07.5 | 22.7 | 07.8 | 71 |
| 20 | 16.0 | 05.8 | 16.9 | 06.2 | 17.9 | 06.5 | 18.8 | 06.8 | 19.7 | 07.2 | 20.7 | 07.5 | 21.6 | 07.9 | 22.6 | 08.2 | 70 |
| 21 | 15.9 | 06.1 | 16.8 | 06.5 | 17.7 | 06.8 | 18.7 | 07.2 | 19.6 | 07.5 | 20.5 | 07.9 | 21.5 | 08.2 | 22.4 | 08.6 | 69 |
| 22 | 15.8 | 06.4 | 16.7 | 06.7 | 17.6 | 07.1 | 18.5 | 07.5 | 19.5 | 07.9 | 20.4 | 08.2 | 21.3 | 08.6 | 22.3 | 09.0 | 68 |
| 23 | 15.6 | 06.6 | 16.6 | 07.0 | 17.5 | 07.4 | 18.4 | 07.8 | 19.3 | 08.2 | 20.3 | 08.6 | 21.2 | 09.0 | 22.1 | 09.4 | 67 |
| 24 | 15.5 | 06.9 | 16.4 | 07.3 | 17.4 | 07.7 | 18.3 | 08.1 | 19.2 | 08.5 | 20.1 | 08.9 | 21.0 | 09.4 | 21.9 | 09.8 | 66 |
| 25 | 15.4 | 07.2 | 16.3 | 07.6 | 17.2 | 08.0 | 18.1 | 08.5 | 19.0 | 08.9 | 19.9 | 09.3 | 20.8 | 09.7 | 21.8 | 10.1 | 65 |
| 26 | 15.3 | 07.5 | 16.2 | 07.9 | 17.1 | 08.3 | 18.0 | 08.8 | 18.9 | 09.2 | 19.8 | 09.6 | 20.7 | 10.1 | 21.6 | 10.5 | 64 |
| 27 | 15.1 | 07.7 | 16.0 | 08.2 | 16.9 | 08.6 | 17.8 | 09.1 | 18.7 | 09.5 | 19.6 | 10.0 | 20.5 | 10.4 | 21.4 | 10.9 | 63 |
| 28 | 15.0 | 08.0 | 15.9 | 08.5 | 16.8 | 08.9 | 17.7 | 09.4 | 18.5 | 09.9 | 19.4 | 10.3 | 20.3 | 10.8 | 21.2 | 11.3 | 62 |
| 29 | 14.9 | 08.2 | 15.7 | 08.7 | 16.6 | 09.2 | 17.5 | 09.7 | 18.4 | 10.2 | 19.2 | 10.7 | 20.1 | 11.2 | 21.0 | 11.6 | 61 |
| 30 | 14.7 | 08.5 | 15.6 | 09.0 | 16.5 | 09.5 | 17.3 | 10.0 | 18.2 | 10.5 | 19.1 | 11.0 | 19.9 | 11.5 | 20.8 | 12.0 | 60 |
| 31 | 14.6 | 08.8 | 15.4 | 09.3 | 16.3 | 09.8 | 17.1 | 10.3 | 18.0 | 10.8 | 18.9 | 11.3 | 19.7 | 11.8 | 20.6 | 12.4 | 59 |
| 32 | 14.4 | 09.0 | 15.3 | 09.5 | 16.1 | 10.1 | 17.0 | 10.6 | 17.8 | 11.1 | 18.7 | 11.7 | 19.5 | 12.2 | 20.4 | 12.7 | 58 |
| 33 | 14.3 | 09.3 | 15.1 | 09.8 | 15.9 | 10.3 | 16.8 | 10.9 | 17.6 | 11.4 | 18.5 | 12.0 | 19.3 | 12.5 | 20.1 | 13.1 | 57 |
| 34 | 14.1 | 09.5 | 14.9 | 10.1 | 15.8 | 10.6 | 16.6 | 11.2 | 17.4 | 11.7 | 18.2 | 12.3 | 19.1 | 12.9 | 19.9 | 13.4 | 56 |
| 35 | 13.9 | 09.8 | 14.7 | 10.3 | 15.6 | 10.9 | 16.4 | 11.5 | 17.2 | 12.0 | 18.0 | 12.6 | 18.8 | 13.2 | 19.7 | 13.8 | 55 |
| 36 | 13.8 | 10.0 | 14.6 | 10.6 | 15.4 | 11.2 | 16.2 | 11.8 | 17.0 | 12.3 | 17.8 | 12.9 | 18.6 | 13.5 | 19.4 | 14.1 | 54 |
| 37 | 13.6 | 10.2 | 14.4 | 10.8 | 15.2 | 11.4 | 16.0 | 12.0 | 16.8 | 12.6 | 17.6 | 13.2 | 18.4 | 13.8 | 19.2 | 14.4 | 53 |
| 38 | 13.4 | 10.5 | 14.2 | 11.1 | 15.0 | 11.7 | 15.8 | 12.3 | 16.5 | 12.9 | 17.3 | 13.5 | 18.1 | 14.2 | 18.9 | 14.8 | 52 |
| 39 | 13.2 | 10.7 | 14.0 | 11.3 | 14.8 | 12.0 | 15.5 | 12.6 | 16.3 | 13.2 | 17.1 | 13.8 | 17.9 | 14.5 | 18.7 | 15.1 | 51 |
| 40 | 13.0 | 10.9 | 13.8 | 11.6 | 14.6 | 12.2 | 15.3 | 12.9 | 16.1 | 13.5 | 16.9 | 14.1 | 17.6 | 14.8 | 18.4 | 15.4 | 50 |
| 41 | 12.8 | 11.2 | 13.6 | 11.8 | 14.3 | 12.5 | 15.1 | 13.1 | 15.8 | 13.8 | 16.6 | 14.4 | 17.4 | 15.1 | 18.1 | 15.7 | 49 |
| 42 | 12.6 | 11.4 | 13.4 | 12.0 | 14.1 | 12.7 | 14.9 | 13.4 | 15.6 | 14.1 | 16.3 | 14.7 | 17.1 | 15.4 | 17.8 | 16 1 | 48 |
| 43 | 12.4 | 11.6 | 13.2 | 12.3 | 13.9 | 13.0 | 14.6 | 13.6 | 15.4 | 14.3 | 16.1 | 15.0 | 16.8 | 15.7 | 17.6 | 16.4 | 47 |
| 44 | 12.2 | 11.8 | 12.9 | 12.5 | 13 7 | 13.2 | 14.4 | 13.9 | 15.1 | 14.6 | 15.8 | 15.3 | 16.5 | 16.0 | 17.3 | 16.7 | 46 |
| 45 | 12.0 | 12.0 | 12.7 | 12.7 | 13.4 | 13.4 | 14.1 | 14.1 | 14.8 | 14.8 | 15.6 | 15.6 | 16.3 | 16.3 | 17.0 | 17.0 | 45 |
| Cres | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Cres. |

## Traverse Table (x.)

| Distance. | 25 | | 26 | | 27 | | 28 | | 29 | | 30 | | 31 | | 32 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Course. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 25.0 | 01.2 | 26.0 | 01.3 | 27.0 | 01.3 | 28.0 | 01.4 | 29.0 | 01.4 | 30.0 | 01.5 | 31.0 | 01.5 | 32.0 | 01.6 | 73 ¼ |
| ½ | 24.9 | 02.4 | 25.9 | 02.5 | 26.9 | 02.6 | 27.9 | 02.7 | 28.9 | 02.8 | 29.9 | 02.9 | 30.9 | 03.0 | 31.8 | 03.1 | ½ |
| ¾ | 24.7 | 03.7 | 25.7 | 03.8 | 26.7 | 04.0 | 27.7 | 04.1 | 28.7 | 04.3 | 29.7 | 04.4 | 30.7 | 04.5 | 31.7 | 04.7 | ¾ |
| 1 | 24.5 | 04.9 | 25.5 | 05.1 | 26.5 | 05.3 | 27.5 | 05.5 | 28.4 | 05 7 | 29.4 | 05.9 | 30.4 | 06.0 | 31.4 | 06.2 | 7 |
| ¼ | 24.3 | 06.1 | 25.2 | 06.3 | 26.2 | 06.6 | 27.2 | 06.8 | 28.1 | 07.0 | 29.1 | 07.3 | 30.1 | 07.5 | 31.0 | 07.8 | ¼ |
| ½ | 23.9 | 07.3 | 24.9 | 07.5 | 25.8 | 07.8 | 26.8 | 08.1 | 27.8 | 08.4 | 28.7 | 08.7 | 29.7 | 09.0 | 30.6 | 09.3 | ½ |
| ¾ | 23.5 | 08.4 | 24.5 | 08.8 | 25.4 | 09.1 | 26.4 | 09.4 | 27.3 | 09.8 | 28.2 | 10.1 | 29.2 | 10.4 | 30.1 | 10.8 | ¾ |
| 2 | 23.1 | 09.6 | 24.0 | 10.0 | 24.9 | 10.3 | 25.9 | 10.7 | 26.8 | 11.1 | 27.7 | 11.5 | 28.6 | 11.9 | 29.6 | 12.2 | 6 |
| ¼ | 22.6 | 10.7 | 23.5 | 11.1 | 24.4 | 11.5 | 25.3 | 12.0 | 26.2 | 12.4 | 27.1 | 12.8 | 28.0 | 13.3 | 28.9 | 13.7 | ¼ |
| ½ | 22.1 | 11.8 | 22.9 | 12.3 | 23.8 | 12.7 | 24.7 | 13.2 | 25.6 | 13.7 | 26.5 | 14.1 | 27.3 | 14.6 | 28.2 | 15.1 | ½ |
| ¾ | 21.4 | 12.9 | 22.3 | 13.4 | 23.2 | 13.9 | 24.0 | 14.4 | 24.9 | 14.9 | 25.7 | 15.4 | 26.6 | 15.9 | 27.4 | 16.4 | ¾ |
| 3 | 20.8 | 13.9 | 21.6 | 14.4 | 22.4 | 15.0 | 23.3 | 15.6 | 24.1 | 16.1 | 24.9 | 16.7 | 25.8 | 17.2 | 26.6 | 17.8 | 5 |
| ¼ | 20.1 | 14.9 | 20.9 | 15.5 | 21.7 | 16.1 | 22.5 | 16.7 | 23.3 | 17.3 | 24.1 | 17.9 | 24.9 | 18.5 | 25.7 | 19.1 | ¼ |
| ½ | 19.3 | 15.9 | 20.1 | 16.5 | 20.9 | 17.1 | 21.6 | 17.8 | 22.4 | 18.4 | 23.2 | 19.0 | 24.0 | 19.7 | 24.7 | 20.3 | ½ |
| ¾ | 18.5 | 16.8 | 19.3 | 17.5 | 20.0 | 18.1 | 20.7 | 18.8 | 21.5 | 19.5 | 22.2 | 20.1 | 23.0 | 20.8 | 23.7 | 21.5 | ¾ |
| 4 | 17.7 | 17.7 | 18.4 | 18.4 | 19.1 | 19.1 | 19.8 | 19.8 | 20.5 | 20.5 | 21.2 | 21.2 | 21.9 | 21.9 | 22.6 | 22.6 | 4 |
| 1° | 25.0 | 00.4 | 26.0 | 00.5 | 27.0 | 00.5 | 28.0 | 00.5 | 29.0 | 00.5 | 30.0 | 00.5 | 31.0 | 00.5 | 32.0 | 00.6 | 89° |
| 2 | 25.0 | 00.9 | 26.0 | 00.9 | 27.0 | 00.9 | 28.0 | 01.0 | 29.0 | 01.0 | 30.0 | 01.0 | 31.0 | 01.1 | 32.0 | 01.1 | 88 |
| 3 | 25.0 | 01.3 | 26.0 | 01.4 | 27.0 | 01.4 | 28.0 | 01.5 | 29.0 | 01.5 | 30.0 | 01.6 | 31.0 | 01.6 | 32.0 | 01.7 | 87 |
| 4 | 24.9 | 01.7 | 25.9 | 01.8 | 26.9 | 01.9 | 27.9 | 02.0 | 28.9 | 02.0 | 29.9 | 02.1 | 30.9 | 02.2 | 31.9 | 02.2 | 86 |
| 5 | 24.9 | 02.2 | 25.9 | 02.3 | 26.9 | 02.4 | 27.9 | 02.4 | 28.9 | 02.5 | 29.9 | 02.6 | 30.9 | 02.7 | 31.9 | 02.8 | 85 |
| 6 | 24.9 | 02.6 | 25.9 | 02.7 | 26.9 | 02.8 | 27.8 | 02.9 | 28.8 | 03.0 | 29.8 | 03.1 | 30.8 | 03.2 | 31.8 | 03.3 | 84 |
| 7 | 24.8 | 03.0 | 25.8 | 03.2 | 26.8 | 03.3 | 27.8 | 03.4 | 28.8 | 03.5 | 29.8 | 03.7 | 30.8 | 03.8 | 31.8 | 03.9 | 83 |
| 8 | 24.8 | 03.5 | 25.7 | 03.6 | 26.7 | 03.8 | 27.7 | 03.9 | 28.7 | 04.0 | 29.7 | 04.2 | 30.7 | 04.3 | 31.7 | 04.5 | 82 |
| 9 | 24.7 | 03.9 | 25.7 | 04.1 | 26.7 | 04.2 | 27.7 | 04.4 | 28.6 | 04.5 | 29.6 | 04.7 | 30.6 | 04.8 | 31.6 | 05.0 | 81 |
| 10 | 24.6 | 04.3 | 25.6 | 04.5 | 26.6 | 04.7 | 27.6 | 04.9 | 28.6 | 05.0 | 29.5 | 05.2 | 30.5 | 05.4 | 31.5 | 05.6 | 80 |
| 11 | 24.5 | 04.8 | 25.5 | 05.0 | 26.5 | 05.2 | 27.5 | 05.3 | 28.5 | 05.5 | 29.4 | 05.7 | 30.4 | 05.9 | 31.4 | 06.1 | 79 |
| 12 | 24.5 | 05.2 | 25.4 | 05.4 | 26.4 | 05.6 | 27.4 | 05.8 | 28.4 | 06.0 | 29.3 | 06.2 | 30.3 | 06.4 | 31.3 | 06.7 | 78 |
| 13 | 24.4 | 05.6 | 25.3 | 05.8 | 26.3 | 06.1 | 27.3 | 06.3 | 28.3 | 06.5 | 29.2 | 06.7 | 30.2 | 07.0 | 31.2 | 07.2 | 77 |
| 14 | 24.3 | 06.0 | 25.2 | 06.3 | 26.2 | 06.5 | 27.2 | 06.8 | 28.1 | 07.0 | 29.1 | 07.3 | 30.1 | 07.5 | 31.0 | 07.7 | 76 |
| 15 | 24.1 | 06.5 | 25.1 | 06.7 | 26.1 | 07.0 | 27.0 | 07.2 | 28.0 | 07.5 | 29.0 | 07.8 | 29.9 | 08.0 | 30.9 | 08.3 | 75 |
| 16 | 24.0 | 06.9 | 25.0 | 07.2 | 26.0 | 07.4 | 26.9 | 07.7 | 27.9 | 08.0 | 28.8 | 08.3 | 29.8 | 08.5 | 30.8 | 08.8 | 74 |
| 17 | 23.9 | 07.3 | 24.9 | 07.6 | 25.8 | 07.9 | 26.8 | 08.2 | 27.7 | 08.5 | 28.7 | 08.8 | 29.6 | 09.1 | 30.6 | 09.4 | 73 |
| 18 | 23.8 | 07.7 | 24.7 | 08.0 | 25.7 | 08.3 | 26.6 | 08.7 | 27.6 | 09.0 | 28.5 | 09.3 | 29·5 | 09.6 | 30.4 | 09.9 | 72 |
| 19 | 23.6 | 08.1 | 24.6 | 08.5 | 25.5 | 08.8 | 26.5 | 09.1 | 27.4 | 09.4 | 28.4 | 09.8 | 29.3 | 10.1 | 30.3 | 10.4 | 71 |
| 20 | 23.5 | 08.6 | 24.4 | 08.9 | 25.4 | 09.2 | 26.3 | 09.6 | 27.3 | 09.9 | 28.2 | 10.3 | 29.1 | 10.6 | 30.1 | 10.9 | 70 |
| 21 | 23·3 | 09.0 | 24.3 | 09.3 | 25.2 | 09.7 | 26.1 | 10.0 | 27.1 | 10.4 | 28.0 | 10.8 | 28.9 | 11.1 | 29.9 | 11.5 | 69 |
| 22 | 23.2 | 09.4 | 24.1 | 09.7 | 25.0 | 10.1 | 26.0 | 10.5 | 26.9 | 10.9 | 27.8 | 11.2 | 28.7 | 11.6 | 29.7 | 12.0 | 68 |
| 23 | 23.0 | 09.8 | 23.9 | 10.2 | 24.9 | 10.5 | 25.8 | 10.9 | 26.7 | 11.3 | 27.6 | 11.7 | 28.5 | 12·1 | 29.5 | 12.5 | 67 |
| 24 | 22.8 | 10.2 | 23.8 | 10.6 | 24.7 | 11.0 | 25.6 | 11.4 | 26.5 | 11.8 | 27.4 | 12.2 | 28.3 | 12.6 | 29.2 | 13.0 | 66 |
| 25 | 22.7 | 10.6 | 23.6 | 11.0 | 24.5 | 11.4 | 25.4 | 11.8 | 26.3 | 12.3 | 27.2 | 12.7 | 28.1 | 13.1 | 29.0 | 13.5 | 65 |
| 26 | 22.5 | 11.0 | 23.4 | 11.4 | 24.3 | 11.8 | 25.2 | 12.3 | 26.1 | 12.7 | 27.0 | 13.2 | 27.9 | 13.6 | 28.8 | 14.0 | 64 |
| 27 | 22.3 | 11.3 | 23.2 | 11.8 | 24.1 | 12.3 | 24.9 | 12.7 | 25.8 | 13.2 | 26.7 | 13.6 | 27.6 | 14.1 | 28.5 | 14.5 | 63 |
| 28 | 22.1 | 11.7 | 23.0 | 12.2 | 23.8 | 12.7 | 24.7 | 13.1 | 25.6 | 13.6 | 26.5 | 14.1 | 27.4 | 14.6 | 28.3 | 15.0 | 62 |
| 29 | 21.9 | 12.1 | 22.7 | 12.6 | 23.6 | 13.1 | 24.5 | 13.6 | 25.4 | 14.1 | 26.2 | 14.5 | 27.1 | 15.0 | 28.0 | 15.5 | 61 |
| 30 | 21.7 | 12.5 | 22.5 | 13.0 | 23.4 | 13.5 | 24.2 | 14.0 | 25.1 | 14.5 | 26.0 | 15.0 | 26.8 | 15.5 | 27.7 | 16.0 | 60 |
| 31 | 21.4 | 12.9 | 22.3 | 13.4 | 23.1 | 13.9 | 24.0 | 14.4 | 24.9 | 14.9 | 25.7 | 15.5 | 26.6 | 16.0 | 27.4 | 16.5 | 59 |
| 32 | 21.2 | 13.2 | 22.0 | 13.8 | 22.9 | 14.3 | 23.7 | 14.8 | 24.6 | 15.4 | 25.4 | 15.9 | 26.3 | 16.4 | 27.1 | 17.0 | 58 |
| 33 | 21.0 | 13.6 | 21.8 | 14.2 | 22.6 | 14.7 | 23.5 | 15.2 | 24.3 | 15.8 | 25.2 | 16.3 | 26.0 | 16.9 | 26.8 | 17.4 | 57 |
| 34 | 20.7 | 14.0 | 21.6 | 14.5 | 22.4 | 15.1 | 23.2 | 15.7 | 24.0 | 16.2 | 24.9 | 16.8 | 25.7 | 17.3 | 26.5 | 17.9 | 56 |
| 35 | 20.5 | 14.3 | 21.3 | 14.9 | 22.1 | 15.5 | 22.9 | 16 1 | 23.8 | 16.6 | 24.6 | 17.2 | 25.4 | 17.8 | 26.2 | 18.4 | 55 |
| 36 | 20.2 | 14.7 | 21.0 | 15.3 | 21.8 | 15.9 | 22.7 | 16.5 | 23.5 | 17.0 | 24.3 | 17.6 | 25.1 | .8.2 | 25.9 | 18.8 | 54 |
| 37 | 20.0 | 15.0 | 20.8 | 15.6 | 21.6 | 16.2 | 22.4 | 16.9 | 23.2 | 17.5 | 24.0 | 18.1 | 24.8 | 18.7 | 25.6 | 19.3 | 53 |
| 38 | 19.7 | 15.4 | 20.5 | 16.0 | 21.3 | 16.6 | 22.1 | 17.2 | 22.9 | 17.9 | 23.6 | 18.5 | 24.4 | 19.1 | 25.2 | 19.7 | 52 |
| 39 | 19.4 | 15.7 | 20.2 | 16.4 | 21.0 | 17.0 | 21.8 | 17.6 | 22.5 | 18.3 | 23.3 | 18.9 | 24.1 | 19.5 | 24.9 | 20.1 | 51 |
| 40 | 19.2 | 16.1 | 19.9 | 16.7 | 20.7 | 17.4 | 21.4 | 18.0 | 22.2 | 18.6 | 23.0 | 19.3 | 23.7 | 19.9 | 24.5 | 20.6 | 50 |
| 41 | 18.9 | 16.4 | 19.6 | 17.1 | 20.4 | 17.7 | 21.1 | 18.4 | 21.9 | 19.0 | 22.6 | 19.7 | 23.4 | 20.3 | 24.2 | 21.0 | 49 |
| 42 | 18.6 | 16.7 | 19.3 | 17.4 | 20.1 | 18.1 | 20.8 | 18.7 | 21.6 | 19.4 | 22 3 | 20.1 | 23.0 | 20.7 | 23.8 | 21.4 | 48 |
| 43 | 18.3 | 17.0 | 19.0 | 17.7 | 19.7 | 18.4 | 20.5 | 19.1 | 21.2 | 19.8 | 21.9 | 20.5 | 22.7 | 21.1 | 23.4 | 21.8 | 47 |
| 44 | 18.0 | 17.4 | 18.7 | 18.1 | 19.4 | 18.8 | 20.1 | 19.5 | 20.9 | 20.1 | 21.6 | 20.8 | 22.3 | 21.5 | 23.0 | 22.2 | 46 |
| 45 | 17.7 | 17.7 | 18.4 | 18 4 | 19.1 | 19.1 | 19.8 | 19.8 | 20.5 | 20.5 | 21.2 | 21.2 | 21.9 | 21.9 | 22.6 | 22.6 | 45 |
| | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Course. |

## Traverse Table. (x.)

| Distance. | 33 | | 34 | | 35 | | 36 | | 37 | | 38 | | 39 | | 40 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts | | | | | | | | | | | | | | | | | Pts |
| ¼ | 33.0 | 01.6 | 34.0 | 01.7 | 35.0 | 01.7 | 36.0 | 01.8 | 37.0 | 01.8 | 38.0 | 01.9 | 39.0 | 01.9 | 40.0 | 02.0 | ¼ |
| ½ | 32.8 | 03.2 | 33.8 | 03.3 | 34.8 | 03.4 | 35.8 | 03.5 | 36.8 | 03.6 | 37.8 | 03.7 | 38.8 | 03.8 | 39.8 | 03.9 | ½ |
| ¾ | 32.6 | 04.8 | 33.6 | 05.0 | 34.6 | 05.1 | 35.6 | 05.3 | 36.6 | 05.4 | 37.6 | 05.6 | 38.6 | 05.7 | 39.6 | 05.9 | ¾ |
| 1 | 32.4 | 06.4 | 33.3 | 06.6 | 34.3 | 06.8 | 35.3 | 07.0 | 36.3 | 07.2 | 37.3 | 07.4 | 38.2 | 07.6 | 39.2 | 07.8 | 7 |
| ¼ | 32.0 | 08.0 | 33.0 | 08.3 | 34.0 | 08.5 | 34.9 | 08.7 | 35.9 | 09.0 | 36.9 | 09.2 | 37.8 | 09.5 | 38.8 | 09.7 | ¼ |
| ½ | 31.6 | 09.6 | 32.5 | 09.9 | 33.5 | 10.2 | 34.5 | 10.4 | 35.4 | 10.7 | 36.4 | 11.0 | 37.3 | 11.3 | 38.3 | 11.6 | ½ |
| ¾ | 31.1 | 11.1 | 32.0 | 11.5 | 33.0 | 11.8 | 33.9 | 12.1 | 34.8 | 12.5 | 35.8 | 12.8 | 36.7 | 13.1 | 37.7 | 13.5 | ¾ |
| 2 | 30.5 | 12.6 | 31.4 | 13.0 | 32.3 | 13.4 | 33.3 | 13.8 | 34.2 | 14.2 | 35.1 | 14.5 | 36.0 | 14.9 | 37.0 | 15.3 | 6 |
| ¼ | 29.8 | 14.1 | 30.7 | 14.5 | 31.6 | 15.0 | 32.5 | 15.4 | 33.4 | 15.8 | 34.4 | 16.2 | 35.3 | 16.7 | 36.2 | 17.1 | ¼ |
| ½ | 29.1 | 15.6 | 30.0 | 16.0 | 30.9 | 16.5 | 31.8 | 17.0 | 32.6 | 17.4 | 33.5 | 17.9 | 34.4 | 18.4 | 35.3 | 18.9 | ½ |
| ¾ | 28.3 | 17.0 | 29.2 | 17.5 | 30.0 | 18.0 | 30.9 | 18.5 | 31.7 | 19.0 | 32.6 | 19.5 | 33.5 | 20.0 | 34.3 | 20.6 | ¾ |
| 3 | 27.4 | 18.3 | 28.3 | 18.9 | 29.1 | 19.4 | 29.9 | 20.0 | 30.8 | 20.6 | 31.6 | 21.1 | 32.4 | 21.7 | 33.3 | 22.2 | 5 |
| ¼ | 26.5 | 19.7 | 27.3 | 20.3 | 28.1 | 20.9 | 28.9 | 21.4 | 29.7 | 22.0 | 30.5 | 22.6 | 31.3 | 23.2 | 32.1 | 23.8 | ¼ |
| ½ | 25.5 | 20.9 | 26.3 | 21.6 | 27.1 | 22.2 | 27.8 | 22.8 | 28.6 | 23.5 | 29.4 | 24.1 | 30.1 | 24.7 | 30.9 | 25.4 | ½ |
| ¾ | 24.4 | 22.2 | 25.2 | 22.8 | 25.9 | 23.5 | 26.7 | 24.2 | 27.4 | 24.8 | 28.2 | 25.5 | 28.9 | 26.2 | 29.6 | 26.9 | ¾ |
| 4 | 23.3 | 23.3 | 24.0 | 24.0 | 24.7 | 24.7 | 25.5 | 25.5 | 26.2 | 26.2 | 26.9 | 26.9 | 27.6 | 27.6 | 28.3 | 28.3 | 4 |
| 1° | 33.0 | 00.6 | 34.0 | 00.6 | 35.0 | 00.6 | 36.0 | 00.6 | 37.0 | 00.6 | 38.0 | 00.7 | 39.0 | 00.7 | 40.0 | 00.7 | 89° |
| 2 | 33.0 | 01.2 | 34.0 | 01.2 | 35.0 | 01.2 | 36.0 | 01.3 | 37.0 | 01.3 | 38.0 | 01.3 | 39.0 | 01.4 | 40.0 | 01.4 | 88 |
| 3 | 33.0 | 01.7 | 34.0 | 01.8 | 35.0 | 01.8 | 36.0 | 01.9 | 36.9 | 01.9 | 37.9 | 02.0 | 38.9 | 02.0 | 39.9 | 02.1 | 87 |
| 4 | 32.9 | 02.3 | 33.9 | 02.4 | 34.9 | 02.4 | 35.9 | 02.5 | 36.9 | 02.6 | 37.9 | 02.7 | 38.9 | 02.7 | 39.9 | 02.8 | 86 |
| 5 | 32.9 | 02.9 | 33.9 | 03.0 | 34.9 | 03.1 | 35.9 | 03.1 | 36.9 | 03.2 | 37.9 | 03.3 | 38.9 | 03.4 | 39.8 | 03.5 | 85 |
| 6 | 32.8 | 03.4 | 33.8 | 03.6 | 34.8 | 03.7 | 35.8 | 03.8 | 36.8 | 03.9 | 37.8 | 04.0 | 38.8 | 04.1 | 39.8 | 04.2 | 84 |
| 7 | 32.8 | 04.0 | 33.7 | 04.1 | 34.7 | 04.3 | 35.7 | 04.4 | 36.7 | 04.5 | 37.7 | 04.6 | 38.7 | 04.8 | 39.7 | 04.9 | 83 |
| 8 | 32.7 | 04.6 | 33.7 | 04.7 | 34.7 | 04.9 | 35.6 | 05.0 | 36.6 | 05.1 | 37.6 | 05.3 | 38.6 | 05.4 | 39.6 | 05.6 | 82 |
| 9 | 32.6 | 05.2 | 33.6 | 05.3 | 34.6 | 05.5 | 35.6 | 05.6 | 36.5 | 05.8 | 37.5 | 05.9 | 38.5 | 06.1 | 39.5 | 06.3 | 81 |
| 10 | 32.5 | 05.7 | 33.5 | 05.9 | 34.5 | 06.1 | 35.5 | 06.3 | 36.4 | 06.4 | 37.4 | 06.6 | 38.4 | 06.8 | 39.4 | 06.9 | 80 |
| 11 | 32.4 | 06.3 | 33.4 | 06.5 | 34.4 | 06.7 | 35.3 | 06.9 | 36.3 | 07.1 | 37.3 | 07.3 | 38.3 | 07.4 | 39.3 | 07.6 | 79 |
| 12 | 32.3 | 06.9 | 33.3 | 07.1 | 34.2 | 07.3 | 35.2 | 07.5 | 36.2 | 07.7 | 37.2 | 07.9 | 38.1 | 08.1 | 39.1 | 08.3 | 78 |
| 13 | 32.2 | 07.4 | 33.1 | 07.6 | 34.1 | 07.9 | 35.1 | 08.1 | 36.1 | 08.3 | 37.0 | 08.5 | 38.0 | 08.8 | 39.0 | 09.0 | 77 |
| 14 | 32.0 | 08.0 | 33.0 | 08.2 | 34.0 | 08.5 | 34.9 | 08.7 | 35.9 | 09.0 | 36.9 | 09.2 | 37.8 | 09.4 | 38.8 | 09.7 | 76 |
| 15 | 31.9 | 08.5 | 32.8 | 08.8 | 33.8 | 09.1 | 34.8 | 09.3 | 35.7 | 09.6 | 36.7 | 09.8 | 37.7 | 10.1 | 38.6 | 10.4 | 75 |
| 16 | 31.7 | 09.1 | 32.7 | 09.4 | 33.6 | 09.6 | 34.6 | 09.9 | 35.6 | 10.2 | 36.5 | 10.5 | 37.5 | 10.7 | 38.5 | 11.0 | 74 |
| 17 | 31.6 | 09.6 | 32.5 | 09.9 | 33.5 | 10.2 | 34.4 | 10.5 | 35.4 | 10.8 | 36.3 | 11.1 | 37.3 | 11.4 | 38.3 | 11.7 | 73 |
| 18 | 31.4 | 10.2 | 32.3 | 10.5 | 33.3 | 10.8 | 34.2 | 11.1 | 35.2 | 11.4 | 36.1 | 11.7 | 37.1 | 12.1 | 38.0 | 12.4 | 72 |
| 19 | 31.2 | 10.7 | 32.1 | 11.1 | 33.1 | 11.4 | 34.0 | 11.7 | 35.0 | 12.0 | 35.9 | 12.4 | 36.9 | 12.7 | 37.8 | 13.0 | 71 |
| 20 | 31.0 | 11.3 | 31.9 | 11.6 | 32.9 | 12.0 | 33.8 | 12.3 | 34.8 | 12.7 | 35.7 | 13.0 | 36.6 | 13.3 | 37.6 | 13.7 | 70 |
| 21 | 30.8 | 11.8 | 31.7 | 12.2 | 32.7 | 12.5 | 33.6 | 12.9 | 34.5 | 13.3 | 35.5 | 13.6 | 36.4 | 14.0 | 37.3 | 14.3 | 69 |
| 22 | 30.6 | 12.4 | 31.5 | 12.7 | 32.5 | 13.1 | 33.4 | 13.5 | 34.3 | 13.9 | 35.2 | 14.2 | 36.2 | 14.6 | 37.1 | 15.0 | 68 |
| 23 | 30.4 | 12.9 | 31.3 | 13.3 | 32.2 | 13.7 | 33.1 | 14.1 | 34.1 | 14.5 | 35.0 | 14.8 | 35.9 | 15.2 | 36.8 | 15.6 | 67 |
| 24 | 30.1 | 13.4 | 31.1 | 13.8 | 32.0 | 14.2 | 32.9 | 14.6 | 33.8 | 15.0 | 34.7 | 15.5 | 35.6 | 15.9 | 36.5 | 16.3 | 66 |
| 25 | 29.9 | 13.9 | 30.8 | 14.4 | 31.7 | 14.8 | 32.6 | 15.2 | 33.5 | 15.6 | 34.4 | 16.1 | 35.3 | 16.5 | 36.3 | 16.9 | 65 |
| 26 | 29.7 | 14.5 | 30.6 | 14.9 | 31.5 | 15.3 | 32.4 | 15.8 | 33.3 | 16.2 | 34.2 | 16.7 | 35.1 | 17.1 | 36.0 | 17.5 | 64 |
| 27 | 29.4 | 15.0 | 30.3 | 15.4 | 31.2 | 15.9 | 32.1 | 16.3 | 33.0 | 16.8 | 33.9 | 17.3 | 34.7 | 17.7 | 35.6 | 18.2 | 63 |
| 28 | 29.1 | 15.5 | 30.0 | 16.0 | 30.9 | 16.4 | 31.8 | 16.9 | 32.7 | 17.4 | 33.6 | 17.8 | 34.4 | 18.3 | 35.3 | 18.8 | 62 |
| 29 | 28.9 | 16.0 | 29.7 | 16.5 | 30.6 | 17.0 | 31.5 | 17.5 | 32.4 | 17.9 | 33.2 | 18.4 | 34.1 | 18.9 | 35.0 | 19.4 | 61 |
| 30 | 28.6 | 16.5 | 29.4 | 17.0 | 30 3 | 17.5 | 31.2 | 18.0 | 32.0 | 18.5 | 32.9 | 19.0 | 33.8 | 19.5 | 34.6 | 20.0 | 60 |
| 31 | 28.3 | 17.0 | 29.1 | 17.5 | 30.0 | 18.0 | 30.9 | 18.5 | 31.7 | 19.1 | 32.6 | 19.6 | 33.4 | 20.1 | 34.3 | 20.6 | 59 |
| 32 | 28.0 | 17.5 | 28.8 | 18.0 | 29.7 | 18.5 | 30.5 | 19.1 | 31.4 | 19.6 | 32.2 | 20.1 | 33.1 | 20.7 | 33.9 | 21.2 | 58 |
| 33 | 27.7 | 18.0 | 28.5 | 18.5 | 29.4 | 19.1 | 30.2 | 19.6 | 31.0 | 20.2 | 31.9 | 20.7 | 32.7 | 21.2 | 33.5 | 21.8 | 57 |
| 34 | 27.4 | 18.5 | 28.2 | 19.0 | 29.0 | 19.6 | 29.8 | 20.1 | 30.7 | 20.7 | 31.5 | 21.2 | 32.3 | 21.8 | 33.2 | 22.4 | 56 |
| 35 | 27.0 | 18.9 | 27.9 | 19.5 | 28.7 | 20.1 | 29.5 | 20.6 | 30.3 | 21.2 | 31.1 | 21.8 | 31.9 | 22.4 | 32.8 | 22.9 | 55 |
| 36 | 26.7 | 19.4 | 27.5 | 20.0 | 28.3 | 20.6 | 29.1 | 21.2 | 29.9 | 21.7 | 30.7 | 22.3 | 31.6 | 22.9 | 32.4 | 23.5 | 54 |
| 37 | 26.4 | 19.9 | 27.2 | 20.5 | 28.0 | 21.1 | 28.8 | 21.7 | 29.5 | 22.3 | 30.3 | 22.9 | 31.1 | 23.5 | 31.9 | 24.1 | 53 |
| 38 | 26.0 | 20.3 | 26.8 | 20.9 | 27.6 | 21.5 | 28.4 | 22.2 | 29.2 | 22.8 | 29.9 | 23.4 | 30.7 | 24.0 | 31 5 | 24.6 | 52 |
| 39 | 25.6 | 20.8 | 26.4 | 21.4 | 27.2 | 22.0 | 28.0 | 22.7 | 28.8 | 23.3 | 29.5 | 23.9 | 30.3 | 24.5 | 31.1 | 25.2 | 51 |
| 40 | 25.3 | 21.2 | 26.0 | 21.9 | 26.8 | 22.5 | 27.6 | 23.1 | 28.3 | 23.8 | 29.1 | 24.4 | 29.9 | 25.1 | 30.6 | 25.7 | 50 |
| 41 | 24.9 | 21.6 | 25.7 | 22.3 | 26.4 | 23.0 | 27.2 | 23.6 | 27.9 | 24.3 | 28.7 | 24.9 | 29.4 | 25.6 | 30.2 | 26.2 | 49 |
| 42 | 24.5 | 22.1 | 25.3 | 22.8 | 26.0 | 23.4 | 26.8 | 24.1 | 27.5 | 24.8 | 28.2 | 25.4 | 29.0 | 26.1 | 29 7 | 26.8 | 48 |
| 43 | 24.1 | 22.5 | 24.9 | 23.2 | 25.6 | 23.9 | 26.3 | 24.6 | 27.1 | 25.2 | 27.8 | 25.9 | 28.5 | 26.6 | 29.3 | 27.3 | 47 |
| 44 | 23.7 | 22.9 | 24.5 | 23.6 | 25.2 | 24.3 | 25.9 | 25.0 | 26.6 | 25.7 | 27.3 | 26.4 | 28.1 | 27.1 | 28.8 | 27.8 | 46 |
| 45 | 23.3 | 23.3 | 24.0 | 24.0 | 24.7 | 24.7 | 25.5 | 25.5 | 26.2 | 26.2 | 26.9 | 26.9 | 27.6 | 27.6 | 28.3 | 28.3 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table (x.)

| Distance. | 41 | | 42 | | 43 | | 44 | | 45 | | 46 | | 47 | | 48 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Course. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 41.0 | 02.0 | 41.9 | 02.1 | 42.9 | 02.1 | 43.9 | 02.2 | 44.9 | 02.2 | 45.9 | 02.3 | 46.9 | 02.3 | 47.9 | 02.4 | 7¾ |
| ½ | 40.8 | 04.0 | 41.8 | 04.1 | 42.8 | 04.2 | 43.8 | 04.3 | 44.8 | 04.4 | 45.8 | 04.5 | 46.8 | 04.6 | 47.8 | 04.7 | ½ |
| ¾ | 40.6 | 06.0 | 41.5 | 06.2 | 42.5 | 06.3 | 43.5 | 06.5 | 44.5 | 06.6 | 45.5 | 06.7 | 46.5 | 06.9 | 47.5 | 07.0 | ¼ |
| 1 | 40.2 | 08.0 | 41.2 | 08.2 | 42.2 | 08.4 | 43.2 | 08.6 | 44.1 | 08.8 | 45.1 | 09.0 | 46.1 | 09.2 | 47.1 | 09.4 | 7 |
| ¼ | 39.8 | 10.0 | 40.7 | 10.2 | 41.7 | 10.4 | 42.7 | 10.7 | 43.7 | 10.9 | 44.6 | 11.2 | 45.6 | 11.4 | 46.6 | 11.7 | ¾ |
| ½ | 39.2 | 11.9 | 40.2 | 12.2 | 41.2 | 12.5 | 42.1 | 12.8 | 43.1 | 13.1 | 44.0 | 13.3 | 45.0 | 13.6 | 45.9 | 13.9 | ½ |
| ¾ | 38.6 | 13.8 | 39.5 | 14.1 | 40.5 | 14.5 | 41.4 | 14.8 | 42.4 | 15.2 | 43.3 | 15.5 | 44.3 | 15.8 | 45.2 | 16.2 | ¼ |
| 2 | 37.9 | 15.7 | 38.8 | 16.1 | 39.7 | 16.5 | 40.6 | 16.8 | 41.6 | 17.2 | 42.5 | 17.6 | 43.4 | 18.0 | 44.4 | 18.4 | 6 |
| ¼ | 37.1 | 17.5 | 38.0 | 18.0 | 38.9 | 18.4 | 39.8 | 18.8 | 40.7 | 19.2 | 41.6 | 19.7 | 42.5 | 20.1 | 43.4 | 20.5 | ¾ |
| ½ | 36.2 | 19.3 | 37.0 | 19.8 | 37.9 | 20.3 | 38.8 | 20.7 | 39.7 | 21.2 | 40.6 | 21.7 | 41.5 | 22.2 | 42.3 | 22.6 | ½ |
| ¾ | 35.2 | 21.1 | 36.0 | 21.6 | 36.9 | 22.1 | 37.7 | 22.6 | 38.6 | 23.1 | 39.5 | 23.6 | 40.3 | 24.2 | 41.2 | 24.7 | ¼ |
| 3 | 34.1 | 22.8 | 34.9 | 23.3 | 35.8 | 23.9 | 36.6 | 24.4 | 37.4 | 25.0 | 38.2 | 25.6 | 39.1 | 26.1 | 39.9 | 26.7 | 5 |
| ¼ | 32.9 | 24.4 | 33.7 | 25.0 | 34.5 | 25.6 | 35.3 | 26.2 | 36.1 | 26.8 | 36.9 | 27.4 | 37.7 | 28.0 | 38.6 | 28.6 | ¾ |
| ½ | 31.7 | 26.0 | 32.5 | 26.6 | 33.2 | 27.3 | 34.0 | 27.9 | 34.8 | 28.5 | 35.6 | 29.2 | 36.3 | 29.8 | 37.1 | 30.4 | ½ |
| ¾ | 30.4 | 27.5 | 31.1 | 28.2 | 31.9 | 28.9 | 32.6 | 29.5 | 33.3 | 30.2 | 34.1 | 30.9 | 34.8 | 31.6 | 35.6 | 32.2 | ¼ |
| 4 | 29.0 | 29.0 | 29.7 | 29.7 | 30.4 | 30.4 | 31.1 | 31.1 | 31.8 | 31.8 | 32.5 | 32.5 | 33.2 | 33.2 | 33.9 | 33.9 | 4 |
| 1° | 41.0 | 00.7 | 42.0 | 00.7 | 43.0 | 00.8 | 44.0 | 00.8 | 45.0 | 00.8 | 46.0 | 00.8 | 47.0 | 00.8 | 48.0 | 00.8 | 89° |
| 2 | 41.0 | 01.4 | 42.0 | 01.5 | 43.0 | 01.5 | 44.0 | 01.5 | 45.0 | 01.6 | 46.0 | 01.6 | 47.0 | 01.6 | 48.0 | 01.7 | 88 |
| 3 | 40.9 | 02.1 | 41.9 | 02.2 | 42.9 | 02.3 | 43.9 | 02.3 | 44.9 | 02.4 | 45.9 | 02.4 | 46.9 | 02.5 | 47.9 | 02.5 | 87 |
| 4 | 40.9 | 02.9 | 41.9 | 02.9 | 42.9 | 03.0 | 43.9 | 03.1 | 44.9 | 03.1 | 45.9 | 03.2 | 46.9 | 03.3 | 47.9 | 03.3 | 86 |
| 5 | 40.8 | 03.6 | 41.8 | 03.7 | 42.8 | 03.7 | 43.8 | 03.8 | 44.8 | 03.9 | 45.8 | 04.0 | 46.8 | 04.1 | 47.8 | 04.2 | 85 |
| 6 | 40.8 | 04.3 | 41.8 | 04.4 | 42.8 | 04.5 | 43.8 | 04.6 | 44.8 | 04.7 | 45.7 | 04.8 | 46.7 | 04.9 | 47.7 | 05.0 | 84 |
| 7 | 40.7 | 05.0 | 41.7 | 05.1 | 42.7 | 05.2 | 43.7 | 05.4 | 44.7 | 05.5 | 45.7 | 05.6 | 46.6 | 05.7 | 47.6 | 05.8 | 83 |
| 8 | 40.6 | 05.7 | 41.6 | 05.8 | 42.6 | 06.0 | 43.6 | 06.1 | 44.6 | 06.3 | 45.6 | 06.4 | 46.6 | 06.5 | 47.5 | 06.7 | 82 |
| 9 | 40.5 | 06.4 | 41.5 | 06.6 | 42.5 | 06.7 | 43.5 | 06.9 | 44.4 | 07.0 | 45.4 | 07.2 | 46.4 | 07.4 | 47.4 | 07.5 | 81 |
| 10 | 40.4 | 07.1 | 41.4 | 07.3 | 42.3 | 07.5 | 43.3 | 07.6 | 44.3 | 07.8 | 45.3 | 08.0 | 46.3 | 08.2 | 47.3 | 08.3 | 80 |
| 11 | 40.2 | 07.8 | 41.2 | 08.0 | 42.2 | 08.2 | 43.2 | 08.4 | 44.2 | 08.6 | 45.2 | 08.8 | 46.1 | 09.0 | 47.1 | 09.2 | 79 |
| 12 | 40.1 | 08.5 | 41.1 | 08.7 | 42.1 | 08.9 | 43.0 | 09.1 | 44.0 | 09.4 | 45.0 | 09.6 | 46.0 | 09.8 | 47.0 | 10.0 | 78 |
| 13 | 39.9 | 09.2 | 40.9 | 09.4 | 41.9 | 09.7 | 42.9 | 09.9 | 43.8 | 10.1 | 44.8 | 10.3 | 45.8 | 10.6 | 46.8 | 10.8 | 77 |
| 14 | 39.8 | 09.9 | 40.8 | 10.2 | 41.7 | 10.4 | 42.7 | 10.6 | 43.7 | 10.9 | 44.6 | 11.1 | 45.6 | 11.4 | 46.6 | 11.6 | 76 |
| 15 | 39.6 | 10.6 | 40.6 | 10.9 | 41.5 | 11.1 | 42.5 | 11.4 | 43.5 | 11.6 | 44.4 | 11.9 | 45.4 | 12.2 | 46.4 | 12.4 | 75 |
| 16 | 39.4 | 11.3 | 40.4 | 11.6 | 41.3 | 11.9 | 42.3 | 12.1 | 43.3 | 12.4 | 44.2 | 12.7 | 45.2 | 13.0 | 46.1 | 13.2 | 74 |
| 17 | 39.2 | 12.0 | 40.2 | 12.3 | 41.1 | 12.6 | 42.1 | 12.9 | 43.0 | 13.2 | 44.0 | 13.4 | 44.9 | 13.7 | 45.9 | 14.0 | 73 |
| 18 | 39.0 | 12.7 | 39.9 | 13.0 | 40.9 | 13.3 | 41.8 | 13.6 | 42.8 | 13.9 | 43.7 | 14.2 | 44.7 | 14.5 | 45.7 | 14.8 | 72 |
| 19 | 38.8 | 13.3 | 39.7 | 13.7 | 40.7 | 14.0 | 41.6 | 14.3 | 42.5 | 14.7 | 43.5 | 15.0 | 44.4 | 15.3 | 45.4 | 15.6 | 71 |
| 20 | 38.5 | 14.0 | 39.5 | 14.4 | 40.4 | 14.7 | 41.3 | 15.0 | 42.3 | 15.4 | 43.2 | 15.7 | 44.2 | 16.1 | 45.1 | 16.4 | 70 |
| 21 | 38.3 | 14.7 | 39.2 | 15.1 | 40.1 | 15.4 | 41.1 | 15.8 | 42.0 | 16.1 | 42.9 | 16.5 | 43.9 | 16.8 | 44.8 | 17.2 | 69 |
| 22 | 38.0 | 15.4 | 38.9 | 15.7 | 39.9 | 16.1 | 40.8 | 16.5 | 41.7 | 16.9 | 42.7 | 17.2 | 43.6 | 17.6 | 44.5 | 18.0 | 68 |
| 23 | 37.7 | 16.0 | 38.7 | 16.4 | 39.6 | 16.8 | 40.5 | 17.2 | 41.4 | 17.6 | 42.3 | 18.0 | 43.3 | 18.4 | 44.2 | 18.8 | 67 |
| 24 | 37.5 | 16.7 | 38.4 | 17.1 | 39.3 | 17.5 | 40.2 | 17.9 | 41.1 | 18.3 | 42.0 | 18.7 | 42.9 | 19.1 | 43.9 | 19.5 | 66 |
| 25 | 37.2 | 17.3 | 38.1 | 17.7 | 39.0 | 18.2 | 39.9 | 18.6 | 40.8 | 19.0 | 41.7 | 19.4 | 42.6 | 19.9 | 43.5 | 20.3 | 65 |
| 26 | 36.9 | 18.0 | 37.7 | 18.4 | 38.6 | 18.8 | 39.5 | 19.3 | 40.4 | 19.7 | 41.3 | 20.2 | 42.2 | 20.6 | 43.1 | 21.0 | 64 |
| 27 | 36.5 | 18.6 | 37.4 | 19.1 | 38.3 | 19.5 | 39.2 | 20.0 | 40.1 | 20.4 | 41.0 | 20.9 | 41.9 | 21.3 | 42.8 | 21.8 | 63 |
| 28 | 36.2 | 19.2 | 37.1 | 19.7 | 38.0 | 20.2 | 38.8 | 20.7 | 39.7 | 21.1 | 40.6 | 21.6 | 41.5 | 22.1 | 42.4 | 22.5 | 62 |
| 29 | 35.9 | 19.9 | 36.7 | 20.4 | 37.6 | 20.8 | 38.5 | 21.3 | 39.4 | 21.8 | 40.2 | 22.3 | 41.1 | 22.8 | 42.0 | 23.3 | 61 |
| 30 | 35.5 | 20.5 | 36.4 | 21.0 | 37.2 | 21.5 | 38.1 | 22.0 | 39.0 | 22.5 | 39.8 | 23.0 | 40.7 | 23.5 | 41.6 | 24.0 | 60 |
| 31 | 35.1 | 21.1 | 36.0 | 21.6 | 36.9 | 22.1 | 37.7 | 22.7 | 38.6 | 23.2 | 39.4 | 23.7 | 40.3 | 24.2 | 41.1 | 24.7 | 59 |
| 32 | 34.8 | 21.7 | 35.6 | 22.3 | 36.5 | 22.8 | 37.3 | 23.3 | 38.2 | 23.8 | 39.0 | 24.4 | 39.9 | 24.9 | 40.7 | 25.4 | 58 |
| 33 | 34.4 | 22.3 | 35.2 | 22.9 | 36.1 | 23.4 | 36.9 | 24.0 | 37.7 | 24.5 | 38.6 | 25.1 | 39.4 | 25.6 | 40.3 | 26.1 | 57 |
| 34 | 34.0 | 22.9 | 34.8 | 23.5 | 35.6 | 24.0 | 36.5 | 24.6 | 37.3 | 25.2 | 38.1 | 25.7 | 39.0 | 26.3 | 39.8 | 26.8 | 56 |
| 35 | 33.6 | 23.5 | 34.4 | 24.1 | 35.2 | 24.7 | 36.0 | 25.2 | 36.9 | 25.8 | 37.7 | 26.4 | 38.5 | 27.0 | 39.3 | 27.5 | 55 |
| 36 | 33.2 | 24.1 | 34.0 | 24.7 | 34.8 | 25.3 | 35.6 | 25.9 | 36.4 | 26.5 | 37.2 | 27.0 | 38.0 | 27.6 | 38.8 | 28.2 | 54 |
| 37 | 32.7 | 24.7 | 33.5 | 25.3 | 34.3 | 25.9 | 35.1 | 26.5 | 35.9 | 27.1 | 36.7 | 27.7 | 37.5 | 28.3 | 38.3 | 28.9 | 53 |
| 38 | 32.3 | 25.2 | 33.1 | 25.9 | 33.9 | 26.5 | 34.7 | 27.1 | 35.5 | 27.7 | 36.2 | 28.3 | 37.0 | 28.9 | 37.8 | 29.6 | 52 |
| 39 | 31.9 | 25.8 | 32.6 | 26.4 | 33.4 | 27.1 | 34.2 | 27.7 | 35.0 | 28.3 | 35.7 | 28.9 | 36.5 | 29.6 | 37.3 | 30.2 | 51 |
| 40 | 31.4 | 26.4 | 32.2 | 27.0 | 32.9 | 27.6 | 33.7 | 28.3 | 34.5 | 28.9 | 35.2 | 29.6 | 36.0 | 30.2 | 36.8 | 30.9 | 50 |
| 41 | 30.9 | 26.9 | 31.7 | 27.6 | 32.5 | 28.2 | 33.2 | 28.9 | 34.0 | 29.5 | 34.7 | 30.2 | 35.5 | 30.8 | 36.2 | 31.5 | 49 |
| 42 | 30.5 | 27.4 | 31.2 | 28.1 | 32.0 | 28.8 | 32.7 | 29.4 | 33.4 | 30.1 | 34.2 | 30.8 | 34.9 | 31.4 | 35.7 | 32.1 | 48 |
| 43 | 30.0 | 28.0 | 30.7 | 28.6 | 31.4 | 29.3 | 32.2 | 30.0 | 32.9 | 30.7 | 33.6 | 31.4 | 34.4 | 32.1 | 35.1 | 32.7 | 47 |
| 44 | 29.5 | 28.5 | 30.2 | 29.2 | 30.9 | 29.9 | 31.7 | 30.6 | 32.4 | 31.3 | 33.1 | 32.0 | 33.8 | 32.6 | 34.5 | 33.3 | 46 |
| 45 | 29.0 | 29.0 | 29.7 | 29.7 | 30.4 | 30.4 | 31.1 | 31.1 | 31.8 | 31.8 | 32.5 | 32.5 | 33.2 | 33.2 | 33.9 | 33.9 | 45 |
| Course. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Course. |

## Traverse Table. (x.)

| Distance. | 49 | | 50 | | 51 | | 52 | | 53 | | 54 | | 55 | | 56 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 48.9 | 02.4 | 49.9 | 02.5 | 50.9 | 02.5 | 51.9 | 02.6 | 52.9 | 02.6 | 53.9 | 02.7 | 54.9 | 02.7 | 55 9 | 02.8 | 75 |
| ½ | 48.8 | 04.8 | 49.8 | 04.9 | 50.8 | 05.0 | 51.7 | 05.1 | 52.7 | 05.2 | 53.7 | 05.3 | 54.7 | 05.4 | 55.7 | 05.5 | ½ |
| ¾ | 48.5 | 07.2 | 49.5 | 07.3 | 50.4 | 07.5 | 51.4 | 07.6 | 52.4 | 07.8 | 53.4 | 07.9 | 54.4 | 08.1 | 55.4 | 08.2 | ¼ |
| 1′ | 48.1 | 09.6 | 49.0 | 09.8 | 50.0 | 10.0 | 51.0 | 10.1 | 52.0 | 10.3 | 53.0 | 10.5 | 53.9 | 10.7 | 54.9 | 10.9 | 7 |
| ¼ | 47.5 | 11.9 | 48.5 | 12.2 | 49.5 | 12.4 | 50.4 | 12.6 | 51.4 | 12.9 | 52.4 | 13.1 | 53.4 | 13.4 | 54.3 | 13.6 | ¾ |
| ½ | 46.9 | 14.2 | 47.9 | 14.5 | 48.8 | 14.8 | 49.8 | 15.1 | 50.7 | 15.4 | 51.7 | 15.7 | 52.6 | 16.0 | 53.6 | 16.3 | ½ |
| ¾ | 46.1 | 16.5 | 47.1 | 16.8 | 48.0 | 17.2 | 49.0 | 17.5 | 49.9 | 17.9 | 50.8 | 18.2 | 51.8 | 18.5 | 52.7 | 18.9 | ¼ |
| 2 | 45.3 | 18.8 | 46.2 | 19.1 | 47.1 | 19.5 | 48.0 | 19.9 | 49.0 | 20.3 | 49.9 | 20.7 | 50.8 | 21.0 | 51.7 | 21.4 | 6 |
| ¼ | 44.3 | 21.0 | 45.2 | 21.4 | 46.1 | 21.8 | 47.0 | 22.2 | 47.9 | 22.7 | 48.8 | 23.1 | 49.7 | 23.5 | 50.6 | 23.9 | ¾ |
| ½ | 43.2 | 23.1 | 44.1 | 23.6 | 45.0 | 24.0 | 45.9 | 24.5 | 46.7 | 25.0 | 47.6 | 25.5 | 48.5 | 25.9 | 49.4 | 26.4 | ½ |
| ¾ | 42.0 | 25.2 | 42.9 | 25.7 | 43.7 | 26.2 | 44.6 | 26.7 | 45.5 | 27.2 | 46.3 | 27.8 | 47.2 | 28.3 | 48.0 | 28.8 | ¼ |
| 3 | 40.7 | 27.2 | 41.6 | 27.8 | 42.4 | 28.3 | 43.2 | 28.9 | 44.1 | 29.4 | 44.9 | 30.0 | 45.7 | 30.6 | 46.6 | 31.1 | 5 |
| ¼ | 39.4 | 29.2 | 40.2 | 29.8 | 41.0 | 30.4 | 41.8 | 31.0 | 42.6 | 31.6 | 43.4 | 32.2 | 44.2 | 32.8 | 45.0 | 33.4 | ¾ |
| ½ | 37.9 | 31.1 | 38.6 | 31.7 | 39.4 | 32.3 | 40.2 | 33.0 | 41.0 | 33.6 | 41.7 | 34.3 | 42.5 | 34.9 | 43.3 | 35.5 | ½ |
| ¾ | 36.3 | 32.9 | 37.0 | 33.6 | 37.8 | 34.2 | 38.5 | 34.9 | 39.3 | 35.6 | 40.0 | 36.3 | 40.7 | 36.9 | 41.5 | 37.6 | ¼ |
| 4 | 34.6 | 34.6 | 35.4 | 35.4 | 36.1 | 36.1 | 36.8 | 36.8 | 37.5 | 37.5 | 38.2 | 38.2 | 38.9 | 38.9 | 39.6 | 39.6 | 4 |
| 1° | 49.0 | 00.9 | 50.0 | 00.9 | 51.0 | 00.9 | 52.0 | 00.9 | 53.0 | 00.9 | 54.0 | 00.9 | 55.0 | 01.0 | 56.0 | 01.0 | 89° |
| 2 | 49.0 | 01.7 | 50.0 | 01.7 | 51.0 | 01.8 | 52.0 | 01.8 | 53.0 | 01.8 | 54.0 | 01.9 | 55.0 | 01.9 | 56.0 | 02.0 | 88 |
| 3 | 48.9 | 02.6 | 49.9 | 02.6 | 50.9 | 02.7 | 51.9 | 02.7 | 52.9 | 02.8 | 53.9 | 02.8 | 54.9 | 02.9 | 55.9 | 02.9 | 87 |
| 4 | 48.9 | 03.4 | 49.9 | 03.5 | 50.9 | 03.6 | 51.9 | 03.6 | 52.9 | 03.7 | 53.9 | 03.8 | 54.9 | 03.8 | 55.9 | 03.9 | 86 |
| 5 | 48.8 | 04.3 | 49.8 | 04.4 | 50.8 | 04.4 | 51.8 | 04.5 | 52.8 | 04.6 | 53.8 | 04.7 | 54.8 | 04.8 | 55.8 | 04.9 | 85 |
| 6 | 48.7 | 05.1 | 49.7 | 05.2 | 50.7 | 05.3 | 51.7 | 05.4 | 52.7 | 05.5 | 53.7 | 05.6 | 54.7 | 05.7 | 55.7 | 05.9 | 84 |
| 7 | 48.6 | 06.0 | 49.6 | 06.1 | 50.6 | 06.2 | 51.6 | 06.3 | 52.6 | 06.5 | 53.6 | 06.6 | 54.6 | 06.7 | 55.6 | 06.8 | 83 |
| 8 | 48.5 | 06.8 | 49 5 | 07.0 | 50.5 | 07.1 | 51.5 | 07.2 | 52.5 | 07.4 | 53.5 | 07.5 | 54.5 | 07.7 | 55.5 | 07.8 | 82 |
| 9 | 48.4 | 07.7 | 49.4 | 07.8 | 50.4 | 08.0 | 51.4 | 08.1 | 52.3 | 08.3 | 53.3 | 08.4 | 54.3 | 08.6 | 55.3 | 08.8 | 81 |
| 10 | 48.3 | 08.5 | 49.2 | 08.7 | 50.2 | 08.9 | 51.2 | 09.0 | 52.0 | 09.2 | 53.2 | 09.4 | 54.2 | 09.6 | 55.1 | 09.7 | 80 |
| 11 | 48.1 | 09.3 | 49.1 | 09.5 | 50.1 | 09.7 | 51.0 | 09.9 | 52.0 | 10.1 | 53.0 | 10.3 | 54.0 | 10.5 | 55.0 | 10.7 | 79 |
| 12 | 47.9 | 10.2 | 48.9 | 10.4 | 49.9 | 10.6 | 50.9 | 10.8 | 51.8 | 11.0 | 52.8 | 11.2 | 53.8 | 11.4 | 54.8 | 11.6 | 78 |
| 13 | 47.7 | 11.0 | 48.7 | 11.2 | 49.7 | 11.5 | 50.7 | 11.7 | 51.6 | 11.9 | 52.6 | 12.1 | 53.6 | 12.4 | 54.6 | 12.6 | 77 |
| 14 | 47.5 | 11.9 | 48.5 | 12.1 | 49.5 | 12.3 | 50.5 | 12.6 | 51.4 | 12.8 | 52.4 | 13.1 | 53.4 | 13.3 | 54.4 | 13.5 | 76 |
| 15 | 47.3 | 12.7 | 48.3 | 12.9 | 49.3 | 13.2 | 50.2 | 13.5 | 51.2 | 13.7 | 52.2 | 14.0 | 53.1 | 14.2 | 54.1 | 14.5 | 75 |
| 16 | 47.1 | 13.5 | 48.1 | 13.8 | 49.0 | 14.1 | 50.0 | 14.3 | 50.9 | 14.6 | 51.9 | 14.9 | 52.9 | 15.2 | 53.8 | 15.4 | 74 |
| 17 | 46.9 | 14.3 | 47.8 | 14.6 | 48.8 | 14.9 | 49.7 | 15.2 | 50.7 | 15.5 | 51.6 | 15.8 | 52.6 | 16.1 | 53.6 | 16.4 | 73 |
| 18 | 46.6 | 15.1 | 47.6 | 15.5 | 48.5 | 15.8 | 49.5 | 16.1 | 50.4 | 16.4 | 51.4 | 16.7 | 52.3 | 17.0 | 53.3 | 17.3 | 72 |
| 19 | 46.3 | 16.0 | 47.3 | 16.3 | 48.2 | 16.6 | 49.2 | 16.9 | 50.1 | 17.3 | 51.1 | 17.6 | 52.0 | 17.9 | 52.9 | 18.2 | 71 |
| 20 | 46.0 | 16.8 | 47.0 | 17.1 | 47.9 | 17.4 | 48.9 | 17.8 | 49.8 | 18.1 | 50.7 | 18.5 | 51.7 | 18.8 | 52.6 | 19.2 | 70 |
| 21 | 45.7 | 17.6 | 46.7 | 17.9 | 47.6 | 18.3 | 48.5 | 18.6 | 49.5 | 19.0 | 50.4 | 19.4 | 51.3 | 19.7 | 52.3 | 20.1 | 69 |
| 22 | 45.4 | 18.4 | 46.4 | 18.7 | 47.3 | 19.1 | 48.2 | 19.5 | 49.1 | 19.9 | 50.1 | 20.2 | 51.0 | 20.6 | 51.9 | 21.0 | 68 |
| 23 | 45.1 | 19.1 | 46.0 | 19.5 | 46.9 | 19.9 | 47.9 | 20.3 | 48.8 | 20.7 | 49.7 | 21.1 | 50.6 | 21.5 | 51.5 | 21.9 | 67 |
| 24 | 44.8 | 19.9 | 45.7 | 20.3 | 46.6 | 20.7 | 47.5 | 21.2 | 48.4 | 21.6 | 49.3 | 22.0 | 50.2 | 22.4 | 51.2 | 22.8 | 66 |
| 25 | 44.4 | 20.7 | 45.3 | 21.1 | 46.2 | 21.6 | 47.1 | 22.0 | 48.0 | 22.4 | 48.9 | 22.8 | 49.8 | 23.2 | 50.8 | 23.7 | 65 |
| 26 | 44.0 | 21.5 | 44.9 | 21.9 | 45.8 | 22.4 | 46.7 | 22.8 | 47.6 | 23.2 | 48.5 | 23.7 | 49.4 | 24.1 | 50.3 | 24.5 | 64 |
| 27 | 43.7 | 22.2 | 44.6 | 22.7 | 45 4 | 23.2 | 46.3 | 23.6 | 47.2 | 24.1 | 48.1 | 24.5 | 49.0 | 25.0 | 49.9 | 25.4 | 63 |
| 28 | 43.3 | 23.0 | 44.1 | 23.5 | 45.0 | 23.9 | 45.9 | 24.4 | 46.8 | 24.9 | 47.7 | 25.4 | 48.6 | 25.8 | 49.4 | 26.3 | 62 |
| 29 | 42.9 | 23.8 | 43.7 | 24.2 | 44.6 | 24.7 | 45.5 | 25.2 | 46.4 | 25.7 | 47.2 | 26.2 | 48.1 | 26.7 | 49.0 | 27.1 | 61 |
| 30 | 42.4 | 24.5 | 43.3 | 25.0 | 44.2 | 25.5 | 45.0 | 26.0 | 45.9 | 26.5 | 46.8 | 27.0 | 47.6 | 27.5 | 48.5 | 28.0 | 60 |
| 31 | 42.0 | 25.2 | 42.9 | 25.8 | 43.7 | 26.3 | 44.6 | 26.8 | 45.4 | 27.3 | 46.3 | 27.8 | 47.1 | 28.3 | 48.0 | 28.8 | 59 |
| 32 | 41.6 | 26.0 | 42.4 | 26.5 | 43.3 | 27.0 | 44.1 | 27.6 | 44.9 | 28.1 | 45.8 | 28.6 | 46.6 | 29.1 | 47.5 | 29.7 | 58 |
| 33 | 41.1 | 26.7 | 41.9 | 27.2 | 42.8 | 27.8 | 43.6 | 28.3 | 44.4 | 28.9 | 45.3 | 29.4 | 46.1 | 30.0 | 47.0 | 30.5 | 57 |
| 34 | 40.6 | 27.4 | 41.5 | 28.0 | 42.3 | 28.5 | 43.1 | 29.1 | 43.9 | 29.6 | 44.8 | 30.2 | 45.6 | 30.8 | 46.4 | 31.3 | 56 |
| 35 | 40.1 | 28.1 | 41.0 | 28.7 | 41.8 | 29.3 | 42.6 | 29.8 | 43.4 | 30.4 | 44.2 | 31.0 | 45.1 | 31.5 | 45.9 | 32.1 | 55 |
| 36 | 39.6 | 28.8 | 40.5 | 29.4 | 41.3 | 30.0 | 42.1 | 30.6 | 42.9 | 31.2 | 43.7 | 31.7 | 44.5 | 32.3 | 45.3 | 32.9 | 54 |
| 37 | 39.1 | 29.5 | 39.9 | 30.1 | 40.7 | 30.7 | 41.5 | 31.3 | 42.3 | 31.9 | 43.1 | 32.5 | 43.9 | 33.1 | 44.7 | 33.7 | 53 |
| 38 | 38.6 | 30.2 | 39.4 | 30.8 | 40.2 | 31.4 | 41.0 | 32.0 | 41.8 | 32.6 | 42.6 | 33.2 | 43.3 | 33.9 | 44.1 | 34.5 | 52 |
| 39 | 38.1 | 30.8 | 38.9 | 31.5 | 39.6 | 32.1 | 40.4 | 32.7 | 41.2 | 33.4 | 42.0 | 34.0 | 42.7 | 34.6 | 43.5 | 35.2 | 51 |
| 40 | 37.5 | 31.5 | 38.3 | 32.1 | 39.1 | 32.8 | 39.8 | 33.4 | 40.6 | 34.1 | 41.4 | 34.7 | 42.1 | 35.4 | 42.9 | 36.0 | 50 |
| 41 | 37.0 | 32.1 | 37.7 | 32.8 | 38.5 | 33.5 | 39.2 | 34.1 | 40.0 | 34.8 | 40.8 | 35.4 | 41.5 | 36.1 | 42.3 | 36.7 | 49 |
| 42 | 36.4 | 32.8 | 37.2 | 33.5 | 37.9 | 34.1 | 38.6 | 34.8 | 39.4 | 35.5 | 40.1 | 36.1 | 40.9 | 36.8 | 41.6 | 37.5 | 48 |
| 43 | 35.8 | 33.4 | 36.6 | 34.1 | 37.3 | 34.8 | 38.0 | 35.5 | 38.8 | 36.1 | 39.5 | 36.8 | 40.2 | 37.5 | 41.0 | 38.2 | 47 |
| 44 | 35.2 | 34.0 | 36.0 | 34.7 | 36.7 | 35.4 | 37.4 | 36.1 | 38.1 | 36.8 | 38.8 | 37.5 | 39.6 | 38.2 | 40.3 | 38.9 | 46 |
| 45 | 34.6 | 34.6 | 35.4 | 35.4 | 36.1 | 36.1 | 36.8 | 36.8 | 37.5 | 37.5 | 38.2 | 38.2 | 38.9 | 38.9 | 39.6 | 39.6 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 57 | | 58 | | 59 | | 60 | | 61 | | 62 | | 63 | | 64 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cnse. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Cnse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 56.9 | 02.8 | 57.9 | 02.9 | 58.9 | 02.9 | 59.9 | 02.9 | 60.9 | 03.0 | 61.9 | 03.0 | 62.9 | 03.1 | 63.9 | 03.1 | 7¼ |
| ½ | 56.7 | 05.6 | 57.7 | 05.7 | 58.7 | 05.8 | 59.7 | 05.9 | 60.7 | 06.0 | 61.7 | 06.1 | 62.7 | 06.2 | 63.7 | 06.3 | ½ |
| ¾ | 56.4 | 08.4 | 57.4 | 08.5 | 58.4 | 08.7 | 59.3 | 08.8 | 60.3 | 08.9 | 61.3 | 09.1 | 62.3 | 09.2 | 63.3 | 09.4 | ¾ |
| 1 | 55.9 | 11.1 | 56.9 | 11.3 | 57.9 | 11.5 | 58.8 | 11.7 | 59.8 | 11.9 | 60.8 | 12.1 | 61.8 | 12.3 | 62.8 | 12.5 | 7 |
| ¼ | 55.3 | 13.9 | 56.3 | 14.1 | 57.2 | 14.3 | 58.2 | 14.6 | 59.2 | 14.8 | 60.1 | 15.1 | 61.1 | 15.3 | 62.1 | 15.6 | ¼ |
| ½ | 54.5 | 16.5 | 55.5 | 16.8 | 56.5 | 17.1 | 57.4 | 17.4 | 58.4 | 17.7 | 59.3 | 18.0 | 60.3 | 18.3 | 61.2 | 18.6 | ½ |
| ¾ | 53.7 | 19.2 | 54.6 | 19.5 | 55.5 | 19.9 | 56.5 | 20.2 | 57.4 | 20.5 | 58.4 | 20.9 | 59.3 | 21.2 | 60.3 | 21.6 | ¾ |
| 2 | 52.7 | 21.8 | 53.6 | 22.2 | 54.5 | 22.6 | 55.4 | 23.0 | 56.4 | 23.3 | 57.3 | 23.7 | 58.2 | 24.1 | 59.1 | 24.5 | 6 |
| ¼ | 51.5 | 24.4 | 52.4 | 24.8 | 53.3 | 25.2 | 54.2 | 25.7 | 55.1 | 26.1 | 56.0 | 26.5 | 57.0 | 26.9 | 57.9 | 27.4 | ¼ |
| ½ | 50.3 | 26.9 | 51.2 | 27.3 | 52.0 | 27.8 | 52.9 | 28.3 | 53.8 | 28.8 | 54.7 | 29.2 | 55.6 | 29.7 | 56.4 | 30.2 | ½ |
| ¾ | 48.9 | 29.3 | 49.7 | 29.8 | 50.6 | 30.3 | 51.5 | 30.8 | 52.3 | 31.4 | 53.2 | 31.9 | 54.0 | 32.4 | 54.9 | 32.9 | ¾ |
| 3 | 47.4 | 31.7 | 48.2 | 32.2 | 49.1 | 32.8 | 49.9 | 33.3 | 50 7 | 33.9 | 51.5 | 34.4 | 52.4 | 35.0 | 53.2 | 35.6 | 5 |
| ¼ | 45.8 | 34.0 | 46.6 | 34.6 | 47.4 | 35.1 | 48.2 | 35.7 | 49.0 | 36.3 | 49.8 | 36.9 | 50.6 | 37.5 | 51.4 | 38.1 | ¼ |
| ½ | 44.1 | 36.2 | 44.8 | 36 8 | 45.6 | 37.4 | 46.4 | 38.1 | 47.1 | 38.7 | 47.9 | 39.3 | 48.7 | 40.0 | 49.5 | 40.6 | ½ |
| ¾ | 42.2 | 38.3 | 43 0 | 38.9 | 43.7 | 39.6 | 44.5 | 40.3 | 45.2 | 41.0 | 45.9 | 41.6 | 46.7 | 42.3 | 47.4 | 43.0 | ¾ |
| 4 | 40.3 | 40.3 | 41.0 | 41.0 | 41.7 | 41.7 | 42.4 | 42.4 | 43.1 | 43.1 | 43.8 | 43.8 | 44.5 | 44.5 | 45.3 | 45.3 | 4 |
| 1° | 57.0 | 01.0 | 58.0 | 01.0 | 59.0 | 01.0 | 60.0 | 01.0 | 61.0 | 01.0 | 62.0 | 01.1 | 63.0 | 01.1 | 64.0 | 01.1 | 89° |
| 2 | 57.0 | 02.0 | 58.0 | 02.0 | 59.0 | 02.1 | 60.0 | 02.1 | 61.0 | 02.1 | 62.0 | 02.2 | 63.0 | 02.2 | 64.0 | 02.2 | 88 |
| 3 | 56.9 | 03.0 | 57.9 | 03.0 | 58.9 | 03.1 | 59.9 | 03.1 | 60.9 | 03.2 | 61.9 | 03.2 | 62.9 | 03.3 | 63.9 | 03.3 | 87 |
| 4 | 56.9 | 04.0 | 57.9 | 04.0 | 58.9 | 04.1 | 59.9 | 04.2 | 60.9 | 04.3 | 61.8 | 04.3 | 62.8 | 04.4 | 63.8 | 04.5 | 86 |
| 5 | 56.8 | 05.0 | 57.8 | 05.1 | 58.8 | 05.1 | 59.8 | 05.2 | 60.8 | 05.3 | 61.8 | 05.4 | 62.8 | 05.5 | 63.8 | 05.6 | 85 |
| 6 | 56.7 | 06.0 | 57.7 | 06.1 | 58.7 | 06.2 | 59.7 | 06.3 | 60.7 | 06.4 | 61.7 | 06.5 | 62.7 | 06.6 | 63.6 | 06.7 | 84 |
| 7 | 56.6 | 06.9 | 57.6 | 07.1 | 58.6 | 07.2 | 59.6 | 07.3 | 60.5 | 07.4 | 61.5 | 07.6 | 62.5 | 07.7 | 63.5 | 07.8 | 83 |
| 8 | 56.4 | 07.9 | 57.4 | 08.1 | 58.4 | 08.2 | 59.4 | 08.4 | 60.4 | 08.5 | 61.4 | 08.6 | 62.4 | 08.8 | 63.4 | 08.9 | 82 |
| 9 | 56.3 | 08.9 | 57.3 | 09.1 | 58.3 | 09.2 | 59.3 | 09.4 | 60.2 | 09.5 | 61.2 | 09.7 | 62.2 | 09.9 | 63.2 | 10.0 | 81 |
| 10 | 56.1 | 09.9 | 57.1 | 10.1 | 58.1 | 10.2 | 59.1 | 10.4 | 60.1 | 10.6 | 61.1 | 10.8 | 62.0 | 10.9 | 63.0 | 11.1 | 80 |
| 11 | 56.0 | 10.9 | 56.9 | 11.1 | 57.9 | 11.3 | 58.9 | 11.4 | 59.9 | 11.6 | 60.9 | 11.8 | 61.8 | 12.0 | 62.8 | 12.2 | 79 |
| 12 | 55.8 | 11.9 | 56.7 | 12.1 | 57.7 | 12.3 | 58.7 | 12.5 | 59.7 | 12.7 | 60.6 | 12.9 | 61.6 | 13.1 | 62.6 | 13.3 | 78 |
| 13 | 55.5 | 12.8 | 56.5 | 13.0 | 57.5 | 13.3 | 58.5 | 13.5 | 59.4 | 13.7 | 60.4 | 13.9 | 61.4 | 14.2 | 62.4 | 14.4 | 77 |
| 14 | 55.3 | 13.8 | 56.3 | 14.0 | 57.2 | 14.3 | 58.2 | 14.5 | 59.2 | 14.8 | 60.2 | 15.0 | 61.1 | 15.2 | 62.1 | 15.5 | 76 |
| 15 | 55.1 | 14.8 | 56.0 | 15.0 | 57.0 | 15.3 | 58.0 | 15.5 | 58.9 | 15.8 | 59.9 | 16.0 | 60.9 | 16.3 | 61.8 | 16.6 | 75 |
| 16 | 54.8 | 15.7 | 55.8 | 16.0 | 56.7 | 16.3 | 57.7 | 16.5 | 58.6 | 16.8 | 59.6 | 17.1 | 60.6 | 17.4 | 61.5 | 17.6 | 74 |
| 17 | 54.5 | 16.7 | 55.5 | 17.0 | 56.4 | 17.2 | 57.4 | 17.5 | 58.3 | 17.8 | 59.3 | 18.1 | 60.2 | 18.4 | 61.2 | 18.7 | 73 |
| 18 | 54.2 | 17.6 | 55.2 | 17.9 | 56.1 | 18.2 | 57.1 | 18.5 | 58.0 | 18.9 | 59.0 | 19.2 | 59.9 | 19.5 | 60.9 | 19.8 | 72 |
| 19 | 53.9 | 18.6 | 54.8 | 18.9 | 55.8 | 19.2 | 56.7 | 19.5 | 57.7 | 19.9 | 58.6 | 20.2 | 59.6 | 20.5 | 60.5 | 20.8 | 71 |
| 20 | 53.6 | 19.5 | 54.5 | 19.8 | 55.4 | 20.2 | 56.4 | 20.5 | 57.3 | 20.9 | 58.3 | 21.2 | 59.2 | 21.5 | 60.1 | 21.9 | 70 |
| 21 | 53.2 | 20.4 | 54.1 | 20.8 | 55.1 | 21.1 | 56.0 | 21.5 | 56.9 | 21.9 | 57.9 | 22.2 | 58.8 | 22.6 | 59.7 | 22.9 | 69 |
| 22 | 52.8 | 21.4 | 53.8 | 21.7 | 54.7 | 22.1 | 55.6 | 22.5 | 56.6 | 22.9 | 57.5 | 23.2 | 58.4 | 23.6 | 59.3 | 24.0 | 68 |
| 23 | 52.5 | 22.3 | 53.4 | 22.7 | 54.3 | 23.1 | 55.2 | 23.4 | 56.2 | 23.8 | 57.1 | 24.2 | 58.0 | 24.6 | 58.9 | 25.0 | 67 |
| 24 | 52.1 | 23.2 | 53.0 | 23.6 | 53.9 | 24.0 | 54.8 | 24.4 | 55.7 | 24.8 | 56.6 | 25.2 | 57.6 | 25.6 | 58.5 | 26.0 | 66 |
| 25 | 51.7 | 24.1 | 52.6 | 24.5 | 53.5 | 24.9 | 54.4 | 25.4 | 55.3 | 25.8 | 56.2 | 26.2 | 57.1 | 26.6 | 58.0 | 27.0 | 65 |
| 26 | 51.2 | 25.0 | 52.1 | 25.4 | 53.0 | 25.9 | 53.9 | 26.3 | 54.8 | 26.7 | 55.7 | 27.2 | 56.6 | 27.6 | 57.5 | 28.1 | 64 |
| 27 | 50.8 | 25.9 | 51.7 | 26.3 | 52.6 | 26.8 | 53.5 | 27.2 | 54.4 | 27.7 | 55.2 | 28.1 | 56.1 | 28.6 | 57.0 | 29.1 | 63 |
| 28 | 50.3 | 26.8 | 51.2 | 27.2 | 52.1 | 27.7 | 53.0 | 28.2 | 53.9 | 28.6 | 54.7 | 29.1 | 55.6 | 29.6 | 56.5 | 30.0 | 62 |
| 29 | 49.9 | 27.6 | 50.7 | 28.1 | 51.6 | 28.6 | 52.5 | 29.1 | 53.4 | 29.6 | 54.2 | 30.1 | 55.1 | 30.5 | 56.0 | 31.0 | 61 |
| 30 | 49.4 | 28.5 | 50.2 | 29.0 | 51.1 | 29.5 | 52.0 | 30.0 | 52.8 | 30.5 | 53.7 | 31.0 | 54.6 | 31.5 | 55.4 | 32.0 | 60 |
| 31 | 48.9 | 29.4 | 49.7 | 29.9 | 50.6 | 30.4 | 51.4 | 30.9 | 52.3 | 31.4 | 53.1 | 31.9 | 54.0 | 32.4 | 54.9 | 33.0 | 59 |
| 32 | 48.3 | 30.2 | 49.2 | 30.7 | 50.0 | 31.3 | 50.9 | 31.8 | 51.7 | 32.3 | 52.6 | 32.9 | 53.4 | 33.4 | 54.3 | 33.9 | 58 |
| 33 | 47.8 | 31.0 | 48.6 | 31.6 | 49.5 | 32.1 | 50.3 | 32.7 | 51.2 | 33.2 | 52.0 | 33.8 | 52.8 | 34.3 | 53.7 | 34.9 | 57 |
| 34 | 47.3 | 31.9 | 48.1 | 32.4 | 48.9 | 33.0 | 49.7 | 33.6 | 50.6 | 34.1 | 51.4 | 34.7 | 52.2 | 35.2 | 53.1 | 35.8 | 56 |
| 35 | 46.7 | 32.7 | 47.5 | 33.3 | 48.3 | 33.8 | 49.1 | 34.4 | 50.0 | 35.0 | 50.8 | 35.6 | 51.6 | 36.1 | 52.4 | 36.7 | 55 |
| 36 | 46.1 | 33.5 | 46.9 | 34.1 | 47.7 | 34.7 | 48.5 | 35.3 | 49.4 | 35.9 | 50.2 | 36.4 | 51.0 | 37.0 | 51.8 | 37.6 | 54 |
| 37 | 45.5 | 34.3 | 46.3 | 34.9 | 47.1 | 35.5 | 47.9 | 36.1 | 48.7 | 36.7 | 49.5 | 37.3 | 50.3 | 37.9 | 51.1 | 38.5 | 53 |
| 38 | 44.9 | 35.1 | 45.7 | 35.7 | 46.5 | 36.3 | 47.3 | 36.9 | 48.1 | 37.6 | 48.9 | 38.2 | 49.6 | 38.8 | 50.4 | 39.4 | 52 |
| 39 | 44.3 | 35.9 | 45.1 | 36.5 | 45.9 | 37.1 | 46.6 | 37.8 | 47.4 | 38.4 | 48.2 | 39.0 | 49.0 | 39.6 | 49.7 | 40.3 | 51 |
| 40 | 43.7 | 36.6 | 44.4 | 37.3 | 45.2 | 37.9 | 46.0 | 38.6 | 46.7 | 39.2 | 47.5 | 39.9 | 48.3 | 40.5 | 49.0 | 41.1 | 50 |
| 41 | 43.0 | 37.4 | 43.8 | 38.1 | 44.5 | 38.7 | 45.3 | 39.4 | 46.0 | 40.0 | 46.8 | 40.7 | 47.5 | 41.3 | 48.3 | 42.0 | 49 |
| 42 | 42.4 | 38.1 | 43.1 | 38.8 | 43.8 | 39.5 | 44.6 | 40.1 | 45.3 | 40.8 | 46.1 | 41.5 | 46.8 | 42.2 | 47.6 | 42.8 | 48 |
| 43 | 41.7 | 38.9 | 42.4 | 39.6 | 43.1 | 40.2 | 43.9 | 40.9 | 44.6 | 41.6 | 45.3 | 42.3 | 46.1 | 43.0 | 46.8 | 43.6 | 47 |
| 44 | 41.0 | 39.6 | 41.7 | 40.3 | 42.4 | 41.0 | 43.2 | 41.7 | 43.9 | 42.4 | 44.6 | 43.1 | 45.3 | 43.8 | 46.0 | 44.5 | 46 |
| 45 | 40.3 | 40.3 | 41.0 | 41.0 | 41.7 | 41.7 | 42.4 | 42.4 | 43.1 | 43.1 | 43.8 | 43.8 | 44.5 | 44.5 | 45.3 | 45.3 | 45 |
| | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Cnse. |

## Traverse Table. (x.)

| Distance. | 65 | | 66 | | 67 | | 68 | | 69 | | 70 | | 71 | | 72 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 64.9 | 03.2 | 65.9 | 03.2 | 66.9 | 03.3 | 67.9 | 03.3 | 68.9 | 03.4 | 69.9 | 03.4 | 70.9 | 03.5 | 71.9 | 03.5 | 89¾ |
| ½ | 64.7 | 06.4 | 65.7 | 06.5 | 66.7 | 06.6 | 67.7 | 06.7 | 68.7 | 06.8 | 69.7 | 06.9 | 70.7 | 07.0 | 71.7 | 07.1 | ½ |
| ¾ | 64.3 | 09.5 | 65.3 | 09.7 | 66.3 | 09.8 | 67.3 | 10.0 | 68.2 | 10.1 | 69.2 | 10.3 | 70.2 | 10.4 | 71.2 | 10.6 | ¼ |
| 1 | 63.7 | 12.7 | 64.7 | 12.9 | 65.7 | 13.1 | 66.7 | 13.3 | 67.7 | 13.5 | 68.7 | 13.7 | 69.6 | 13.9 | 70.6 | 14.0 | 7 |
| ¼ | 63.1 | 15.8 | 64.0 | 16.0 | 65.0 | 16.3 | 66.0 | 16.5 | 66.9 | 16.8 | 67.9 | 17.0 | 68.9 | 17.3 | 69.8 | 17.5 | ¾ |
| ½ | 62.2 | 18.9 | 63.2 | 19.2 | 64.1 | 19.4 | 65.1 | 19.7 | 66.0 | 20.0 | 67.0 | 20.3 | 67.9 | 20.6 | 68.9 | 20.9 | ½ |
| ¾ | 61.2 | 21.9 | 62.1 | 22.2 | 63.1 | 22.6 | 64.0 | 22 9 | 65.0 | 23.2 | 65.9 | 23.6 | 66.8 | 23.9 | 67.8 | 24.3 | ¼ |
| 2 | 60.1 | 24.9 | 61.0 | 25.3 | 61.9 | 25.6 | 62.8 | 26.0 | 63.8 | 26.4 | 64.7 | 26.8 | 65.6 | 27.2 | 66.5 | 27.6 | 6 |
| ¼ | 58.8 | 27.8 | 59.7 | 28.2 | 60.6 | 28.6 | 61.5 | 29.1 | 62.4 | 29.5 | 63.3 | 29.9 | 64.2 | 30.4 | 65.1 | 30.8 | ¾ |
| ½ | 57.3 | 30.6 | 58.2 | 31.1 | 59.1 | 31.6 | 60.0 | 32.1 | 60.9 | 32.5 | 61.7 | 33.0 | 62.6 | 33.5 | 63.5 | 33.9 | ½ |
| ¾ | 55.8 | 33.4 | 56.6 | 33.9 | 57.5 | 34.4 | 58.3 | 35.0 | 59.2 | 35.5 | 60.0 | 36.0 | 60.9 | 36.5 | 61.8 | 37.0 | ¼ |
| 3 | 54.0 | 36.1 | 54.9 | 36.7 | 55.7 | 37.2 | 56.5 | 37.8 | 57.4 | 38.3 | 58.2 | 38.9 | 59.0 | 39 4 | 59.9 | 40.0 | 5 |
| ¼ | 52.2 | 38.7 | 53.0 | 39.3 | 53.8 | 39.9 | 54.6 | 40.5 | 55.4 | 41.1 | 56.2 | 41.7 | 57.0 | 42.3 | 57.8 | 42.9 | ¾ |
| ½ | 50.2 | 41.2 | 51.0 | 41.9 | 51.8 | 42.5 | 52.6 | 43.1 | 53.3 | 43.8 | 54.1 | 44.4 | 54.9 | 45.0 | 55.7 | 45.7 | ½ |
| ¾ | 48.2 | 43.6 | 48.9 | 44.3 | 49.6 | 45.0 | 50.4 | 45.7 | 51.1 | 46.3 | 51.9 | 47.0 | 52.6 | 47.7 | 53.3 | 48.3 | ¼ |
| 4 | 46.0 | 46.0 | 46.7 | 46.7 | 47.4 | 47.4 | 48.1 | 48.1 | 48.8 | 48.8 | 49.5 | 49.5 | 50.2 | 50.2 | 50.9 | 50.9 | 4 |
| 1° | 65.0 | 01.1 | 66.0 | 01.2 | 67.0 | 01.2 | 68.0 | 01.2 | 69.0 | 01.2 | 70.0 | 01.2 | 71.0 | 01.2 | 72.0 | 01.3 | 89° |
| 2 | 65.0 | 02.3 | 66.0 | 02.3 | 67.0 | 02.3 | 68.0 | 02.4 | 69.0 | 02.4 | 70.0 | 02.4 | 71.0 | 02.5 | 72.0 | 02.5 | 88 |
| 3 | 64.9 | 03.4 | 65.9 | 03.5 | 66.9 | 03.5 | 67.9 | 03.6 | 68.9 | 03.6 | 69.9 | 03.7 | 70.9 | 03.7 | 71.9 | 03.8 | 87 |
| 4 | 64.8 | 04.5 | 65.8 | 04.6 | 66.8 | 04.7 | 67.8 | 04.7 | 68.8 | 04.8 | 69.8 | 04.9 | 70.9 | 05.0 | 71.8 | 05.0 | 86 |
| 5 | 64.8 | 05.7 | 65.7 | 05.8 | 66.7 | 05.8 | 67.7 | 05.9 | 68.7 | 06.0 | 69.7 | 06.1 | 70.7 | 06.2 | 71.7 | 06.3 | 85 |
| 6 | 64.6 | 06.8 | 65.6 | 06.9 | 66.6 | 07.0 | 67.6 | 07.1 | 68.6 | 07.2 | 69.6 | 07.3 | 70.6 | 07.4 | 71.6 | 07.5 | 84 |
| 7 | 64.5 | 07.9 | 65.5 | 08.0 | 66.5 | 08.2 | 67.5 | 08.3 | 68.5 | 08 4 | 69.5 | 08.5 | 70.5 | 08.7 | 71.5 | 08.8 | 83 |
| 8 | 64.4 | 09.0 | 65.4 | 09.2 | 66.3 | 09.3 | 67.3 | 09.5 | 68.3 | 09.6 | 69.3 | 09.7 | 70.3 | 09.9 | 71.3 | 10.0 | 82 |
| 9 | 64.2 | 10.2 | 65.2 | 10.3 | 66.2 | 10.5 | 67.2 | 10.6 | 68.2 | 10.8 | 69.1 | 11.0 | 70.1 | 11.1 | 71.1 | 11.3 | 81 |
| 10 | 64.0 | 11.3 | 65.0 | 11.5 | 66.0 | 11.6 | 67.0 | 11.8 | 68.0 | 12.0 | 68.9 | 12.2 | 69.9 | 12.3 | 70.9 | 12.5 | 80 |
| 11 | 63.8 | 12.4 | 64.8 | 12.6 | 65.8 | 12.8 | 66.8 | 13.0 | 67.7 | 13.2 | 68.7 | 13.4 | 69.7 | 13.5 | 70.7 | 13.7 | 79 |
| 12 | 63.6 | 13.5 | 64.6 | 13.7 | 65.5 | 13.9 | 66.5 | 14.1 | 67.5 | 14.3 | 68.5 | 14.6 | 69.4 | 14.8 | 70.4 | 15.0 | 78 |
| 13 | 63.3 | 14.6 | 64.3 | 14.8 | 65.3 | 15.1 | 66.3 | 15.3 | 67.2 | 15.5 | 68.2 | 15.7 | 69.2 | 16.0 | 70.2 | 16.2 | 77 |
| 14 | 63.1 | 15.7 | 64.0 | 16.0 | 65.0 | 16.2 | 66.0 | 16.5 | 67.0 | 16.7 | 67.9 | 16.9 | 68.9 | 17.2 | 69.9 | 17.4 | 76 |
| 15 | 62.8 | 16.8 | 63.8 | 17.1 | 64.7 | 17.3 | 65.7 | 17.6 | 66.6 | 17.9 | 67.6 | 18.1 | 68.6 | 18.4 | 69.5 | 18.6 | 75 |
| 16 | 62.5 | 17.9 | 63.4 | 18.2 | 64.4 | 18.5 | 65.4 | 18.7 | 66.3 | 19.0 | 67.3 | 19.3 | 68.2 | 19.6 | 69.2 | 19.8 | 74 |
| 17 | 62.2 | 19.0 | 63.1 | 19.3 | 64.1 | 19.6 | 65.0 | 19.9 | 66.0 | 20.2 | 66.9 | 20.5 | 67.9 | 20.8 | 68.9 | 21.1 | 73 |
| 18 | 61.8 | 20.1 | 62.8 | 20.4 | 63.7 | 20.7 | 64.7 | 21.0 | 65.6 | 21.3 | 66.6 | 21.6 | 67.5 | 21.9 | 68.5 | 22.2 | 72 |
| 19 | 61.5 | 21.2 | 62.4 | 21.5 | 63.3 | 21.8 | 64.3 | 22.1 | 65.2 | 22.5 | 66.2 | 22.8 | 67.1 | 23.1 | 68.1 | 23.4 | 71 |
| 20 | 61.1 | 22.2 | 62.0 | 22.6 | 63.0 | 22.9 | 63.9 | 23.3 | 64.8 | 23.6 | 65.8 | 23.9 | 66.7 | 24.3 | 67.7 | 24.6 | 70 |
| 21 | 60.7 | 23.3 | 61.6 | 23.7 | 62.5 | 24.0 | 63.5 | 24.4 | 64.4 | 24.7 | 65.4 | 25.1 | 66.3 | 25.4 | 67.2 | 25.8 | 69 |
| 22 | 60.3 | 24.3 | 61.2 | 24.7 | 62.1 | 25.1 | 63.0 | 25.5 | 64.0 | 25.8 | 64.9 | 26.2 | 65.8 | 26.6 | 66.8 | 27.0 | 68 |
| 23 | 59.8 | 25.4 | 60.8 | 25.8 | 61.7 | 26.2 | 62.6 | 26.6 | 63.5 | 27.0 | 64.4 | 27.4 | 65.4 | 27.7 | 66.3 | 28.1 | 67 |
| 24 | 59.4 | 26.4 | 60.3 | 26.8 | 61.2 | 27.3 | 62.1 | 27.7 | 63.0 | 28.1 | 63.9 | 28.5 | 64.9 | 28.9 | 65.8 | 29.3 | 66 |
| 25 | 58.9 | 27.5 | 59.8 | 27.9 | 60.7 | 28.3 | 61.6 | 28.7 | 62.5 | 29.2 | 63.4 | 29.6 | 64.3 | 30.0 | 65.3 | 30.4 | 65 |
| 26 | 58.4 | 28.5 | 59.3 | 28.9 | 60.2 | 29.4 | 61.1 | 29.8 | 62.0 | 30.2 | 62.9 | 30.7 | 63.8 | 31.1 | 64.7 | 31.6 | 64 |
| 27 | 57.9 | 29.5 | 58.8 | 30.0 | 59.7 | 30.4 | 60.6 | 30.9 | 61.5 | 31.3 | 62.4 | 31.8 | 63.3 | 32.2 | 64.2 | 32.7 | 63 |
| 28 | 57.4 | 30.5 | 58.3 | 31.0 | 59.2 | 31.5 | 60.0 | 31.9 | 60.9 | 32.4 | 61.8 | 32.9 | 62.7 | 33.3 | 63.6 | 33.8 | 62 |
| 29 | 56.9 | 31.5 | 57.7 | 32.0 | 58.6 | 32.5 | 59.5 | 33.0 | 60.3 | 33.5 | 61.2 | 33.9 | 62.1 | 34.4 | 63.0 | 34.9 | 61 |
| 30 | 56.3 | 32.5 | 57.2 | 33.0 | 58.0 | 33.5 | 58.9 | 34.0 | 59.8 | 34.5 | 60.6 | 35.0 | 61.5 | 35.5 | 62.4 | 36.0 | 60 |
| 31 | 55.7 | 33.5 | 56.6 | 34.0 | 57.4 | 34.5 | 58.3 | 35 0 | 59.1 | 35.5 | 60.0 | 36.1 | 60.9 | 36.6 | 61.7 | 37.1 | 59 |
| 32 | 55.1 | 34.4 | 56.0 | 35.0 | 56.8 | 35.5 | 57.7 | 36.0 | 58.5 | 36.6 | 59.4 | 37.1 | 60.2 | 37.6 | 61.1 | 38.2 | 58 |
| 33 | 54.5 | 35.4 | 55.4 | 35.9 | 56.2 | 36.5 | 57.0 | 37.0 | 57.9 | 37.6 | 58.7 | 38.1 | 59.5 | 38.7 | 60.4 | 39.2 | 57 |
| 34 | 53.9 | 36.3 | 54.7 | 36.9 | 55.5 | 37.5 | 56.4 | 38.0 | 57.2 | 38.6 | 58.0 | 39.1 | 58.9 | 39.7 | 59.7 | 40.3 | 56 |
| 35 | 53.2 | 37.3 | 54.1 | 37.9 | 54.9 | 38.4 | 55.7 | 39.0 | 56.5 | 39.6 | 57.3 | 40.2 | 58.2 | 40.7 | 59.0 | 41.3 | 55 |
| 36 | 52.6 | 38.2 | 53.4 | 38.8 | 54.2 | 39.4 | 55.0 | 40.0 | 55.8 | 40.6 | 56.6 | 41.1 | 57.4 | 41.7 | 58.2 | 42.3 | 54 |
| 37 | 51.9 | 39.1 | 52.7 | 39.7 | 53.5 | 40.3 | 54.3 | 40.9 | 55.1 | 41.5 | 55.9 | 42.1 | 56.7 | 42.7 | 57.5 | 43.3 | 53 |
| 38 | 51.2 | 40.0 | 52.0 | 40.6 | 52.8 | 41.2 | 53.6 | 41.9 | 54.4 | 42.5 | 55.2 | 43.1 | 55.9 | 43.7 | 56.7 | 44.3 | 52 |
| 39 | 50.5 | 40.9 | 51.3 | 41.5 | 52.1 | 42.2 | 52.8 | 42.8 | 53.6 | 43.4 | 54.4 | 44.1 | 55.2 | 44.7 | 56.0 | 45.3 | 51 |
| 40 | 49.8 | 41.8 | 50.6 | 42.4 | 51.3 | 43.1 | 52.1 | 43.7 | 52.9 | 44.4 | 53.6 | 45.0 | 54.4 | 45.6 | 55.2 | 46.3 | 50 |
| 41 | 49.1 | 42.6 | 49.8 | 43.3 | 50.6 | 44.0 | 51.3 | 44.6 | 52.1 | 45.3 | 52.8 | 45.9 | 53.6 | 46.6 | 54.3 | 47.2 | 49 |
| 42 | 48.3 | 43.5 | 49.0 | 44.2 | 49.8 | 44.8 | 50 5 | 45.5 | 51.3 | 46.2 | 52.0 | 46.8 | 52.8 | 47.5 | 53.5 | 48.2 | 48 |
| 43 | 47.5 | 44.3 | 48.3 | 45 0 | 49.0 | 45.7 | 49.7 | 46.4 | 50.5 | 47.1 | 51.2 | 47.7 | 51.9 | 48.4 | 52.7 | 49.1 | 47 |
| 44 | 46.8 | 45.2 | 47.5 | 45.8 | 48.2 | 46.5 | 48.9 | 47.2 | 49.6 | 47.9 | 50.4 | 48.6 | 51.1 | 49.3 | 51.8 | 50.0 | 46 |
| 45 | 46.0 | 46.0 | 46.7 | 46.7 | 47.4 | 47.4 | 48.1 | 48.1 | 48.8 | 48.8 | 49.5 | 49.5 | 50.2 | 50.2 | 50.9 | 50.9 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Crse |

## Traverse Table. (x.)

| Distance. | 73 | | 74 | | 75 | | 76 | | 77 | | 78 | | 79 | | 80 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cnr. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Cnr. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 72.9 | 03.6 | 73.9 | 03.6 | 74.9 | 03.7 | 75.9 | 03.7 | 76.9 | 03.8 | 77.9 | 03.8 | 78.9 | 03.9 | 79.9 | 03.9 | ¼ |
| ½ | 72.6 | 07.2 | 73.6 | 07.3 | 74.6 | 07.4 | 75.6 | 07.4 | 76.6 | 07.5 | 77.6 | 07.6 | 78.6 | 07.7 | 79.6 | 07.8 | ½ |
| ¾ | 72.2 | 10.7 | 73.2 | 10.9 | 74.2 | 11.0 | 75.2 | 11.1 | 76.2 | 11.3 | 77.2 | 11.4 | 78.1 | 11.6 | 79.1 | 11.7 | ¾ |
| 1 | 71.6 | 14.2 | 72.6 | 14.4 | 73.6 | 14.6 | 74.5 | 14.8 | 75.5 | 15.0 | 76.5 | 15.2 | 77.5 | 15.4 | 78.5 | 15.6 | 7 |
| ¼ | 70.8 | 17.7 | 71.8 | 18.0 | 72.8 | 18.2 | 73.7 | 18.5 | 74.7 | 18.7 | 75.7 | 19.0 | 76.6 | 19.2 | 77.6 | 19.4 | ¼ |
| ½ | 69.9 | 21.2 | 70.8 | 21.5 | 71.8 | 21.8 | 72.7 | 22.1 | 73.7 | 22.3 | 74.6 | 22.6 | 75.6 | 22.9 | 76.6 | 23.2 | ½ |
| ¾ | 68.7 | 24.6 | 69.7 | 24.9 | 70.6 | 25.3 | 71.6 | 25.6 | 72.5 | 25.9 | 73.4 | 26.3 | 74.4 | 26.6 | 75.3 | 26.9 | ¾ |
| 2 | 67.4 | 27.9 | 68.4 | 28.3 | 69.3 | 28.7 | 70.2 | 29.1 | 71.1 | 29.5 | 72.1 | 29.9 | 73.0 | 30.2 | 73.9 | 30.6 | 6 |
| ¼ | 66.0 | 31.2 | 66.9 | 31.6 | 67.8 | 32.1 | 68.7 | 32.5 | 69.6 | 32.9 | 70.5 | 33.4 | 71.4 | 33.8 | 72.3 | 34.2 | ¼ |
| ½ | 64.4 | 34.4 | 65.3 | 34.9 | 66.1 | 35.4 | 67.0 | 35.8 | 67.9 | 36.3 | 68.8 | 36.8 | 69.7 | 37.2 | 70.6 | 37.7 | ½ |
| ¾ | 62.6 | 37.5 | 63.5 | 38.0 | 64.3 | 38.6 | 65.2 | 39.1 | 66.0 | 39.6 | 66.9 | 40.1 | 67.8 | 40.6 | 68.6 | 41.1 | ¾ |
| 3 | 60.7 | 40.6 | 61.5 | 41.1 | 62.4 | 41.7 | 63.2 | 42.2 | 64.0 | 42.8 | 64.8 | 43.3 | 65.7 | 43.9 | 66.5 | 44.4 | 5 |
| ¼ | 58.6 | 43.5 | 59.4 | 44.1 | 60.2 | 44.7 | 61.0 | 45.3 | 61.8 | 45.9 | 62.6 | 46.5 | 63.4 | 47.1 | 64.3 | 47.7 | ¼ |
| ½ | 56.4 | 46.3 | 57.2 | 46.9 | 58.0 | 47.6 | 58.7 | 48.2 | 59.5 | 48.8 | 60.3 | 49.5 | 61.1 | 50.1 | 61.8 | 50.7 | ½ |
| ¾ | 54.1 | 49.0 | 54.8 | 49.7 | 55.6 | 50.4 | 56.3 | 51.0 | 57.0 | 51.7 | 57.8 | 52.4 | 58.5 | 53.0 | 59.3 | 53.7 | ¾ |
| 4 | 51.6 | 51.6 | 52.3 | 52.3 | 53.0 | 53.0 | 53.7 | 53.7 | 54.4 | 54.4 | 55.2 | 55.2 | 55.9 | 55.9 | 56.6 | 56.6 | 4 |
| 1° | 73.0 | 01.3 | 74.0 | 01.3 | 75.0 | 01.3 | 76.0 | 01.3 | 77.0 | 01.3 | 78.0 | 01.4 | 79.0 | 01.4 | 80.0 | 01.4 | 89° |
| 2 | 73.0 | 02.5 | 74.0 | 02.6 | 75.0 | 02.6 | 76.0 | 02.7 | 77.0 | 02.7 | 78.0 | 02.7 | 79.0 | 02.8 | 80.0 | 02.8 | 88 |
| 3 | 72.9 | 03.8 | 73.9 | 03.9 | 74.9 | 03.9 | 75.9 | 04.0 | 76.9 | 04.0 | 77.9 | 04.1 | 78.9 | 04.1 | 79.9 | 04.2 | 87 |
| 4 | 72.8 | 05.1 | 73.8 | 05.2 | 74.8 | 05.2 | 75.8 | 05.3 | 76.8 | 05.4 | 77.8 | 05.4 | 78.8 | 05.5 | 79.8 | 05.6 | 86 |
| 5 | 72.7 | 06.4 | 73.7 | 06.4 | 74.7 | 06.5 | 75.7 | 06.6 | 76.7 | 06.7 | 77.7 | 06.8 | 78.7 | 06.9 | 79.7 | 07.0 | 85 |
| 6 | 72.6 | 07.6 | 73.6 | 07.7 | 74.6 | 07.8 | 75.6 | 07.9 | 76.6 | 08.0 | 77.6 | 08.2 | 78.6 | 08.3 | 79.6 | 08.4 | 84 |
| 7 | 72.5 | 08.9 | 73.4 | 09.0 | 74.4 | 09.1 | 75.4 | 09.3 | 76.4 | 09.4 | 77.4 | 09.5 | 78.4 | 09.6 | 79.4 | 09.7 | 83 |
| 8 | 72.3 | 10.2 | 73.3 | 10.3 | 74.3 | 10.4 | 75.3 | 10.6 | 76.3 | 10.7 | 77.2 | 10.9 | 78.2 | 11.0 | 79.2 | 11.1 | 82 |
| 9 | 72.1 | 11.4 | 73.1 | 11.6 | 74.1 | 11.7 | 75.1 | 11.9 | 76.1 | 12.0 | 77.0 | 12.2 | 78.0 | 12.4 | 79.0 | 12.5 | 81 |
| 10 | 71.9 | 12.7 | 72.9 | 12.8 | 73.9 | 13.0 | 74.8 | 13.2 | 75.8 | 13.4 | 76.8 | 13.5 | 77.8 | 13.7 | 78.8 | 13.9 | 80 |
| 11 | 71.7 | 13.9 | 72.6 | 14.1 | 73.6 | 14.3 | 74.6 | 14.5 | 75.6 | 14.7 | 76.6 | 14.9 | 77.5 | 15.1 | 78.5 | 15.3 | 79 |
| 12 | 71.4 | 15.2 | 72.4 | 15.4 | 73.4 | 15.6 | 74.3 | 15.8 | 75.3 | 16.0 | 76.3 | 16.2 | 77.3 | 16.4 | 78.3 | 16.6 | 78 |
| 13 | 71.1 | 16.4 | 72.1 | 16.6 | 73.1 | 16.9 | 74.1 | 17.1 | 75.0 | 17.3 | 76.0 | 17.5 | 77.0 | 17.8 | 77.9 | 18.0 | 77 |
| 14 | 70.8 | 17.7 | 71.8 | 17.9 | 72.8 | 18.1 | 73.7 | 18.4 | 74.7 | 18.6 | 75.7 | 18.9 | 76.7 | 19.1 | 77.6 | 19.4 | 76 |
| 15 | 70.5 | 18.9 | 71.5 | 19.2 | 72.4 | 19.4 | 73.4 | 19.7 | 74.4 | 19.9 | 75.3 | 20.2 | 76.3 | 20.4 | 77.3 | 20.7 | 75 |
| 16 | 70.2 | 20.1 | 71.1 | 20.4 | 72.1 | 20.7 | 73.1 | 20.9 | 74.0 | 21.2 | 75.0 | 21.5 | 75.9 | 21.8 | 76.9 | 22.1 | 74 |
| 17 | 69.8 | 21.3 | 70.8 | 21.6 | 71.7 | 21.9 | 72.7 | 22.2 | 73.6 | 22.5 | 74.6 | 22.8 | 75.5 | 23.1 | 76.5 | 23.4 | 73 |
| 18 | 69.4 | 22.6 | 70.4 | 22.9 | 71.3 | 23.2 | 72.3 | 23.5 | 73.2 | 23.8 | 74.2 | 24.1 | 75.1 | 24.4 | 76.1 | 24.7 | 72 |
| 19 | 69.0 | 23.8 | 70.0 | 24.1 | 70.9 | 24.4 | 71.9 | 24.7 | 72.8 | 25.1 | 73.8 | 25.4 | 74.7 | 25.7 | 75.6 | 26.0 | 71 |
| 20 | 68.6 | 25.0 | 69.5 | 25.3 | 70.5 | 25.7 | 71.4 | 26.0 | 72.4 | 26.3 | 73.3 | 26.7 | 74.2 | 27.0 | 75.2 | 27.4 | 70 |
| 21 | 68.2 | 26.2 | 69.1 | 26.5 | 70.0 | 26.9 | 71.0 | 27.2 | 71.9 | 27.6 | 72.8 | 28.0 | 73.8 | 28.3 | 74.7 | 28.7 | 69 |
| 22 | 67.7 | 27.3 | 68.6 | 27.7 | 69.5 | 28.1 | 70.5 | 28.5 | 71.4 | 28.8 | 72.3 | 29.2 | 73.2 | 29.6 | 74.2 | 30.0 | 68 |
| 23 | 67.2 | 28.5 | 68.1 | 28.9 | 69.0 | 29.3 | 70.0 | 29.7 | 70.9 | 30.1 | 71.8 | 30.5 | 72.7 | 30.9 | 73.6 | 31.3 | 67 |
| 24 | 66.7 | 29.7 | 67.6 | 30.1 | 68.5 | 30.5 | 69.4 | 30.9 | 70.3 | 31.3 | 71.3 | 31.7 | 72.2 | 32.1 | 73.1 | 32.5 | 66 |
| 25 | 66.2 | 30.9 | 67.1 | 31.3 | 68.0 | 31.7 | 68.9 | 32.1 | 69.8 | 32.5 | 70.7 | 33.0 | 71.6 | 33.4 | 72.5 | 33.8 | 65 |
| 26 | 65.6 | 32.0 | 66.5 | 32.4 | 67.4 | 32.9 | 68.3 | 33.3 | 69.2 | 33.8 | 70.1 | 34.2 | 71.0 | 34.6 | 71.9 | 35.1 | 64 |
| 27 | 65.0 | 33.1 | 65.9 | 33.6 | 66.8 | 34.0 | 67.7 | 34.5 | 68.6 | 35.0 | 69.5 | 35.4 | 70.4 | 35.9 | 71.3 | 36.3 | 63 |
| 28 | 64.5 | 34.3 | 65.3 | 34.7 | 66.2 | 35.2 | 67.1 | 35.7 | 68.0 | 36.1 | 68.9 | 36.6 | 69.8 | 37.1 | 70.6 | 37.6 | 62 |
| 29 | 63.8 | 35.4 | 64.7 | 35.9 | 65.6 | 36.4 | 66.5 | 36.8 | 67.3 | 37.3 | 68.2 | 37.8 | 69.1 | 38.3 | 70.0 | 38.8 | 61 |
| 30 | 63.2 | 36.5 | 64.1 | 37.0 | 65.0 | 37.5 | 65.8 | 38.0 | 66.7 | 38.5 | 67.5 | 39.0 | 68.4 | 39.5 | 69.3 | 40.0 | 60 |
| 31 | 62.6 | 37.6 | 63.4 | 38.1 | 64.3 | 38.6 | 65.1 | 39.1 | 66.0 | 39.7 | 66.9 | 40.2 | 67.7 | 40.7 | 68.6 | 41.2 | 59 |
| 32 | 61.9 | 38.7 | 62.8 | 39.2 | 63.6 | 39.7 | 64.5 | 40.3 | 65.3 | 40.8 | 66.1 | 41.3 | 67.0 | 41.9 | 67.8 | 42.4 | 58 |
| 33 | 61.2 | 39.8 | 62.1 | 40.3 | 62.9 | 40.8 | 63.7 | 41.4 | 64.6 | 41.9 | 65.4 | 42.5 | 66.3 | 43.0 | 67.1 | 43.6 | 57 |
| 34 | 60.5 | 40.8 | 61.3 | 41.4 | 62.2 | 41.9 | 63.0 | 42.5 | 63.8 | 43.1 | 64.7 | 43.6 | 65.5 | 44.2 | 66.3 | 44.7 | 56 |
| 35 | 59.8 | 41.9 | 60.6 | 42.4 | 61.4 | 43.0 | 62.3 | 43.6 | 63.1 | 44.2 | 63.9 | 44.7 | 64.7 | 45.3 | 65.5 | 45.9 | 55 |
| 36 | 59.1 | 42.9 | 59.9 | 43.5 | 60.7 | 44.1 | 61.5 | 44.7 | 62.3 | 45.3 | 63.1 | 45.8 | 63.9 | 46.4 | 64.7 | 47.0 | 54 |
| 37 | 58.3 | 43.9 | 59.1 | 44.5 | 59.9 | 45.1 | 60.7 | 45.7 | 61.5 | 46.3 | 62.3 | 46.9 | 63.1 | 47.5 | 63.9 | 48.1 | 53 |
| 38 | 57.5 | 44.9 | 58.3 | 45.6 | 59.1 | 46.2 | 59.9 | 46.8 | 60.7 | 47.4 | 61.5 | 48.0 | 62.3 | 48.6 | 63.0 | 49.3 | 52 |
| 39 | 56.7 | 45.9 | 57.5 | 46.6 | 58.3 | 47.2 | 59.1 | 47.8 | 59.8 | 48.5 | 60.6 | 49.1 | 61.4 | 49.7 | 62.2 | 50.3 | 51 |
| 40 | 55.9 | 46.9 | 56.7 | 47.6 | 57.5 | 48.2 | 58.2 | 48.9 | 59.0 | 49.5 | 59.8 | 50.1 | 60.5 | 50.8 | 61.3 | 51.4 | 50 |
| 41 | 55.1 | 47.9 | 55.8 | 48.5 | 56.6 | 49.2 | 57.4 | 49.9 | 58.1 | 50.5 | 58.9 | 51.2 | 59.6 | 51.8 | 60.4 | 52.5 | 49 |
| 42 | 54.2 | 48.8 | 55.0 | 49.5 | 55.7 | 50.2 | 56.5 | 50.9 | 57.2 | 51.5 | 58.0 | 52.2 | 58.7 | 52.9 | 59.5 | 53.5 | 48 |
| 43 | 53.4 | 49.8 | 54.1 | 50.5 | 54.9 | 51.1 | 55.6 | 51.8 | 56.3 | 52.5 | 57.0 | 53.2 | 57.8 | 53.9 | 58.5 | 54.6 | 47 |
| 44 | 52.5 | 50.7 | 53.2 | 51.4 | 54.0 | 52.1 | 54.7 | 52.8 | 55.4 | 53.5 | 56.1 | 54.2 | 56.8 | 54.9 | 57.5 | 55.6 | 46 |
| 45 | 51.6 | 51.6 | 52.3 | 52.3 | 53.0 | 53.0 | 53.7 | 53.7 | 54.4 | 54.4 | 55.2 | 55.2 | 55.9 | 55.9 | 56.6 | 56.6 | 45 |
| | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | |

## Traverse Table. (x)

| Distance. | 81 | | 82 | | 83 | | 84 | | 85 | | 86 | | 87 | | 88 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 80.9 | 04.0 | 81.9 | 04.0 | 82.9 | 04.1 | 83.9 | 04.1 | 84.9 | 04.2 | 85.9 | 04.2 | 86.9 | 04.3 | 87.9 | 04.3 | ¾ |
| ½ | 80.6 | 07.9 | 81.6 | 08.0 | 82.6 | 08.1 | 83.6 | 08.2 | 84.6 | 08.3 | 85.6 | 08.4 | 86.6 | 08.5 | 87.6 | 08.6 | ½ |
| ¾ | 80.1 | 11.9 | 81.1 | 12.0 | 82.1 | 12.2 | 83.1 | 12.3 | 84.1 | 12.5 | 85.1 | 12.6 | 86.1 | 12.8 | 87.0 | 12.9 | ¼ |
| 1 | 79.4 | 15.8 | 80.4 | 16.0 | 81.4 | 16.2 | 82.4 | 16.4 | 83.4 | 16.6 | 84.3 | 16.8 | 85.3 | 17.0 | 86.3 | 17.2 | 7 |
| ¼ | 78.6 | 19.7 | 79.5 | 19.9 | 80.5 | 20.2 | 81.5 | 20.4 | 82.5 | 20.7 | 83.4 | 20.9 | 84.4 | 21.1 | 85.4 | 21.4 | ¾ |
| ½ | 77.5 | 23.5 | 78.5 | 23.8 | 79.4 | 24.1 | 80.4 | 24.4 | 81.3 | 24.7 | 82.3 | 25.0 | 83.3 | 25.2 | 84.2 | 25.5 | ½ |
| ¾ | 76.3 | 27.3 | 77.2 | 27.6 | 78.1 | 28.0 | 79.1 | 28.3 | 80.0 | 28.6 | 81.0 | 29.0 | 81.9 | 29.3 | 82.9 | 29.6 | ¼ |
| 2 | 74.8 | 31.0 | 75.8 | 31.4 | 76.7 | 31.8 | 77.6 | 32.1 | 78.5 | 32.5 | 79.5 | 32.9 | 80.4 | 33.3 | 81.3 | 33.7 | 6 |
| ¼ | 73.2 | 34.6 | 74.1 | 35.1 | 75.0 | 35.5 | 75.9 | 35.9 | 76.8 | 36.3 | 77.7 | 36.8 | 78.6 | 37.2 | 79.6 | 37.6 | ¾ |
| ½ | 71.4 | 38.2 | 72.3 | 38.6 | 73.2 | 39.1 | 74.1 | 39.6 | 75.0 | 40.1 | 75.9 | 40.5 | 76.7 | 41.0 | 77.6 | 41.5 | ½ |
| ¾ | 69.5 | 41.6 | 70.3 | 42.2 | 71.2 | 42.7 | 72.0 | 43.2 | 72.9 | 43.7 | 73.8 | 44.2 | 74·6 | 44.7 | 75.5 | 45.2 | ¼ |
| 3 | 67.3 | 45.0 | 68.2 | 45.6 | 69.0 | 46.1 | 69.8 | 46.7 | 70.7 | 47.2 | 71.5 | 47.8 | 72.3 | 48.3 | 73.2 | 48.9 | 5 |
| ¼ | 65.1 | 48.3 | 65.9 | 48.9 | 66.7 | 49.4 | 67.5 | 50.0 | 68.3 | 50.6 | 69.1 | 51.2 | 69.9 | 51.8 | 70.7 | 52.4 | ¾ |
| ½ | 62.6 | 51.4 | 63.4 | 52 0 | 64.2 | 52.7 | 64.9 | 53.3 | 65.7 | 53.9 | 66.5 | 54.6 | 67.2 | 55.2 | 68.0 | 55.8 | ½ |
| ¾ | 60.0 | 54.4 | 60.8 | 55.1 | 61.5 | 55.7 | 62.2 | 56.4 | 63.0 | 57.1 | 63.7 | 57.7 | 64.5 | 58.4 | 65.2 | 59.1 | ¼ |
| 4 | 57.3 | 57.3 | 58.0 | 58.0 | 58.7 | 58.7 | 59.4 | 59.4 | 60.1 | 60.1 | 60.8 | 60.8 | 61.5 | 61.5 | 62.2 | 62.2 | 4 |
| 1° | 81·0 | 01.4 | 82.0 | 01.4 | 83.0 | 01.4 | 84.0 | 01.5 | 85.0 | 01.5 | 86.0 | 01.5 | 87.0 | 01.5 | 88.0 | 01 5 | 89° |
| 2 | 81.0 | 02.8 | 82.0 | 02.9 | 82.9 | 02.9 | 83.9 | 02.9 | 84.9 | 03.0 | 85.9 | 03.0 | 86.9 | 03.0 | 87.9 | 03.1 | 88 |
| 3 | 80.9 | 04.2 | 81.9 | 04.3 | 82.9 | 04.3 | 83.9 | 04.4 | 84.9 | 04.4 | 85.9 | 04.5 | 86.9 | 04.6 | 87.9 | 04.6 | 87 |
| 4 | 80.8 | 05.7 | 81.8 | 05.7 | 82.8 | 05.8 | 83.8 | 05.9 | 84.8 | 05.9 | 85.8 | 06.0 | 86.8 | 06.1 | 87.8 | 06.1 | 86 |
| 5 | 80.7 | 07.1 | 81.7 | 07.1 | 82.7 | 07.2 | 83.7 | 07.3 | 84.7 | 07.4 | 85.7 | 07.5 | 86.7 | 07.6 | 87.7 | 07.7 | 85 |
| 6 | 80.6 | 08.5 | 81.6 | 08.6 | 82.5 | 08.7 | 83.5 | 08.8 | 84.5 | 08.9 | 85.5 | 09.0 | 86.5 | 09.1 | 87.5 | 09.2 | 84 |
| 7 | 80.4 | 09.9 | 81.4 | 10.0 | 82.4 | 10.1 | 83.4 | 10.2 | 84.4 | 10.4 | 85.4 | 10.5 | 86.4 | 10.6 | 87 3 | 10.7 | 83 |
| 8 | 80.2 | 11.3 | 81.2 | 11.4 | 82.2 | 11.6 | 83.2 | 11.7 | 84.2 | 11.8 | 85.2 | 12.0 | 86.2 | 12.1 | 87.1 | 12.2 | 82 |
| 9 | 80.0 | 12.7 | 81.0 | 12.8 | 82.0 | 13.0 | 83.0 | 13.1 | 84.0 | 13.3 | 84.9 | 13.5 | 85.9 | 13.6 | 86.9 | 13.8 | 81 |
| 10 | 79.8 | 14.1 | 80.8 | 14.2 | 81.7 | 14.4 | 82.7 | 14.6 | 83.7 | 14.8 | 84.7 | 14.9 | 85.7 | 15.1 | 86.7 | 15.3 | 80 |
| 11 | 79.5 | 15.5 | 80.5 | 15.6 | 81.5 | 15.8 | 82.5 | 16.0 | 83.4 | 16.2 | 84.4 | 16.4 | 85.4 | 16.6 | 86.4 | 16.8 | 79 |
| 12 | 79.2 | 16.8 | 80.2 | 17.0 | 81.2 | 17.3 | 82.2 | 17.5 | 83.1 | 17.7 | 84.1 | 17.9 | 85.1 | 18.1 | 86.1 | 18.3 | 78 |
| 13 | 78.9 | 18.2 | 79.9 | 18.4 | 80.9 | 18.7 | 81.8 | 18.9 | 82.8 | 19.1 | 83.8 | 19.3 | 84.8 | 19.6 | 85.7 | 19 8 | 77 |
| 14 | 78.6 | 19.6 | 79.6 | 19.8 | 80.5 | 20.1 | 81.5 | 20.3 | 82.5 | 20.6 | 83.4 | 20.8 | 84.4 | 21.0 | 85.4 | 21.3 | 76 |
| 15 | 78.2 | 21.0 | 79.2 | 21.2 | 80.2 | 21.5 | 81.1 | 21.7 | 82.1 | 22.0 | 83.1 | 22.3 | 84.0 | 22.5 | 85.0 | 22.8 | 75 |
| 16 | 77.9 | 22.3 | 78.8 | 22.6 | 79.8 | 22.9 | 80.7 | 23.2 | 81.7 | 23.4 | 82.7 | 23.7 | 83.6 | 24.0 | 84.6 | 24.3 | 74 |
| 17 | 77.5 | 23.7 | 78.4 | 24.0 | 79.4 | 24.3 | 80.3 | 24.6 | 81.3 | 24.9 | 82.2 | 25.1 | 83.2 | 25.4 | 84.2 | 25.7 | 73 |
| 18 | 77.0 | 25.0 | 78.0 | 25.3 | 78.9 | 25.6 | 79.9 | 26.0 | 80.8 | 26.3 | 81.8 | 26.6 | 82.7 | 26.9 | 83.7 | 27.2 | 72 |
| 19 | 76.6 | 26.4 | 77.5 | 26.7 | 78.5 | 27.0 | 79.4 | 27.3 | 80.4 | 27.7 | 81.3 | 28.0 | 82.3 | 28.3 | 83.2 | 28.7 | 71 |
| 20 | 76.1 | 27.7 | 77.1 | 28.0 | 78.0 | 28.4 | 78.9 | 28.7 | 79.9 | 29.1 | 80.8 | 29.4 | 81.8 | 29.8 | 82.7 | 30.1 | 70 |
| 21 | 75.6 | 29.0 | 76.6 | 29.4 | 77.5 | 29.7 | 78.4 | 30.1 | 79.4 | 30.5 | 80.3 | 30.8 | 81.2 | 31.2 | 82.2 | 31.5 | 69 |
| 22 | 75.1 | 30.3 | 76.0 | 30.7 | 77.0 | 31.1 | 77.9 | 31.5 | 78.8 | 31.8 | 79.7 | 32.2 | 80.7 | 32.6 | 81.6 | 33.0 | 68 |
| 23 | 74.6 | 31.6 | 75.5 | 32.0 | 76.4 | 32.4 | 77.3 | 32.8 | 78.2 | 33.2 | 79.2 | 33.6 | 80.1 | 34.0 | 81.0 | 34.4 | 67 |
| 24 | 74.0 | 32.9 | 74.9 | 33.4 | 75.8 | 33.8 | 76.7 | 34.2 | 77.7 | 34.6 | 78.6 | 35.0 | 79.5 | 35.4 | 80.4 | 35.8 | 66 |
| 25 | 73.4 | 34.2 | 74.3 | 34.7 | 75.2 | 35.1 | 76.1 | 35.5 | 77.0 | 35.9 | 77.9 | 36.3 | 78.8 | 36.8 | 79.8 | 37.2 | 65 |
| 26 | 72.8 | 35.5 | 73.7 | 35.9 | 74.6 | 36.4 | 75.5 | 36.8 | 76.4 | 37.3 | 77.3 | 37.7 | 78.2 | 38.1 | 79.1 | 38.6 | 64 |
| 27 | 72.2 | 36.8 | 73.1 | 37.2 | 74.0 | 37.7 | 74.8 | 38.1 | 75.7 | 38.6 | 76.6 | 39.0 | 77.5 | 39.5 | 78.4 | 40.0 | 63 |
| 28 | 71.5 | 38.0 | 72.4 | 38.5 | 73.3 | 39.0 | 74.2 | 39.4 | 75.1 | 39.9 | 75.9 | 40.4 | 76.8 | 40.8 | 77.7 | 41.3 | 62 |
| 29 | 70.8 | 39.3 | 71.7 | 39.8 | 72.6 | 40.2 | 73.5 | 40.7 | 74 3 | 41.2 | 75.2 | 41.7 | 76.1 | 42.2 | 77.0 | 42.7 | 61 |
| 30 | 70.1 | 40.5 | 71.0 | 41.0 | 71.9 | 41.5 | 72.7 | 42.0 | 73.6 | 42.5 | 74.5 | 43.0 | 75.3 | 43.5 | 76.2 | 44.0 | 60 |
| 31 | 69.4 | 41.7 | 70.3 | 42.2 | 71.1 | 42.7 | 72.0 | 43.3 | 72.9 | 43.8 | 73.7 | 44.3 | 74.6 | 44.8 | 75.4 | 45.3 | 59 |
| 32 | 68.7 | 42.9 | 69.5 | 43.5 | 70.4 | 44.0 | 71.2 | 44.5 | 72.1 | 45.0 | 72.9 | 45.6 | 73.8 | 46.1 | 74.6 | 46.6 | 58 |
| 33 | 67.9 | 44.1 | 68.8 | 44.7 | 69.6 | 45.2 | 70.4 | 45.7 | 71.3 | 46.3 | 72.1 | 46.8 | 73.0 | 47.4 | 73.8 | 47.9 | 57 |
| 34 | 67.2 | 45.3 | 68.0 | 45.9 | 68.8 | 46.4 | 69.6 | 47.0 | 70.5 | 47.5 | 71.3 | 48.1 | 72.1 | 48.6 | 73.0 | 49.2 | 56 |
| 35 | 66.4 | 46.5 | 67.2 | 47.0 | 68.0 | 47.6 | 68.8 | 48.2 | 69.6 | 48.8 | 70.4 | 49.3 | 71.3 | 49.9 | 72.1 | 50.5 | 55 |
| 36 | 65.5 | 47.6 | 66.3 | 48 2 | 67.1 | 48.8 | 68.0 | 49.4 | 68.8 | 50.0 | 69.6 | 50.5 | 70.4 | 51.1 | 71.2 | 51.7 | 54 |
| 37 | 64.7 | 48.7 | 65.5 | 49.3 | 66.3 | 50.0 | 67.1 | 50.6 | 67.9 | 51.2 | 68.7 | 51.8 | 69.5 | 52.4 | 70.3 | 53.0 | 53 |
| 38 | 63.8 | 49.9 | 64.6 | 50.5 | 65.4 | 51.1 | 66.2 | 51.7 | 67.0 | 52.3 | 67.8 | 52.9 | 68.6 | 53.6 | 69.3 | 54.2 | 52 |
| 39 | 62.9 | 51.0 | 63.7 | 51.6 | 64.5 | 52.2 | 65.3 | 52.9 | 66.1 | 53.5 | 66.8 | 54.1 | 67.6 | 54.8 | 68.4 | 55.4 | 51 |
| 40 | 62.0 | 52.1 | 62.8 | 52.7 | 63.6 | 53.4 | 64.3 | 54.0 | 65.1 | 54.6 | 65.9 | 55.3 | 66.6 | 55.9 | 67.4 | 56.6 | 50 |
| 41 | 61.1 | 53.1 | 61.9 | 53.8 | 62.6 | 54.5 | 63.4 | 55.1 | 64.2 | 55.8 | 64.9 | 56.4 | 65.7 | 57.1 | 66.4 | 57.7 | 49 |
| 42 | 60.2 | 54.2 | 60 9 | 54.9 | 61.7 | 55.5 | 62.4 | 56.2 | 63.2 | 56.9 | 63.9 | 57.5 | 64.7 | 58.2 | 65.4 | 58.9 | 48 |
| 43 | 59.2 | 55.2 | 60.0 | 55.9 | 60.7 | 56.6 | 61.4 | 57.3 | 62.2 | 58 0 | 62.9 | 58.7 | 63.6 | 59.3 | 64.4 | 60.0 | 47 |
| 44 | 58.3 | 56.3 | 59.0 | 57.0 | 59.7 | 57.7 | 60.4 | 58.4 | 61.1 | 59.0 | 61.9 | 59.7 | 62.6 | 60.4 | 63.3 | 61.1 | 46 |
| 45 | 57.3 | 57.3 | 58.0 | 58.0 | 58.7 | 58.7 | 59.4 | 59.4 | 60.1 | 60.1 | 60.8 | 60.8 | 61.5 | 61.5 | 62.2 | 62.2 | 45 |
| Crse | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse |

## Traverse Table. (x.)

| Distance. | 89 | | 90 | | 91 | | 92 | | 93 | | 94 | | 95 | | 96 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Course |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 88.9 | 04.4 | 89.9 | 04.4 | 90.9 | 04.5 | 91.9 | 04.5 | 92.9 | 04.6 | 93.9 | 04.6 | 94.9 | 04.7 | 95.9 | 04.7 | 7¾ |
| ½ | 88.6 | 08.7 | 89.6 | 08.8 | 90.6 | 08.9 | 91.6 | 09.0 | 92.6 | 09.1 | 93.5 | 09.2 | 94.5 | 09.3 | 95.5 | 09.4 | ½ |
| ¾ | 88.0 | 13.1 | 89.0 | 13.2 | 90.0 | 13.3 | 91.0 | 13.5 | 92.0 | 13.6 | 93.0 | 13.8 | 94.0 | 13.9 | 95.0 | 14.1 | ¼ |
| 1 | 87.3 | 17.4 | 88.3 | 17.6 | 89.2 | 17.8 | 90.2 | 18.0 | 91.2 | 18.1 | 92.2 | 18.3 | 93.2 | 18.5 | 94.2 | 18.7 | 7 |
| ¼ | 86.3 | 21.6 | 87.3 | 21.9 | 88.3 | 22.1 | 89.2 | 22.4 | 90.2 | 22.6 | 91.2 | 22.8 | 92.2 | 23.1 | 93.1 | 23.3 | ¾ |
| ½ | 85.2 | 25.8 | 86.1 | 26.1 | 87.1 | 26.4 | 88.0 | 26.7 | 89.0 | 27.0 | 90.0 | 27.3 | 90.9 | 27.6 | 91.9 | 27 9 | ½ |
| ¾ | 83.8 | 30.0 | 84.7 | 30.3 | 85.7 | 30.7 | 86.6 | 31.0 | 87.6 | 31.3 | 88.5 | 31.7 | 89.4 | 32.0 | 90.4 | 32.3 | ¼ |
| 2 | 82.2 | 34.1 | 83.2 | 34.4 | 84.1 | 34.8 | 85.0 | 35.2 | 85.9 | 35.6 | 86.8 | 36.0 | 87.8 | 36.4 | 88.7 | 36.7 | 6 |
| ¼ | 80.5 | 38.1 | 81.4 | 38.5 | 82.3 | 38.9 | 83.2 | 39.3 | 84.1 | 39.8 | 85.0 | 40.2 | 85.9 | 40.6 | 86.8 | 41.1 | ¾ |
| ½ | 78.5 | 41.9 | 79.4 | 42.4 | 80.3 | 42.9 | 81.1 | 43.4 | 82.0 | 43.8 | 82.9 | 44.3 | 83.8 | 44.8 | 84.7 | 45.2 | ½ |
| ¾ | 76.3 | 45.7 | 77.2 | 46.3 | 78.1 | 46.8 | 78.9 | 47.3 | 79.8 | 47.8 | 80.6 | 48.3 | 81.5 | 48.8 | 82.3 | 49.3 | ¼ |
| 3 | 74.0 | 49.4 | 74.8 | 50.0 | 75.7 | 50.6 | 76.5 | 51.1 | 77.3 | 51.7 | 78.2 | 52.2 | 79.0 | 52.8 | 79.8 | 53.3 | 5 |
| ¼ | 71.5 | 53.0 | 72.3 | 53.6 | 73.1 | 54.2 | 73.9 | 54.8 | 74.7 | 55.4 | 75.5 | 56.0 | 76.3 | 56.6 | 77.1 | 57.2 | ¾ |
| ½ | 68.8 | 56.5 | 69.6 | 57.1 | 70.3 | 57.7 | 71.1 | 58.4 | 71.9 | 59.0 | 72.7 | 59.6 | 73.4 | 60.3 | 74.2 | 60.9 | ½ |
| ¾ | 65.9 | 59.8 | 66.7 | 60.4 | 67.4 | 61.1 | 68.2 | 61.8 | 68.9 | 62.4 | 69.6 | 63.1 | 70.4 | 63.8 | 71.1 | 64.5 | ¼ |
| 4 | 62.9 | 62.9 | 63.6 | 63.6 | 64.3 | 64.3 | 65.1 | 65.1 | 65.8 | 65.8 | 66.5 | 66.5 | 67.2 | 67.2 | 67.9 | 67.9 | 4 |
| 1° | 89.0 | 01.6 | 90.0 | 01.6 | 91.0 | 01.6 | 92.0 | 01.6 | 93.0 | 01.6 | 94.0 | 01.6 | 95.0 | 01.7 | 96.0 | 01.7 | 89° |
| 2 | 88.9 | 03.1 | 89.9 | 03.1 | 90.9 | 03.2 | 91.9 | 03.2 | 92.9 | 03.2 | 93.9 | 03.3 | 94.9 | 03.3 | 95.9 | 03.4 | 88 |
| 3 | 68.9 | 04.7 | 89.9 | 04.7 | 90.9 | 04.8 | 91.9 | 04.8 | 92.9 | 04.9 | 93.9 | 04.9 | 94.9 | 05.0 | 95.9 | 05.0 | 87 |
| 4 | 88.8 | 06.2 | 89.8 | 06.3 | 90.8 | 06.3 | 91.8 | 06.4 | 92.8 | 06.5 | 93.8 | 06.6 | 94.8 | 06.6 | 95.8 | 06.7 | 86 |
| 5 | 88.7 | 07.8 | 89.7 | 07.8 | 90.7 | 07.9 | 91.6 | 08.0 | 92 6 | 08.1 | 93.6 | 08.2 | 94.6 | 08.3 | 95.6 | 08.4 | 85 |
| 6 | 88.5 | 09.3 | 89.5 | 09.4 | 90.5 | 09.5 | 91.5 | 09.6 | 92.5 | 09.7 | 93.5 | 09.8 | 94.5 | 09.9 | 95.5 | 10.0 | 84 |
| 7 | 88.3 | 10.8 | 89.3 | 11.0 | 90.3 | 11.1 | 91.3 | 11.2 | 92.3 | 11.3 | 93.3 | 11.5 | 94.3 | 11.6 | 95.3 | 11.7 | 83 |
| 8 | 88.1 | 12.4 | 89.1 | 12.5 | 90.1 | 12.7 | 91.1 | 12.8 | 92.1 | 12.9 | 93.1 | 13.1 | 94.1 | 13.2 | 95.1 | 13.4 | 82 |
| 9 | 87.9 | 13.9 | 88.9 | 14.1 | 89.9 | 14.2 | 90.9 | 14.4 | 91.9 | 14.5 | 92.8 | 14.7 | 93.8 | 14.9 | 94.8 | 15.0 | 81 |
| 10 | 87.6 | 15.5 | 88.6 | 15.6 | 89.6 | 15.8 | 90.6 | 16.0 | 91.6 | 16.1 | 92.6 | 16.3 | 93.6 | 16.5 | 94.5 | 16.7 | 80 |
| 11 | 87.4 | 17.0 | 88.3 | 17.2 | 89.3 | 17.4 | 90.3 | 17.6 | 91.3 | 17.7 | 92.3 | 17.9 | 93.3 | 18.1 | 94.2 | 18.3 | 79 |
| 12 | 87.1 | 18.5 | 88.0 | 18.7 | 89.0 | 18.9 | 90.0 | 19.1 | 91.0 | 19.3 | 91.9 | 19.5 | 92.9 | 19.8 | 93.9 | 20.0 | 78 |
| 13 | 86.7 | 20.0 | 87.7 | 20.2 | 88.7 | 20.5 | 89.6 | 20.7 | 90.6 | 20.9 | 91.6 | 21.1 | 92.6 | 21.4 | 93.5 | 21.6 | 77 |
| 14 | 86.4 | 21.5 | 87.3 | 21.8 | 88.3 | 22.0 | 89.3 | 22.3 | 90.2 | 22.5 | 91.2 | 22.7 | 92.2 | 23.0 | 93.1 | 23.2 | 76 |
| 15 | 86.0 | 23.0 | 86.9 | 23.3 | 87.9 | 23.6 | 88.9 | 23.8 | 89.8 | 24.1 | 90.8 | 24.3 | 91.8 | 24.6 | 92.7 | 24.8 | 75 |
| 16 | 85.6 | 24.5 | 86.5 | 24.8 | 87.5 | 25.1 | 88.4 | 25.4 | 89.4 | 25.6 | 90.4 | 25.9 | 91.3 | 26.2 | 92.3 | 26.5 | 74 |
| 17 | 85.1 | 26.0 | 86.1 | 26.3 | 87.0 | 26.6 | 88.0 | 26.9 | 88.9 | 27.2 | 89.9 | 27.5 | 90.8 | 27.8 | 91.8 | 28.1 | 73 |
| 18 | 84.6 | 27.5 | 85.6 | 27.8 | 86.5 | 28.1 | 87.5 | 28.4 | 88.4 | 28.7 | 89.4 | 29.0 | 90.4 | 29.4 | 91.3 | 29.7 | 72 |
| 19 | 84.2 | 29.0 | 85.1 | 29.3 | 86.0 | 29.6 | 87.0 | 30.0 | 87.9 | 30.3 | 88.9 | 30.6 | 89.8 | 30.9 | 90.8 | 31.3 | 71 |
| 20 | 83.6 | 30.4 | 84.6 | 30.8 | 85.5 | 31.1 | 86.5 | 31.5 | 87.4 | 31.8 | 88.3 | 32.1 | 89.3 | 32.5 | 90.2 | 32.8 | 70 |
| 21 | 83.1 | 31.9 | 84.0 | 32.3 | 85.0 | 32.6 | 85.9 | 33.0 | 86.8 | 33.3 | 87.8 | 33.7 | 88.7 | 34.0 | 89.6 | 34.4 | 69 |
| 22 | 82.5 | 33.3 | 83.4 | 33.7 | 84.4 | 34.1 | 85.3 | 34.5 | 86.2 | 34.8 | 87.2 | 35.2 | 88.1 | 35.6 | 89.0 | 36.0 | 68 |
| 23 | 81.9 | 34.8 | 82.8 | 35.2 | 83.8 | 35.6 | 84.7 | 35.9 | 85.6 | 36.3 | 86.5 | 36.7 | 87.4 | 37.1 | 88.4 | 37.5 | 67 |
| 24 | 81.3 | 36.2 | 82.2 | 36.6 | 83.1 | 37.0 | 84.0 | 37.4 | 85.0 | 37.8 | 85.9 | 38.2 | 86.8 | 38.6 | 87.7 | 39.0 | 66 |
| 25 | 80.7 | 37.6 | 81.6 | 38.0 | 82.5 | 38.5 | 83.4 | 38.9 | 84.3 | 39.3 | 85.2 | 39.7 | 86.1 | 40.1 | 87.0 | 40.6 | 65 |
| 26 | 80.0 | 39.0 | 80.9 | 39.5 | 81.8 | 39.9 | 82.7 | 40.3 | 83.6 | 40.8 | 84.5 | 41.2 | 85.4 | 41.6 | 86.3 | 42.1 | 64 |
| 27 | 79.3 | 40.4 | 80.2 | 40.9 | 81.1 | 41.3 | 82.0 | 41.8 | 82.9 | 42.2 | 83.8 | 42.7 | 84.6 | 43.1 | 85.5 | 43.6 | 63 |
| 28 | 78.6 | 41.8 | 79.5 | 42.3 | 80.3 | 42.7 | 81.2 | 43.2 | 82.1 | 43.7 | 83.0 | 44.1 | 83.9 | 44.6 | 84.8 | 45.1 | 62 |
| 29 | 77.8 | 43.1 | 78.7 | 43.6 | 79.6 | 44.1 | 80.5 | 44.6 | 81.3 | 45.1 | 82.2 | 45.6 | 83.1 | 46.1 | 84.0 | 46.5 | 61 |
| 30 | 77.1 | 44.5 | 77.9 | 45.0 | 78.8 | 45.5 | 79.7 | 46.0 | 80.5 | 46.5 | 81.4 | 47.0 | 82.3 | 47.5 | 83.1 | 48.0 | 60 |
| 31 | 76 3 | 45.8 | 77.1 | 46.4 | 78.0 | 46.9 | 78.9 | 47.4 | 79.7 | 47.9 | 80.6 | 48.4 | 81.4 | 48.9 | 82.3 | 49.4 | 59 |
| 32 | 75.5 | 47.2 | 76.3 | 47.7 | 77.2 | 48.2 | 78.0 | 48.8 | 78.9 | 49.3 | 79.7 | 49.8 | 80.6 | 50.3 | 81.4 | 50.9 | 58 |
| 33 | 74.6 | 48.5 | 75.5 | 49.0 | 76.3 | 49.6 | 77.2 | 50.1 | 78.0 | 50.7 | 78.8 | 51.2 | 79.7 | 51.7 | 80.5 | 52.3 | 57 |
| 34 | 73.8 | 49.8 | 74·6 | 50.3 | 75.4 | 50.9 | 76.3 | 51.4 | 77.1 | 52.0 | 77.9 | 52.6 | 78.8 | 53.1 | 79.6 | 53.7 | 56 |
| 35 | 72.9 | 51.0 | 73.7 | 51.6 | 74.5 | 52.2 | 75.4 | 52.8 | 76.2 | 53.3 | 77.0 | 53.9 | 77.8 | 54.5 | 78.6 | 55.1 | 55 |
| 36 | 72.0 | 52.3 | 72.8 | 52.9 | 73.6 | 53.5 | 74.4 | 54.1 | 75.2 | 54.7 | 76.0 | 55.3 | 76.9 | 55.8 | 77.7 | 56.4 | 54 |
| 37 | 71.1 | 53.6 | 71.9 | 54.2 | 72.7 | 54.8 | 73.5 | 55.4 | 74.3 | 56.0 | 75.1 | 56.6 | 75.9 | 57.2 | 76.7 | 57.8 | 53 |
| 38 | 70.1 | 54.8 | 70.9 | 55.4 | 71.7 | 56.0 | 72.5 | 56.6 | 73.3 | 57.3 | 74.1 | 57.9 | 74.9 | 58.5 | 75.6 | 59.1 | 52 |
| 39 | 69.2 | 56.0 | 69.9 | 56.6 | 70.7 | 57.3 | 71.5 | 57.9 | 72.3 | 58.5 | 73.1 | 59.2 | 73.8 | 59.8 | 74.6 | 60.4 | 51 |
| 40 | 68.2 | 57.2 | 68.9 | 57.9 | 69.7 | 58.5 | 70.5 | 59.1 | 71.2 | 59.8 | 72.0 | 60.4 | 72.8 | 61.1 | 73.5 | 61.7 | 50 |
| 41 | 67.2 | 58.4 | 67.9 | 59.0 | 68.7 | 59.7 | 69.4 | 60.4 | 70.2 | 61.0 | 70.9 | 61.7 | 71.7 | 62.3 | 72.5 | 63.0 | 49 |
| 42 | 66.1 | 59.6 | 66.9 | 60.2 | 67.6 | 60.9 | 68.4 | 61.6 | 69.1 | 62.2 | 69.9 | 62.9 | 70.6 | 63.6 | 71.3 | 64.2 | 48 |
| 43 | 65.1 | 60 7 | 65.8 | 61.4 | 66.6 | 62.1 | 67.3 | 62.7 | 68.0 | 63.4 | 68.7 | 64.1 | 69.5 | 64.8 | 70.2 | 65.5 | 47 |
| 44 | 64.0 | 61.8 | 64 7 | 62.5 | 65.5 | 63.2 | 66.2 | 63.9 | 66.9 | 64.6 | 67.6 | 65.3 | 68.3 | 66.0 | 69.1 | 66.7 | 46 |
| 45 | 62.9 | 62 9 | 63.6 | 63.6 | 64.3 | 64.3 | 65.1 | 65.1 | 65.8 | 65.8 | 66.5 | 66.5 | 67.2 | 67.2 | 67.9 | 67.9 | 45 |
| ° | Dep. | Diff. Lat. | Dep | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Course |

## Traverse Table. (x.)

| Distance. | 97 | | 98 | | 99 | | 100 | | 101 | | 102 | | 103 | | 104 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Crse. |
| Pts | | | | | | | | | | | | | | | | | Pts |
| ¼ | 96.9 | 04.8 | 97.9 | 04.8 | 98.9 | 04.9 | 99.9 | 04.9 | 100.9 | 05.0 | 101.9 | 05.0 | 102.9 | 05.1 | 103.9 | 05.1 | 75 |
| ½ | 96.5 | 09.5 | 97.5 | 09.6 | 98.5 | 09.7 | 99.5 | 09.8 | 100.5 | 09.9 | 101.5 | 10.0 | 102.5 | 10.1 | 103.5 | 10.2 | ½ |
| ¾ | 95.9 | 14.2 | 96.9 | 14.4 | 97.9 | 14.5 | 98.9 | 14.7 | 99.9 | 14.8 | 100.9 | 15.0 | 101.9 | 15.1 | 102.9 | 15.3 | ¼ |
| 1 | 95.1 | 18.9 | 96.1 | 19.1 | 97.1 | 19.3 | 98.1 | 19.5 | 99.1 | 19.7 | 100.0 | 19.9 | 101.0 | 20.1 | 102.0 | 20.3 | 7 |
| ¼ | 94.1 | 23.6 | 95.1 | 23.8 | 96.0 | 24.1 | 97.0 | 24.3 | 98.0 | 24.5 | 98.9 | 24.8 | 99.9 | 25.0 | 100.9 | 25.3 | ¾ |
| ½ | 92.8 | 28.2 | 93.8 | 28.4 | 94.7 | 28.7 | 95.7 | 29.0 | 96.7 | 29.3 | 97.6 | 29.6 | 98.6 | 29.9 | 99.5 | 30.2 | ½ |
| ¾ | 91.3 | 32.7 | 92.3 | 33.0 | 93.2 | 33.3 | 94.2 | 33.7 | 95.1 | 34.0 | 96.0 | 34.4 | 97.0 | 34.7 | 97.9 | 35.0 | ¼ |
| 2 | 89.6 | 37.1 | 90.5 | 37.5 | 91.5 | 37.9 | 92.4 | 38.3 | 93.3 | 38.7 | 94.2 | 39.0 | 95.2 | 39.4 | 96.1 | 39.8 | 6 |
| ¼ | 87.7 | 41.5 | 88.6 | 41.9 | 89.5 | 42.3 | 90.4 | 42.8 | 91.3 | 43.2 | 92.2 | 43.6 | 93.1 | 44.0 | 94.0 | 44.5 | ¾ |
| ½ | 85.6 | 45.7 | 86.4 | 46.2 | 87.3 | 46.7 | 88.2 | 47.1 | 89.1 | 47.6 | 90.0 | 48.1 | 90.8 | 48.5 | 91.7 | 49.0 | ½ |
| ¾ | 83.2 | 49.9 | 84.1 | 50.4 | 84.9 | 50.9 | 85.8 | 51.4 | 86.6 | 51.9 | 87.5 | 52.4 | 88.3 | 52.9 | 89.2 | 53.5 | ¼ |
| 3 | 80.6 | 53.9 | 81.5 | 54.4 | 82.3 | 55.0 | 83.1 | 55.6 | 84.0 | 56.1 | 84.8 | 56.7 | 85.6 | 57.2 | 86.5 | 57.8 | 5 |
| ¼ | 77.9 | 57.8 | 78.7 | 58.4 | 79.5 | 59.0 | 80.3 | 59.6 | 81.1 | 60.2 | 81.9 | 60.8 | 82.7 | 61.4 | 83.5 | 62.0 | ¾ |
| ½ | 75.0 | 61.5 | 75.7 | 62.2 | 76.5 | 62.8 | 77.3 | 63.4 | 78.1 | 64.1 | 78.8 | 64.7 | 79.6 | 65.3 | 80.4 | 66.0 | ½ |
| ¾ | 71.9 | 65.1 | 72.6 | 65.8 | 73.3 | 66·5 | 74.1 | 67.2 | 74.8 | 67.8 | 75.6 | 68.5 | 76.3 | 69.2 | 77.1 | 69.8 | ¼ |
| 4 | 68.6 | 68.6 | 69.3 | 69.3 | 70.0 | 70.0 | 70.7 | 70.7 | 71.4 | 71.4 | 72.1 | 72.1 | 72.8 | 72.8 | 73.5 | 73.5 | 4 |
| 1° | 97.0 | 01.7 | 98.0 | 01.7 | 99.0 | 01.7 | 100.0 | 01.7 | 101.0 | 01.8 | 102.0 | 01.8 | 103.0 | 01.8 | 104.0 | 01.8 | 89° |
| 2 | 96.9 | 03.4 | 97.9 | 03.4 | 98.9 | 03.5 | 99.9 | 03.5 | 100.9 | 03.5 | 101.9 | 03.6 | 102.9 | 03.6 | 103.9 | 03.6 | 88 |
| 3 | 96.9 | 05.1 | 97.9 | 05.1 | 98.9 | 05.2 | 99.9 | 05.2 | 100.9 | 05.3 | 101.9 | 05.3 | 102.9 | 05.4 | 103.9 | 05.4 | 87 |
| 4 | 96.8 | 06.8 | 97.8 | 06.8 | 98.8 | 06.9 | 99.8 | 07.0 | 100.8 | 07.0 | 101.8 | 07.1 | 102.7 | 07.2 | 103.7 | 07.3 | 86 |
| 5 | 96.6 | 08.5 | 97.6 | 08.5 | 98.6 | 08.6 | 99.6 | 08.7 | 100.6 | 08.8 | 101.6 | 08.9 | 102.6 | 09.0 | 103.6 | 09.1 | 85 |
| 6 | 96.5 | 10.1 | 97.5 | 10.2 | 98.5 | 10.3 | 99.5 | 10.5 | 100.4 | 10.6 | 101.4 | 10.7 | 102.4 | 10.8 | 103.4 | 10.9 | 84 |
| 7 | 96.3 | 11.8 | 97.3 | 11.9 | 98.3 | 12.1 | 99.3 | 12.2 | 100.2 | 12.3 | 101.2 | 12.4 | 102.2 | 12.6 | 103.2 | 12.7 | 83 |
| 8 | 96.1 | 13.5 | 97.0 | 13.6 | 98.0 | 13.8 | 99.0 | 13.9 | 100.0 | 14.1 | 101.0 | 14.2 | 102.0 | 14.3 | 103.0 | 14.5 | 82 |
| 9 | 95.8 | 15.2 | 96.8 | 15.3 | 97.8 | 15.5 | 98.8 | 15.6 | 99.8 | 15.8 | 100.7 | 16.0 | 101.7 | 16.1 | 102.7 | 16.3 | 81 |
| 10 | 95.5 | 16.8 | 96.5 | 17.0 | 97.5 | 17.2 | 98.5 | 17.4 | 99.5 | 17.5 | 100.5 | 17.7 | 101.4 | 17.9 | 102.4 | 18.1 | 80 |
| 11 | 95.2 | 18.5 | 96.2 | 18.7 | 97.2 | 18.9 | 98.2 | 19.1 | 99.1 | 19.3 | 100.1 | 19.5 | 101.1 | 19.7 | 102.1 | 19.8 | 79 |
| 12 | 94.9 | 20.2 | 95.9 | 20.4 | 96.8 | 20.6 | 97.8 | 20.8 | 98.8 | 21.0 | 99.8 | 21.2 | 100.7 | 21.4 | 101.7 | 21.6 | 78 |
| 13 | 94.5 | 21.8 | 95.5 | 22.0 | 96.5 | 22.3 | 97.4 | 22.5 | 98.4 | 22.7 | 99.4 | 22.9 | 100.4 | 23.2 | 101.3 | 23.4 | 77 |
| 14 | 94.1 | 23.5 | 95.1 | 23.7 | 96.1 | 24.0 | 97.0 | 24.2 | 98.0 | 24.4 | 99.0 | 24.7 | 99.9 | 24.9 | 100.9 | 25.2 | 76 |
| 15 | 93.7 | 25.1 | 94.7 | 25.4 | 95.6 | 25.6 | 96.6 | 25.9 | 97.6 | 26.1 | 98.5 | 26.4 | 99.5 | 26.7 | 100.5 | 26.9 | 75 |
| 16 | 93.2 | 26.7 | 94.2 | 27.0 | 95.2 | 27.3 | 96.1 | 27.6 | 97.1 | 27.8 | 98.0 | 28.1 | 99.0 | 28.4 | 100.0 | 28.7 | 74 |
| 17 | 92.8 | 28.4 | 93.7 | 28.7 | 94.7 | 28.9 | 95.6 | 29.2 | 96.6 | 29.5 | 97.5 | 29.8 | 98.5 | 30.1 | 99.5 | 30.4 | 73 |
| 18 | 92.3 | 30.0 | 93.2 | 30.3 | 94.2 | 30.6 | 95.1 | 30.9 | 96.1 | 31.2 | 97.0 | 31.5 | 98.0 | 31.8 | 98.9 | 32.1 | 72 |
| 19 | 91.7 | 31.6 | 92.7 | 31.9 | 93.6 | 32.2 | 94.6 | 32.6 | 95.5 | 32.9 | 96.4 | 33.2 | 97.4 | 33.5 | 98.3 | 33.9 | 71 |
| 20 | 91.2 | 33.2 | 92.1 | 33.5 | 93.0 | 33.9 | 94.0 | 34.2 | 94.9 | 34.5 | 95.8 | 34.9 | 96.8 | 35.2 | 97.7 | 35.6 | 70 |
| 21 | 90.6 | 34.8 | 91.5 | 35.1 | 92.4 | 35.5 | 93.4 | 35.8 | 94.3 | 36.2 | 95.2 | 36.6 | 96.2 | 36.9 | 97.1 | 37.3 | 69 |
| 22 | 89.9 | 36.3 | 90.9 | 36.7 | 91.8 | 37.1 | 92.7 | 37.5 | 93.6 | 37.8 | 94.6 | 38.2 | 95.5 | 38.6 | 96.4 | 39.0 | 68 |
| 23 | 89.3 | 37.9 | 90.2 | 38.3 | 91.1 | 38.7 | 92.1 | 39.1 | 93.0 | 39.5 | 93.9 | 39.9 | 94.8 | 40.2 | 95.7 | 40.6 | 67 |
| 24 | 88.6 | 39.5 | 89.5 | 39.9 | 90.4 | 40.3 | 91.4 | 40.7 | 92.3 | 41.1 | 93.2 | 41.5 | 94.1 | 41.9 | 95.0 | 42.3 | 66 |
| 25 | 87.9 | 41.0 | 88.8 | 41.4 | 89.7 | 41.8 | 90.6 | 42.3 | 91.5 | 42.7 | 92.4 | 43.1 | 93.3 | 43.5 | 94.3 | 44.0 | 65 |
| 26 | 87.2 | 42.5 | 88.1 | 43.0 | 89.0 | 43.4 | 89.9 | 43.8 | 90.8 | 44.3 | 91.7 | 44.7 | 92.6 | 45.2 | 93.5 | 45.6 | 64 |
| 27 | 86.4 | 44.0 | 87.3 | 44.5 | 88.2 | 44.9 | 89.1 | 45.4 | 90.0 | 45.9 | 90.9 | 46.3 | 91.8 | 46.8 | 92.7 | 47.2 | 63 |
| 28 | 85.6 | 45.5 | 86.5 | 46.0 | 87.4 | 46.5 | 88.3 | 46.9 | 89.2 | 47.4 | 90.1 | 47.9 | 90.9 | 48.4 | 91.8 | 48.8 | 62 |
| 29 | 84.8 | 47.0 | 85.7 | 47.5 | 86.6 | 48.0 | 87.5 | 48.5 | 88.3 | 49.0 | 89.2 | 49.5 | 90.1 | 49.9 | 91.0 | 50.4 | 61 |
| 30 | 84.0 | 48.5 | 84.9 | 49.0 | 85.7 | 49.5 | 86.6 | 50.0 | 87.5 | 50.5 | 88.3 | 51.0 | 89.2 | 51.5 | 90.1 | 52.0 | 60 |
| 31 | 83.1 | 50.0 | 84.0 | 50.5 | 84.9 | 51.0 | 85.7 | 51.5 | 86.6 | 52.0 | 87.4 | 52.5 | 88.3 | 53.0 | 89.1 | 53.6 | 59 |
| 32 | 82.3 | 51.4 | 83.1 | 51.9 | 84.0 | 52.5 | 84.8 | 53.0 | 85.7 | 53.5 | 86.5 | 54.1 | 87.3 | 54.6 | 88.2 | 55.1 | 58 |
| 33 | 81.4 | 52.8 | 82.2 | 53.4 | 83.0 | 53.9 | 83.9 | 54.5 | 84.7 | 55.0 | 85.5 | 55.6 | 86.4 | 56.1 | 87.2 | 56.6 | 57 |
| 34 | 80.4 | 54.2 | 81.2 | 54.8 | 82.1 | 55.4 | 82.9 | 55.9 | 83.7 | 56.5 | 84.6 | 57.0 | 85.4 | 57.6 | 86.2 | 58.2 | 56 |
| 35 | 79.5 | 55.6 | 80.3 | 56.2 | 81·1 | 56.8 | 81.9 | 57.4 | 82.7 | 57.9 | 83.6 | 58.5 | 84.4 | 59.1 | 85.2 | 59.7 | 55 |
| 36 | 78.5 | 57.0 | 79.3 | 57.6 | 80.1 | 58.2 | 80.9 | 58·8 | 81.7 | 59.4 | 82.5 | 60.0 | 83.3 | 60.5 | 84.1 | 61.1 | 54 |
| 37 | 77.5 | 58.4 | 78.3 | 59.0 | 79.1 | 59.6 | 79.9 | 60.2 | 80.7 | 60.8 | 81.5 | 61.4 | 82.3 | 62.0 | 83.1 | 62.6 | 53 |
| 38 | 76.4 | 59.7 | 77.2 | 60.3 | 78.0 | 61.0 | 78.8 | 61.6 | 79.6 | 62.2 | 80.4 | 62.8 | 81.2 | 63.4 | 82.0 | 64.0 | 52 |
| 39 | 75.4 | 61.0 | 76.2 | 61.7 | 76.9 | 62.3 | 77.7 | 62.9 | 78.5 | 63.6 | 79.3 | 64.2 | 80.0 | 64.8 | 80.8 | 65.4 | 51 |
| 40 | 74.3 | 62.4 | 75.1 | 63.0 | 75.8 | 63.6 | 76.6 | 64.3 | 77.4 | 64.9 | 78.1 | 65.6 | 78.9 | 66.2 | 79.7 | 66.8 | 50 |
| 41 | 73.2 | 63.6 | 74.0 | 64.3 | 74.7 | 64.9 | 75.5 | 65.6 | 76.2 | 66.3 | 77.0 | 66.9 | 77.7 | 67.6 | 78.5 | 68.2 | 49 |
| 42 | 72.1 | 64.9 | 72.8 | 65.6 | 73.6 | 66.2 | 74.3 | 66.9 | 75.1 | 67.6 | 75.8 | 68.3 | 76.5 | 68.9 | 77.3 | 69.6 | 48 |
| 43 | 70.9 | 66.2 | 71.7 | 66.8 | 72.4 | 67.5 | 73.1 | 68.2 | 73.9 | 68.9 | 74.6 | 69.6 | 75.3 | 70.2 | 76.1 | 70.9 | 47 |
| 44 | 69 8 | 67.4 | 70.5 | 68.1 | 71.2 | 68.8 | 71.9 | 69.5 | 72.7 | 70.2 | 73.4 | 70.9 | 74.1 | 71.5 | 74.8 | 72.2 | 46 |
| 45 | 68.6 | 68.6 | 69.3 | 69.3 | 70.0 | 70.0 | 70.7 | 70.7 | 71.4 | 71.4 | 72.1 | 72.1 | 72.8 | 72.8 | 73.5 | 73.5 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat | Crse. |

## Traverse Table. (x.)

| Distance. | 105 | | 106 | | 107 | | 108 | | 109 | | 110 | | 111 | | 112 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cnse | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Dist. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 104.9 | 05·2 | 105.9 | 05.2 | 106.9 | 05.3 | 107.9 | 05.3 | 108.9 | 05.4 | 109.9 | 05.4 | 110.9 | 05.5 | 111.9 | 05.5 | 7¼ |
| ½ | 104.5 | 10.3 | 105.5 | 10. | 106.5 | 10.5 | 107.5 | 10.6 | 108.5 | 10.7 | 109.5 | 10.8 | 110.5 | 10.9 | 111.5 | 11.0 | ½ |
| ¾ | 103.9 | 15.4 | 104.8 | 15.5 | 105.8 | 15.7 | 106.8 | 15.8 | 107.8 | 16.0 | 108.8 | 16.1 | 109.8 | 16.3 | 110.8 | 16.4 | ¾ |
| 1 | 103.0 | 20.5 | 104.0 | 20.7 | 104.9 | 20.9 | 105.9 | 21.1 | 106.9 | 21.3 | 107.9 | 21.5 | 108.9 | 21.7 | 109.8 | 21.9 | 7 |
| ¼ | 101.9 | 25.5 | 102.8 | 25.8 | 103.8 | 26.0 | 104.8 | 26.2 | 105.7 | 26.5 | 106.7 | 26.7 | 107.7 | 27.0 | 108.6 | 27.2 | ¼ |
| ½ | 100.5 | 30.5 | 101.4 | 30.8 | 102.4 | 31.1 | 103.4 | 31.4 | 104.3 | 31.6 | 105.3 | 31.9 | 106.2 | 32.2 | 107.2 | 32.5 | ½ |
| ¾ | 98.9 | 35.4 | 99.8 | 35.7 | 100.7 | 36.0 | 101.7 | 36.4 | 102.6 | 36.7 | 103.6 | 37.1 | 104.5 | 37.4 | 105.4 | 37.7 | ¾ |
| 2 | 97.0 | 40.2 | 97.9 | 40.6 | 98.9 | 41.0 | 99.8 | 41.3 | 100.7 | 41.7 | 101.6 | 42.1 | 102.6 | 42.5 | 103.5 | 42.9 | 6 |
| ¼ | 94.9 | 44.9 | 95.8 | 45.3 | 96.7 | 45.8 | 97.6 | 46.2 | 98.5 | 46.6 | 99.4 | 47.0 | 100.3 | 47.5 | 101.2 | 47.9 | ¼ |
| ½ | 92.6 | 49.5 | 93.5 | 50.0 | 94.4 | 50.4 | 95.3 | 50.9 | 96.1 | 51.4 | 97.0 | 51.8 | 97.9 | 52.3 | 98.8 | 52.8 | ½ |
| ¾ | 90.1 | 54.0 | 90.9 | 54.5 | 91.8 | 55.0 | 92.6 | 55.5 | 93.5 | 56.0 | 94.3 | 56.5 | 95.2 | 57.1 | 96.1 | 57.6 | ¾ |
| 3 | 87.3 | 58.3 | 88.1 | 58.9 | 89.0 | 59.4 | 89.8 | 60.0 | 90.6 | 60.6 | 91.5 | 61.1 | 92.3 | 61.7 | 93.1 | 62.2 | 5 |
| ¼ | 84.3 | 62.6 | 85.1 | 63.1 | 85.9 | 63.7 | 86.7 | 64.3 | 87.5 | 64.9 | 88.4 | 65.5 | 89.2 | 66.1 | 90.0 | 66.7 | ¼ |
| ½ | 81.2 | 66.6 | 81.9 | 67.2 | 82.7 | 67.9 | 83.5 | 68.5 | 84.3 | 69.1 | 85.0 | 69.8 | 85.8 | 70.4 | 86.6 | 71.0 | ½ |
| ¾ | 77.8 | 70.5 | 78.5 | 71.2 | 79.3 | 71.8 | 80.0 | 72.5 | 80.8 | 73.2 | 81.5 | 73.9 | 82.2 | 74.5 | 83.0 | 75.2 | ¾ |
| 4 | 74.2 | 74.2 | 75.0 | 75.0 | 75.7 | 75.7 | 76.4 | 76.4 | 77.1 | 77.1 | 77.8 | 77.8 | 78.5 | 78.5 | 79.2 | 79.2 | 4 |
| 1° | 105.0 | 01.8 | 106.0 | 01.8 | 107.0 | 01.9 | 108.0 | 01.9 | 109.0 | 01.9 | 110 0 | 01.9 | 111.0 | 01.9 | 112.0 | 02.0 | 89° |
| 2 | 104.9 | 03.7 | 105.9 | 03.7 | 106.9 | 03.7 | 107.9 | 03.8 | 108.9 | 03.8 | 109.9 | 03.8 | 110.9 | 03.9 | 111.9 | 03.9 | 88 |
| 3 | 104.9 | 05.5 | 105.9 | 05.5 | 106.9 | 05.6 | 107.9 | 05.7 | 108.9 | 05.7 | 109.8 | 05.8 | 110.8 | 05.8 | 111.8 | 05.9 | 87 |
| 4 | 104.7 | 07.3 | 105.7 | 07.4 | 106.7 | 07.5 | 107.7 | 07.5 | 108.7 | 07.6 | 109.7 | 07.7 | 110.7 | 07.7 | 111.7 | 07.8 | 86 |
| 5 | 104.6 | 09.2 | 105.6 | 09.2 | 106.6 | 09.3 | 107.6 | 09.4 | 108.6 | 09.5 | 109.6 | 09.6 | 110.6 | 09.7 | 111.6 | 09.8 | 85 |
| 6 | 104.4 | 11.0 | 105.4 | 11.1 | 106.4 | 11.2 | 107.4 | 11.3 | 108.4 | 11.4 | 109.4 | 11.5 | 110.4 | 11.6 | 111.4 | 11.7 | 84 |
| 7 | 104.2 | 12.8 | 105.2 | 12.9 | 106.2 | 13.0 | 107.2 | 13.2 | 108.2 | 13.3 | 109.2 | 13.4 | 110.2 | 13.5 | 111.2 | 13.6 | 83 |
| 8 | 104.0 | 14.6 | 105.0 | 14.8 | 106.0 | 14.9 | 106.9 | 15.0 | 107.9 | 15.2 | 108.9 | 15.3 | 109.9 | 15.4 | 110.9 | 15.6 | 82 |
| 9 | 103.7 | 16.4 | 104.7 | 16.6 | 105.7 | 16.7 | 106.7 | 16.9 | 107.7 | 17.1 | 108.6 | 17.2 | 109.6 | 17.4 | 110.6 | 17.5 | 81 |
| 10 | 103.4 | 18.2 | 104.4 | 18.4 | 105.4 | 18.6 | 106.4 | 18.8 | 107.3 | 18.9 | 108.3 | 19.1 | 109.3 | 19.3 | 110.3 | 19.4 | 80 |
| 11 | 103.1 | 20.0 | 104.1 | 20.2 | 105.0 | 20.4 | 106.0 | 20.6 | 107.0 | 20.8 | 108.0 | 21.0 | 109.0 | 21.2 | 109.9 | 21.4 | 79 |
| 12 | 102.7 | 21.8 | 103.7 | 22.0 | 104.7 | 22.2 | 105.6 | 22.5 | 106.6 | 22.7 | 107.6 | 22.9 | 108.6 | 23.1 | 109.6 | 23.3 | 78 |
| 13 | 102.3 | 23.6 | 103.3 | 23.8 | 104.3 | 24.1 | 105.2 | 24.3 | 106.2 | 24.5 | 107.2 | 24.7 | 108.2 | 25.0 | 109.1 | 25.2 | 77 |
| 14 | 101.9 | 25.4 | 102.9 | 25.6 | 103.8 | 25.9 | 104.8 | 26.1 | 105.8 | 26.4 | 106.7 | 26.6 | 107.7 | 26.9 | 108.7 | 27.1 | 76 |
| 15 | 101.4 | 27.2 | 102.4 | 27.4 | 103.4 | 27.7 | 104.3 | 28.0 | 105.3 | 28.2 | 106.3 | 28.5 | 107.2 | 28.7 | 108.2 | 29.0 | 75 |
| 16 | 100.9 | 28.9 | 101.9 | 29.2 | 102.9 | 29.5 | 103.8 | 29.8 | 104.8 | 30.0 | 105.7 | 30.3 | 106.7 | 30.6 | 107.7 | 30.9 | 74 |
| 17 | 100.4 | 30.7 | 101.4 | 31.0 | 102.3 | 31.3 | 103.3 | 31.6 | 104.2 | 31.9 | 105.2 | 32.2 | 106.1 | 32.5 | 107.1 | 32.7 | 73 |
| 18 | 99.9 | 32.4 | 100.8 | 32.8 | 101.8 | 33.1 | 102.7 | 33.4 | 103.7 | 33.7 | 104.6 | 34.0 | 105.6 | 34.3 | 106.5 | 34.6 | 72 |
| 19 | 99.3 | 34.2 | 100.2 | 34.5 | 101.2 | 34.8 | 102.1 | 35.2 | 103.1 | 35.5 | 104.0 | 35.8 | 105.0 | 36.1 | 105.9 | 36.5 | 71 |
| 20 | 98.7 | 35.9 | 99.6 | 36.3 | 100.5 | 36.6 | 101.5 | 36.9 | 102.4 | 37.3 | 103.4 | 37.6 | 104.3 | 38.0 | 105.2 | 38.3 | 70 |
| 21 | 98.0 | 37.6 | 99 0 | 38.0 | 99.9 | 38.3 | 100.8 | 38.7 | 101.8 | 39.1 | 102.7 | 39.4 | 103.6 | 39.8 | 104.6 | 40.1 | 69 |
| 22 | 97.4 | 39.3 | 98.3 | 39.7 | 99.2 | 40.1 | 100.1 | 40.5 | 101.1 | 40.8 | 102.0 | 41.2 | 102.9 | 41.6 | 103.8 | 42.0 | 68 |
| 23 | 96.7 | 41.0 | 97.6 | 41.4 | 98.5 | 41.8 | 99.4 | 42.2 | 100.3 | 42.6 | 101.3 | 43.0 | 102.2 | 43.4 | 103.1 | 43.8 | 67 |
| 24 | 95.9 | 42.7 | 96.8 | 43.1 | 97.7 | 43.5 | 98.7 | 43.9 | 99.6 | 44.3 | 100.5 | 44.7 | 101.4 | 45.1 | 102.3 | 45.6 | 66 |
| 25 | 95.2 | 44.4 | 96.1 | 44.8 | 97.0 | 45.2 | 97.9 | 45.6 | 98.8 | 46.1 | 99.7 | 46.5 | 100.6 | 46.9 | 101.5 | 47.3 | 65 |
| 26 | 94.4 | 46.0 | 95.3 | 46.5 | 96.2 | 46.9 | 97.1 | 47.3 | 98.0 | 47.8 | 98.9 | 48.2 | 99.8 | 48.7 | 100.7 | 49.1 | 64 |
| 27 | 93.6 | 47.7 | 94.4 | 48.1 | 95.3 | 48.6 | 96.2 | 49.0 | 97.1 | 49.5 | 98.0 | 49.9 | 98.9 | 50.4 | 99.8 | 50.8 | 63 |
| 28 | 92.7 | 49.3 | 93.6 | 49.8 | 94.5 | 50.2 | 95.4 | 50.7 | 96.2 | 51.2 | 97.1 | 51.6 | 98.0 | 52.1 | 98.9 | 52.6 | 62 |
| 29 | 91.8 | 50 9 | 92.7 | 51.4 | 93.6 | 51.9 | 94.5 | 52.4 | 95.3 | 52.8 | 96.2 | 53.3 | 97.1 | 53.8 | 98.0 | 54.3 | 61 |
| 30 | 90.9 | 52.5 | 91.8 | 53.0 | 92.7 | 53.5 | 93.5 | 54.0 | 94.4 | 54.5 | 95.3 | 55.0 | 96.1 | 55.5 | 97.0 | 56.0 | 60 |
| 31 | 90.0 | 54.1 | 90 9 | 54.6 | 91.7 | 55.1 | 92.6 | 55.6 | 93.4 | 56.1 | 94.3 | 56.7 | 95.1 | 57.2 | 96.0 | 57.7 | 59 |
| 32 | 89.0 | 55.6 | 89.9 | 56.2 | 90.7 | 56.7 | 91.6 | 57.2 | 92.4 | 57.8 | 93.3 | 58.3 | 94.1 | 58.8 | 95.0 | 59.4 | 58 |
| 33 | 88.1 | 57.2 | 88 9 | 57.7 | 89.7 | 58.3 | 90.6 | 58.8 | 91.4 | 59.4 | 92.3 | 59.9 | 93.1 | 60.5 | 93.9 | 61.0 | 57 |
| 34 | 87.0 | 58.7 | 87.9 | 59.3 | 88.7 | 59.8 | 89.5 | 60.4 | 90.4 | 61.0 | 91.2 | 61.5 | 92.0 | 62.1 | 92.9 | 62.6 | 56 |
| 35 | 86.0 | 60.2 | 86.8 | 60.8 | 87.6 | 61.4 | 88.5 | 61.9 | 89.3 | 62.5 | 90.1 | 63.1 | 90.9 | 63.7 | 91.7 | 64.2 | 55 |
| 36 | 84.9 | 61.7 | 85.8 | 62.3 | 86.6 | 62.9 | 87.4 | 63.5 | 88.2 | 64.1 | 89.0 | 64.7 | 89.8 | 65.2 | 90.6 | 65.8 | 54 |
| 37 | 83.9 | 63.2 | 84 7 | 63.8 | 85 5 | 64.4 | 86.3 | 65.0 | 87.1 | 65.6 | 87.8 | 66.2 | 88.6 | 66.8 | 89.4 | 67.4 | 53 |
| 38 | 82.7 | 64.6 | 83.5 | 65.3 | 84.3 | 65.9 | 85.1 | 66.5 | 85.9 | 67.1 | 86.7 | 67.7 | 87.5 | 68.3 | 88.3 | 69.0 | 52 |
| 39 | 81.6 | 66.1 | 82.4 | 66.7 | 83.2 | 67.3 | 83.9 | 68.0 | 84.7 | 68.6 | 85.5 | 69.2 | 86.3 | 69.9 | 87.0 | 70.5 | 51 |
| 40 | 80.4 | 67.5 | 81.2 | 68.1 | 82.0 | 68.8 | 82.7 | 69.4 | 83.5 | 70.1 | 84.3 | 70.7 | 85.0 | 71.3 | 85.8 | 72.0 | 50 |
| 41 | 79.2 | 68 9 | 80 0 | 69 5 | 80 8 | 70.2 | 81.5 | 70.9 | 82.3 | 71.5 | 83.0 | 72.2 | 83.8 | 72 8 | 84.5 | 73.5 | 49 |
| 42 | 78 0 | 70 3 | 78.8 | 70.9 | 79.5 | 71.6 | 80 3 | 72.3 | 81.0 | 72.9 | 81.7 | 73.6 | 82.5 | 74.3 | 83.2 | 74.9 | 48 |
| 43 | 76 8 | 71.6 | 77 5 | 72.3 | 78.3 | 73.0 | 79 0 | 73.7 | 79.7 | 74.3 | 80.4 | 75.0 | 81.2 | 75.7 | 81.9 | 76.4 | 47 |
| 44 | 75.5 | 72.9 | 76.3 | 73.6 | 77.0 | 74.3 | 77.7 | 75.0 | 78.4 | 75.7 | 79.1 | 76.4 | 79.8 | 77.1 | 80.6 | 77.8 | 46 |
| 45 | 74.2 | 74.2 | 75 0 | 75 0 | 75.7 | 75.7 | 76.4 | 76.4 | 77 1 | 77.1 | 77.8 | 77.8 | 78.5 | 78.5 | 79.2 | 79 2 | 45 |
| Cnse. | Dep. | Diff. Lat. | Dep. | Diff. Lat | Dep. | Diff. Lat. | Dep. | Diff. Lat | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat | Dep. | Diff. Lat | Cnse. |

## Traverse Table. (x.)

| Distance. | 113 | | 114 | | 115 | | 116 | | 117 | | 118 | | 119 | | 120 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Course. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 112.9 | 05.5 | 113.9 | 05.6 | 114.9 | 05.6 | 115.9 | 05.7 | 116.9 | 05.7 | 117.9 | 05.8 | 118.9 | 05.8 | 119.9 | 05.9 | 7¾ |
| ½ | 112.5 | 11.1 | 113.5 | 11.2 | 114.4 | 11.3 | 115.4 | 11.4 | 116.4 | 11·5 | 117.4 | 11.6 | 118.4 | 11.7 | 119.4 | 11.8 | ½ |
| ¾ | 111.8 | 16.6 | 112.8 | 16.7 | 113.7 | 16.9 | 114.7 | 17.0 | 115.7 | 17.2 | 116.7 | 17.3 | 117.7 | 17.5 | 118.7 | 17.6 | ¼ |
| 1 | 110.8 | 22.0 | 111.8 | 22.2 | 112.8 | 22.4 | 113.8 | 22.6 | 114.7 | 22.8 | 115.7 | 23.0 | 116.7 | 23.2 | 117.7 | 23.4 | 7 |
| ¼ | 109.6 | 27.5 | 110.6 | 27.7 | 111.6 | 27.9 | 112.5 | 28.2 | 113.5 | 28.4 | 114.5 | 28.7 | 115.4 | 28.9 | 116.4 | 29.2 | ¼ |
| ½ | 108.1 | 32.8 | 109.1 | 33.1 | 110.1 | 33.4 | 111.0 | 33.7 | 112.0 | 34.0 | 112.9 | 34.2 | 113.9 | 34.5 | 114.8 | 34.8 | ½ |
| ¾ | 106.4 | 38.1 | 107.3 | 38.4 | 108.3 | 38.7 | 109.2 | 39.1 | 110.2 | 39.4 | 111.1 | 39.7 | 112.0 | 40.1 | 113.0 | 40.4 | ¼ |
| 2 | 104.4 | 43.2 | 105.3 | 43.6 | 106.3 | 44.0 | 107.2 | 44.4 | 108.1 | 44.8 | 109.0 | 45.2 | 109.9 | 45.5 | 110.9 | 45.9 | 6 |
| ¼ | 102.1 | 48.3 | 103.1 | 48.7 | 104.0 | 49.2 | 104 9 | 49.6 | 105.8 | 50.0 | 106.7 | 50.5 | 107.6 | 50.9 | 108.5 | 51.3 | ¾ |
| ½ | 99.7 | 53.3 | 100.5 | 53.7 | 101.4 | 54.2 | 102.3 | 54.7 | 103.2 | 55.1 | 104.1 | 55.6 | 105.0 | 56.1 | 105.8 | 56.6 | ½ |
| ¾ | 96.9 | 58.1 | 97.8 | 58.6 | 98.6 | 59.1 | 99.5 | 59.6 | 100.4 | 60·1 | 101.2 | 60.7 | 102.1 | 61.2 | 102.9 | 61.7 | ¼ |
| 3 | 94.0 | 62.8 | 94.8 | 63.3 | 95.6 | 63.9 | 96.4 | 64.4 | 97.3 | 65.0 | 98.1 | 65.6 | 98.9 | 66.1 | 99.8 | 66.7 | 5 |
| ¼ | 90.8 | 67.3 | 91.6 | 67.9 | 92.4 | 68.5 | 93.2 | 69.1 | 94.0 | 69.7 | 94.8 | 70.3 | 95.6 | 70.9 | 96.4 | 71.5 | ¾ |
| ½ | 87.3 | 71.7 | 88.1 | 72.8 | 88.9 | 73.0 | 89.7 | 73.6 | 90.4 | 74.2 | 91.2 | 74.9 | 92.0 | 75.5 | 92.8 | 76.1 | ½ |
| ¾ | 83.7 | 75.9 | 84.5 | 76.5 | 85.2 | 77.2 | 85.9 | 77.9 | 86.7 | 78.6 | 87.4 | 79.2 | 88.2 | 79.9 | 88.9 | 80.6 | ¼ |
| 4 | 79.9 | 79.9 | 80.6 | 80.6 | 81.3 | 81.3 | 82.0 | 82.0 | 82.7 | 82.7 | 83.4 | 83.4 | 84.1 | 84.1 | 84.8 | 84.8 | 4 |
| 1° | 113.0 | 02.0 | 114.0 | 02.0 | 115.0 | 02.0 | 116.0 | 02.0 | 117.0 | 02.0 | 118.0 | 02.1 | 119.0 | 02.1 | 120.0 | 02.1 | 89° |
| 2 | 112.9 | 03.9 | 113.9 | 04.0 | 114.9 | 04.0 | 115.9 | 04.0 | 116.9 | 04.1 | 117.9 | 04.1 | 118.9 | 04.2 | 119.9 | 04.2 | 88 |
| 3 | 112.8 | 05.9 | 113.8 | 06.0 | 114.8 | 06.0 | 115.8 | 06.1 | 116.8 | 06.1 | 117.8 | 06.2 | 118.8 | 06.2 | 119.8 | 06.3 | 87 |
| 4 | 112.7 | 07.9 | 113.7 | 08.0 | 114.7 | 08.0 | 115.7 | 08.1 | 116.7 | 08.2 | 117.7 | 08.2 | 118.7 | 08.3 | 119.7 | 08.4 | 86 |
| 5 | 112.6 | 09.8 | 113.6 | 09.9 | 114.6 | 10.0 | 115.6 | 10.1 | 116.6 | 10.2 | 117.6 | 10.3 | 118.5 | 10.4 | 119.5 | 10.5 | 85 |
| 6 | 112.4 | 11.8 | 113.4 | 11.9 | 114.4 | 12.0 | 115.4 | 12.1 | 116.4 | 12.2 | 117.4 | 12.3 | 118.3 | 12.4 | 119.3 | 12.5 | 84 |
| 7 | 112.2 | 13.8 | 113.2 | 13.9 | 114.1 | 14.0 | 115.1 | 14.1 | 116·1 | 14.3 | 117.1 | 14.4 | 118.1 | 14.5 | 119.1 | 14.6 | 83 |
| 8 | 111.9 | 15.7 | 112.9 | 15.9 | 113.9 | 16.0 | 114.9 | 16.1 | 115.9 | 16.3 | 116.9 | 16.4 | 117.8 | 16.6 | 118.8 | 16.7 | 82 |
| 9 | 111.6 | 17.7 | 112.6 | 17.8 | 113.6 | 18.0 | 114.6 | 18.1 | 115.6 | 18.3 | 116.5 | 18.5 | 117.5 | 18.6 | 118.5 | 18.8 | 81 |
| 10 | 111.3 | 19.6 | 112.3 | 19.8 | 113.3 | 20.0 | 114.2 | 20.1 | 115.2 | 20.3 | 116.2 | 20.5 | 117.2 | 20.7 | 118.2 | 20.8 | 80 |
| 11 | 110.9 | 21.6 | 111.9 | 21.8 | 112.9 | 21.9 | 113.9 | 22.1 | 114.9 | 22.3 | 115.8 | 22.5 | 116.8 | 22.7 | 117.8 | 22.9 | 79 |
| 12 | 110.5 | 23.5 | 111.5 | 23.7 | 112.5 | 23.9 | 113.5 | 24.1 | 114.4 | 24.3 | 115.4 | 24.5 | 116.4 | 24.7 | 117.4 | 24.9 | 78 |
| 13 | 110.1 | 25.4 | 111.1 | 25.6 | 112.1 | 25.9 | 113.0 | 26.1 | 114.0 | 26.3 | 115.0 | 26.5 | 116.0 | 26.8 | 116.9 | 27.0 | 77 |
| 14 | 109.6 | 27.3 | 110.6 | 27.6 | 111.6 | 27.8 | 112.6 | 28.1 | 113.5 | 28.3 | 114.5 | 28.6 | 115.5 | 28.8 | 116.4 | 29.0 | 76 |
| 15 | 109.1 | 29.2 | 110.1 | 29.5 | 111.1 | 29.8 | 112.0 | 30.0 | 113.0 | 30.3 | 114.0 | 30.5 | 114.9 | 30.8 | 115.9 | 31.1 | 75 |
| 16 | 108.6 | 31.1 | 109.6 | 31.4 | 110.5 | 31.7 | 111.5 | 32.0 | 112.5 | 32.2 | 113.4 | 32.5 | 114.4 | 32.8 | 115.4 | 33.1 | 74 |
| 17 | 108.1 | 33.0 | 109.0 | 33.3 | 110.0 | 33.6 | 110.9 | 33.9 | 111.9 | 34.2 | 112.8 | 34.5 | 113.8 | 34.8 | 114.8 | 35.1 | 73 |
| 18 | 107.5 | 34.9 | 108.4 | 35.2 | 109.4 | 35.5 | 110.3 | 35.8 | 111.3 | 36.2 | 112.2 | 36.5 | 113.2 | 36.8 | 114.1 | 37.1 | 72 |
| 19 | 106.8 | 36.8 | 107.8 | 37.1 | 108.7 | 37.4 | 109.7 | 37.8 | 110.6 | 38.1 | 111.6 | 38.4 | 112.5 | 38.7 | 113.5 | 39.1 | 71 |
| 20 | 106.2 | 38.6 | 107.1 | 39.0 | 108.1 | 39.3 | 109.0 | 39.7 | 109.9 | 40.0 | 110.9 | 40.4 | 111.8 | 40.7 | 112.8 | 41.0 | 70 |
| 21 | 105.5 | 40.5 | 106.4 | 40.9 | 107.4 | 41.2 | 108.3 | 41.6 | 109.2 | 41.9 | 110.2 | 42.3 | 111.1 | 42.6 | 112.0 | 43.0 | 69 |
| 22 | 104.8 | 42.3 | 105.7 | 42.7 | 106.6 | 43.1 | 107.6 | 43.5 | 108.5 | 43.8 | 109.4 | 44.2 | 110.3 | 44.6 | 111.3 | 45.0 | 68 |
| 23 | 104.0 | 44.2 | 104.9 | 44.5 | 105.9 | 44.9 | 106.8 | 45.3 | 107.7 | 45.7 | 108.6 | 46.1 | 109.5 | 46.5 | 110.5 | 46.9 | 67 |
| 24 | 103.2 | 46.0 | 104.1 | 46.4 | 105.1 | 46.8 | 106.0 | 47.2 | 106.9 | 47.6 | 107.8 | 48.0 | 108.7 | 48.4 | 109.6 | 48.8 | 66 |
| 25 | 102.4 | 47.8 | 103.3 | 48.2 | 104.2 | 48.6 | 105.1 | 49.0 | 106.0 | 49.4 | 106.9 | 49.9 | 107.9 | 50.3 | 108.8 | 50.7 | 65 |
| 26 | 101.6 | 49.5 | 102.5 | 50.0 | 103.4 | 50.4 | 104.3 | 50.9 | 105.2 | 51.3 | 106.1 | 51.7 | 107.0 | 52.2 | 107.9 | 52.6 | 64 |
| 27 | 100.7 | 51.3 | 101.6 | 51.8 | 102.5 | 52.2 | 103.4 | 52.7 | 104.2 | 53.1 | 105.1 | 53.6 | 106.0 | 54.0 | 106.9 | 54.5 | 63 |
| 28 | 99.8 | 53.1 | 100.7 | 53.5 | 101.5 | 54.0 | 102.4 | 54.5 | 103.3 | 54.9 | 104.2 | 55.4 | 105.1 | 55.9 | 106.0 | 56.3 | 62 |
| 29 | 98.8 | 54.8 | 99 7 | 55.3 | 100.6 | 55.8 | 101.5 | 56.2 | 102.3 | 56.7 | 103.2 | 57.2 | 104.1 | 57.7 | 105.0 | 58.2 | 61 |
| 30 | 97.9 | 56.5 | 98.7 | 57.0 | 99.6 | 57.5 | 100.5 | 58.0 | 101.3 | 58.5 | 102.2 | 59.0 | 103.1 | 59.5 | 103.9 | 60.0 | 60 |
| 31 | 96.9 | 58.2 | 97.7 | 58.7 | 98.6 | 59.2 | 99.4 | 59.7 | 100.3 | 60.3 | 101.1 | 60.8 | 102.0 | 61.3 | 102.9 | 61.8 | 59 |
| 32 | 95.8 | 59.9 | 96.7 | 60.4 | 97.5 | 60.9 | 98.4 | 61.5 | 99.2 | 62.0 | 100.1 | 62.5 | 100.9 | 63.1 | 101.8 | 63.6 | 58 |
| 33 | 94.8 | 61.5 | 95.6 | 62.1 | 96.4 | 62.6 | 97.3 | 63.2 | 98.1 | 63.7 | 99.0 | 64.3 | 99.8 | 64.8 | 100.6 | 65.4 | 57 |
| 34 | 93.7 | 63.2 | 94.5 | 63.7 | 95.3 | 64.3 | 96.2 | 64.9 | 97.0 | 65.4 | 97.8 | 66.0 | 98 7 | 66.5 | 99.5 | 67.1 | 56 |
| 35 | 92.6 | 64.8 | 93.4 | 65.4 | 94.2 | 66.0 | 95.0 | 66.5 | 95.8 | 67.1 | 96.7 | 67.7 | 97.5 | 68.3 | 98.3 | 68.8 | 55 |
| 36 | 91.4 | 66.4 | 92.2 | 67.0 | 93.0 | 67.6 | 93.8 | 68.2 | 94.7 | 68.8 | 95.5 | 69.4 | 96.3 | 69.9 | 97.1 | 70.5 | 54 |
| 37 | 90.2 | 68.0 | 91.0 | 68.6 | 91.8 | 69.2 | 92.6 | 69.8 | 93.4 | 70.4 | 94.2 | 71.0 | 95.0 | 71.6 | 95.8 | 72.2 | 53 |
| 38 | 89.0 | 69.6 | 89.8 | 70.2 | 90.6 | 70.8 | 91.4 | 71.4 | 92.2 | 72.0 | 93.0 | 72.6 | 93.8 | 73.3 | 94.6 | 73.9 | 52 |
| 39 | 87.8 | 71.1 | 88.6 | 71.7 | 89.4 | 72.4 | 90.1 | 73.0 | 90.9 | 73.6 | 91.7 | 74.3 | 92.5 | 74.9 | 93.3 | 75.5 | 51 |
| 40 | 86.6 | 72.6 | 87 3 | 73.3 | 88.1 | 73.9 | 88.9 | 74.6 | 89.6 | 75.2 | 90.4 | 75.8 | 91.2 | 76.5 | 91.9 | 77.1 | 50 |
| 41 | 85·3 | 74.1 | 86.0 | 74.8 | 86.8 | 75.4 | 87.5 | 76.1 | 88.3 | 76.8 | 89.1 | 77.4 | 89.8 | 78.1 | 90.6 | 78.7 | 49 |
| 42 | 84.0 | 75.6 | 84.7 | 76.3 | 85.5 | 77.0 | 86.2 | 77.6 | 86.9 | 78.3 | 87.7 | 79.0 | 88.4 | 79.6 | 89.2 | 80.3 | 48 |
| 43 | 82.6 | 77.1 | 83.4 | 77.7 | 84.1 | 78.4 | 84.8 | 79.1 | 85.6 | 79.8 | 86.3 | 80.5 | 87.0 | 81.2 | 87.8 | 81.8 | 47 |
| 44 | 81.3 | 78.5 | 82.0 | 79.2 | 82.7 | 79.9 | 83.4 | 80.6 | 84.2 | 81.3 | 84.9 | 82 0 | 85.6 | 82.7 | 86.3 | 83.4 | 46 |
| 45 | 79 9 | 79.9 | 80.6 | 80 6 | 81.3 | 81.3 | 82 0 | 82.0 | 82.7 | 82.7 | 83.4 | 83.4 | 84.1 | 84.1 | 84.9 | 84.9 | 45 |
| Cour. | Dep. | Diff. Lat. | Dep | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Cour. |

## Traverse Table. (x.)

| Distance. | 121 | | 122 | | 123 | | 124 | | 125 | | 126 | | 127 | | 128 | | Dist. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | |
| ¼ | 120.9 | 05.9 | 121.9 | 06.0 | 122.9 | 06.0 | 123.9 | 06.1 | 124.9 | 06.1 | 125.8 | 06.2 | 126.8 | 06.2 | 127.8 | 06.3 | ¼ |
| ½ | 120.4 | 11.9 | 121.4 | 12.0 | 122.4 | 12.1 | 123.4 | 12.2 | 124.4 | 12.3 | 125.4 | 12.3 | 126.4 | 12.4 | 127.4 | 12.5 | ½ |
| ¾ | 119.7 | 17.7 | 120.7 | 17.9 | 121.7 | 18.0 | 122.7 | 18.2 | 123.6 | 18.3 | 124.6 | 18.5 | 125.6 | 18.6 | 126.6 | 18.8 | ¾ |
| 1 | 118.7 | 23 6 | 119.7 | 23.8 | 120.6 | 24.0 | 121.6 | 24.2 | 122.6 | 24.4 | 123.6 | 24.6 | 124.6 | 24.8 | 125.5 | 25.0 | 1 |
| ¼ | 117.4 | 29.4 | 118.3 | 29.6 | 119.3 | 29.9 | 120.3 | 30.1 | 121.3 | 30.4 | 122.2 | 30.6 | 123.2 | 30.9 | 124.2 | 31.1 | ¼ |
| ½ | 115.8 | 35.1 | 116.8 | 35.4 | 117.7 | 35.7 | 118.7 | 36.0 | 119.6 | 36.3 | 120.6 | 36.6 | 121.5 | 36.9 | 122.5 | 37.2 | ½ |
| ¾ | 113.9 | 40.8 | 114.9 | 41.1 | 115.8 | 41.4 | 116.7 | 41.8 | 117.7 | 42.1 | 118.6 | 42.4 | 119.6 | 42.8 | 120.5 | 43.1 | ¾ |
| 2 | 111.8 | 46.3 | 112.7 | 46.7 | 113.6 | 47.1 | 114.6 | 47.5 | 115.5 | 47.8 | 116.4 | 48.2 | 117.3 | 48.6 | 118.3 | 49.0 | 6 |
| ¼ | 109.4 | 51.7 | 110.3 | 52.2 | 111.2 | 52.6 | 112.1 | 53.0 | 113.0 | 53.5 | 113.9 | 53.9 | 114.8 | 54.3 | 115.7 | 54.7 | ¼ |
| ½ | 106.7 | 57.0 | 107.6 | 57.5 | 108.5 | 58.0 | 109.4 | 58.4 | 110.2 | 58.9 | 111.1 | 59.4 | 112.0 | 59.9 | 112.9 | 60.3 | ½ |
| ¾ | 103.8 | 62.2 | 104.6 | 62.7 | 105.5 | 63.2 | 106.4 | 63.7 | 107.2 | 64.3 | 108.1 | 64.8 | 108.9 | 65.3 | 109.8 | 65.8 | ¾ |
| 3 | 100.6 | 67.2 | 101.4 | 67.8 | 102.3 | 68.3 | 103.1 | 68.9 | 103.9 | 69.4 | 104.8 | 70.0 | 105.6 | 70.6 | 106.4 | 71.1 | 5 |
| ¼ | 97.2 | 72.1 | 98.0 | 72.7 | 98.8 | 73.3 | 99.6 | 73.9 | 100.4 | 74.5 | 101.2 | 75.1 | 102.0 | 75.7 | 102.8 | 76.3 | ¼ |
| ½ | 93.5 | 76.8 | 94.3 | 77.4 | 95.1 | 78.0 | 95.8 | 78.7 | 96.6 | 79.3 | 97.4 | 79.9 | 98.2 | 80.6 | 98.9 | 81.2 | ½ |
| ¾ | 89.6 | 81.3 | 90.4 | 81.9 | 91.1 | 82.6 | 91.9 | 83.3 | 92.6 | 83.9 | 93.4 | 84.6 | 94.1 | 85.3 | 94.8 | 86.0 | ¾ |
| 4 | 85.6 | 85.6 | 86.3 | 86.3 | 87.0 | 87.0 | 87.7 | 87.7 | 88.4 | 88.4 | 89.1 | 89.1 | 89.8 | 89.8 | 90.5 | 90.5 | 4 |
| 1° | 121.0 | 02.1 | 122.0 | 02.1 | 123.0 | 02.1 | 124.0 | 02.2 | 125.0 | 02.2 | 126.0 | 02.2 | 127.0 | 02.2 | 128.0 | 02.2 | 89° |
| 2 | 120.9 | 04.2 | 121.9 | 04.3 | 122.9 | 04.3 | 123.9 | 04.3 | 124.9 | 04.4 | 125.9 | 04.4 | 126.9 | 04.4 | 127.9 | 04.5 | 88 |
| 3 | 120.8 | 06.3 | 121.8 | 06.4 | 122.8 | 06.4 | 123.8 | 06.5 | 124.8 | 06.5 | 125.8 | 06.6 | 126.8 | 06.6 | 127.8 | 06.7 | 87 |
| 4 | 120.7 | 08.4 | 121.7 | 08.5 | 122.7 | 08.6 | 123.7 | 08.6 | 124.7 | 08.7 | 125.7 | 08.8 | 126.7 | 08.9 | 127.7 | 08.9 | 86 |
| 5 | 120.5 | 10.5 | 121.5 | 10.6 | 122.5 | 10.7 | 123.5 | 10.8 | 124.5 | 10.9 | 125.5 | 11.0 | 126.5 | 11.1 | 127.5 | 11.2 | 85 |
| 6 | 120.3 | 12.6 | 121.3 | 12.8 | 122.3 | 12.9 | 123.3 | 13.0 | 124.3 | 13.1 | 125.3 | 13.2 | 126.3 | 13.3 | 127.3 | 13.4 | 84 |
| 7 | 120.1 | 14.7 | 121.1 | 14.9 | 122.1 | 15.0 | 123.1 | 15.1 | 124.1 | 15.2 | 125.1 | 15.4 | 126.1 | 15.5 | 127.0 | 15.6 | 83 |
| 8 | 119.8 | 16.8 | 120.8 | 17.0 | 121.8 | 17.1 | 122.8 | 17.3 | 123.8 | 17.4 | 124.8 | 17.5 | 125.8 | 17.7 | 126.8 | 17.8 | 82 |
| 9 | 119.5 | 18.9 | 120.5 | 19.1 | 121.5 | 19.2 | 122.5 | 19.4 | 123.5 | 19.6 | 124.4 | 19.7 | 125.4 | 19.9 | 126.4 | 20.0 | 81 |
| 10 | 119.2 | 21.0 | 120.1 | 21.2 | 121.1 | 21.4 | 122.1 | 21.5 | 123.1 | 21.7 | 124.1 | 21.9 | 125.1 | 22.1 | 126.1 | 22.2 | 80 |
| 11 | 118.8 | 23.1 | 119.8 | 23.3 | 120.7 | 23.5 | 121.7 | 23.7 | 122.7 | 23.9 | 123.7 | 24.0 | 124.7 | 24.2 | 125.6 | 24.4 | 79 |
| 12 | 118.4 | 25.2 | 119.3 | 25.4 | 120.3 | 25.6 | 121.3 | 25.8 | 122.3 | 26.0 | 123.2 | 26.2 | 124.2 | 26.4 | 125.2 | 26.6 | 78 |
| 13 | 117.9 | 27.2 | 118.9 | 27.4 | 119.8 | 27.7 | 120.8 | 27.9 | 121.8 | 28.1 | 122.8 | 28.3 | 123.7 | 28.6 | 124.7 | 28.8 | 77 |
| 14 | 117.4 | 29.3 | 118.4 | 29.5 | 119.3 | 29.8 | 120.3 | 30.0 | 121.3 | 30.2 | 122.3 | 30.5 | 123.2 | 30.7 | 124.2 | 31.0 | 76 |
| 15 | 116.9 | 31.3 | 117.8 | 31.6 | 118.8 | 31.8 | 119.8 | 32.1 | 120.7 | 32.4 | 121.7 | 32.6 | 122.7 | 32.9 | 123.6 | 33.1 | 75 |
| 16 | 116.3 | 33.4 | 117.3 | 33.6 | 118.2 | 33.9 | 119.2 | 34.2 | 120.2 | 34.5 | 121.1 | 34.7 | 122.1 | 35.0 | 123.0 | 35.3 | 74 |
| 17 | 115.7 | 35.4 | 116.7 | 35.7 | 117.6 | 36.0 | 118.6 | 36.3 | 119.5 | 36.5 | 120.5 | 36.8 | 121.5 | 37.1 | 122.4 | 37.4 | 73 |
| 18 | 115.1 | 37.4 | 116.0 | 37.7 | 117.0 | 38.0 | 117.9 | 38.3 | 118.9 | 38.6 | 119.8 | 38.9 | 120.8 | 39.2 | 121.7 | 39.6 | 72 |
| 19 | 114.4 | 39.4 | 115.4 | 39.7 | 116.3 | 40.0 | 117.2 | 40.4 | 118.2 | 40.7 | 119.1 | 41.0 | 120.1 | 41.3 | 121.0 | 41.7 | 71 |
| 20 | 113.7 | 41.4 | 114.6 | 41.7 | 115.6 | 42.1 | 116.5 | 42.4 | 117.5 | 42.8 | 118.4 | 43.1 | 119.3 | 43.4 | 120.3 | 43.8 | 70 |
| 21 | 113.0 | 43.4 | 113.9 | 43.7 | 114.8 | 44.1 | 115.8 | 44.4 | 116.7 | 44.8 | 117.6 | 45.2 | 118.6 | 45.5 | 119.5 | 45.9 | 69 |
| 22 | 112.2 | 45.3 | 113.1 | 45.7 | 114.0 | 46.1 | 115.0 | 46.5 | 115.9 | 46.8 | 116.8 | 47.2 | 117.8 | 47.6 | 118.7 | 47.9 | 68 |
| 23 | 111.4 | 47.3 | 112.3 | 47.7 | 113.2 | 48.1 | 114.1 | 48.5 | 115.1 | 48.8 | 116.0 | 49.2 | 116.9 | 49.6 | 117.8 | 50.0 | 67 |
| 24 | 110.5 | 49.2 | 111.5 | 49.6 | 112.4 | 50.0 | 113.3 | 50.4 | 114.2 | 50.8 | 115.1 | 51.2 | 116.0 | 51.7 | 116.9 | 52.1 | 66 |
| 25 | 109.7 | 51.1 | 110.6 | 51.6 | 111.5 | 52.0 | 112.4 | 52.4 | 113.3 | 52.8 | 114.2 | 53.2 | 115.1 | 53.7 | 116.0 | 54.1 | 65 |
| 26 | 108.8 | 53.0 | 109.7 | 53.5 | 110.6 | 53.9 | 111.5 | 54.4 | 112.3 | 54.8 | 113.2 | 55.2 | 114.1 | 55.7 | 115.0 | 56.1 | 64 |
| 27 | 107.8 | 54.9 | 108.7 | 55.4 | 109.6 | 55.8 | 110.5 | 56.3 | 111.4 | 56.7 | 112.3 | 57.2 | 113.2 | 57.7 | 114.0 | 58.1 | 63 |
| 28 | 106.8 | 56.8 | 107.7 | 57.3 | 108.6 | 57.7 | 109.5 | 58.2 | 110.4 | 58.7 | 111.3 | 59.2 | 112.1 | 59.6 | 113.0 | 60.1 | 62 |
| 29 | 105.8 | 58.7 | 106.7 | 59.1 | 107.6 | 59.6 | 108.5 | 60.1 | 109.3 | 60.6 | 110.2 | 61.1 | 111.1 | 61.6 | 112.0 | 62.1 | 61 |
| 30 | 104.8 | 60.5 | 105.7 | 61.0 | 106.5 | 61.5 | 107.4 | 62.0 | 108.3 | 62.5 | 109.1 | 63.0 | 110.0 | 63.5 | 110.9 | 64.0 | 60 |
| 31 | 103.7 | 62.3 | 104.6 | 62.8 | 105.4 | 63.3 | 106.3 | 63.9 | 107.1 | 64.4 | 108.0 | 64.9 | 108.9 | 65.4 | 109.7 | 65.9 | 59 |
| 32 | 102.6 | 64.1 | 103.5 | 64.7 | 104.3 | 65.2 | 105.2 | 65.7 | 106.0 | 66.2 | 106.9 | 66.8 | 107.7 | 67.3 | 108.6 | 67.8 | 58 |
| 33 | 101.5 | 65.9 | 102.3 | 66.4 | 103.2 | 67.0 | 104.0 | 67.5 | 104.8 | 68.1 | 105.7 | 68.6 | 106.5 | 69.2 | 107.3 | 69.7 | 57 |
| 34 | 100.3 | 67.7 | 101.1 | 68.2 | 102.0 | 68.8 | 102.8 | 69.3 | 103.6 | 69.9 | 104.5 | 70.5 | 105.3 | 71.0 | 106.1 | 71.6 | 56 |
| 35 | 99.1 | 69.4 | 99.9 | 70.0 | 100.8 | 70.5 | 101.6 | 71.1 | 102.4 | 71.7 | 103.2 | 72.3 | 104.0 | 72.8 | 104.9 | 73.4 | 55 |
| 36 | 97.9 | 71.1 | 98.7 | 71.7 | 99.5 | 72.3 | 100.3 | 72.9 | 101.1 | 73.5 | 101.9 | 74.1 | 102.7 | 74.6 | 103.6 | 75.2 | 54 |
| 37 | 96.6 | 72.8 | 97.4 | 73.4 | 98.2 | 74.0 | 99.0 | 74.6 | 99.8 | 75.2 | 100.6 | 75.8 | 101.4 | 76.4 | 102.2 | 77.0 | 53 |
| 38 | 95.3 | 74.5 | 96.1 | 75.1 | 96.9 | 75.7 | 97.7 | 76.3 | 98.5 | 77.0 | 99.3 | 77.6 | 100.1 | 78.2 | 100.9 | 78.8 | 52 |
| 39 | 94.0 | 76.1 | 94.8 | 76.8 | 95.6 | 77.4 | 96.4 | 78.0 | 97.1 | 78.7 | 97.9 | 79.3 | 98.7 | 79.9 | 99.5 | 80.6 | 51 |
| 40 | 92.7 | 77.8 | 93.5 | 78.4 | 94.2 | 79.1 | 95.0 | 79.7 | 95.8 | 80.3 | 96.5 | 81.0 | 97.3 | 81.6 | 98.1 | 82.3 | 50 |
| 41 | 91.3 | 79.4 | 92.1 | 80.0 | 92.8 | 80.7 | 93.6 | 81.4 | 94.3 | 82.0 | 95.1 | 82.7 | 95.8 | 83.3 | 96.6 | 84.0 | 49 |
| 42 | 89.9 | 81.0 | 90.7 | 81.6 | 91.4 | 82.3 | 92.1 | 83.0 | 92.9 | 83.6 | 93.6 | 84.3 | 94.4 | 85.0 | 95.1 | 85.6 | 48 |
| 43 | 88.5 | 82.5 | 89.2 | 83.2 | 90.0 | 83.9 | 90.7 | 84.6 | 91.4 | 85.2 | 92.2 | 85.9 | 92.9 | 86.6 | 93.6 | 87.3 | 47 |
| 44 | 87.0 | 84.1 | 87.8 | 84.7 | 88.5 | 85.4 | 89.2 | 86.1 | 89.9 | 86.8 | 90.6 | 87.5 | 91.4 | 88.2 | 92.1 | 88.9 | 46 |
| 45 | 85.6 | 85.6 | 86.3 | 86.3 | 87.0 | 87.0 | 87.7 | 87.7 | 88.4 | 88.4 | 89.1 | 89.1 | 89.8 | 89.8 | 90.5 | 90.5 | 45 |
| Dist. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dist. |

## Traverse Table. (x.)

| Distance. | 129 | | 130 | | 131 | | 132 | | 133 | | 134 | | 135 | | 136 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cros. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Cros. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 128.8 | 06.3 | 129.8 | 06.4 | 130.8 | 06.4 | 131.8 | 06.5 | 132.8 | 06.5 | 133.8 | 06.6 | 134.8 | 06.6 | 135.8 | 06.7 | ¾ |
| ½ | 128.4 | 12.6 | 129.4 | 12.7 | 130.4 | 12.8 | 131.4 | 12.9 | 132.4 | 13.0 | 133.4 | 13.1 | 134.3 | 13.2 | 135.3 | 13.3 | ½ |
| ¾ | 127.6 | 18.9 | 128.6 | 19.1 | 129.6 | 19.2 | 130.6 | 19.4 | 131.6 | 19.5 | 132.5 | 19.7 | 133.5 | 19.8 | 134.5 | 20.0 | ¼ |
| 1 | 126.5 | 25.2 | 127.5 | 25.4 | 128.5 | 25.6 | 129.5 | 25.8 | 130.4 | 26.0 | 131.4 | 26.1 | 132.4 | 26.3 | 133.4 | 26.5 | 7 |
| ¼ | 125.1 | 31.3 | 126.1 | 31.6 | 127.1 | 31.8 | 128.0 | 32.1 | 129.0 | 32.3 | 130.0 | 32.6 | 131.0 | 32.8 | 131.9 | 33.0 | ¾ |
| ½ | 123.5 | 37.4 | 124.4 | 37.7 | 125.4 | 38.0 | 126.3 | 38.3 | 127.3 | 38.6 | 128.2 | 38.9 | 129.2 | 39.2 | 130.1 | 39.5 | ½ |
| ¾ | 121.5 | 43.5 | 122.4 | 43.8 | 123.3 | 44.1 | 124.3 | 44.5 | 125.2 | 44.8 | 126.2 | 45.1 | 127.1 | 45.5 | 128.0 | 45.8 | ¼ |
| 2 | 119.2 | 49.4 | 120.1 | 49.8 | 121.0 | 50.1 | 122.0 | 50.5 | 122.9 | 50.9 | 123.8 | 51.3 | 124.7 | 51.7 | 125.7 | 52.0 | 6 |
| ¼ | 116.6 | 55.2 | 117.5 | 55.6 | 118.4 | 56.0 | 119.3 | 56.4 | 120.2 | 56.9 | 121.1 | 57.3 | 122.0 | 57.7 | 122.9 | 58.2 | ¾ |
| ½ | 113.8 | 60.8 | 114.7 | 61.3 | 115.5 | 61.7 | 116.4 | 62.2 | 117.3 | 62.7 | 118.2 | 63.2 | 119.1 | 63.6 | 119.9 | 64.1 | ½ |
| ¾ | 110.6 | 66.3 | 111.5 | 66.8 | 112.4 | 67.3 | 113.2 | 67.9 | 114.1 | 68.4 | 114.9 | 68.9 | 115.8 | 69.4 | 116.6 | 69.9 | ¼ |
| 3 | 107.3 | 71.7 | 108.1 | 72.2 | 108.9 | 72.8 | 109.7 | 73.3 | 110.6 | 73.9 | 111.4 | 74.4 | 112.2 | 75.0 | 113.1 | 75.6 | 5 |
| ¼ | 103.6 | 76.9 | 104.4 | 77.4 | 105.2 | 78.0 | 106.0 | 78.6 | 106.8 | 79.2 | 107.6 | 79.8 | 108.4 | 80.4 | 109.2 | 81.0 | ¾ |
| ½ | 99.7 | 81.8 | 100.5 | 82.5 | 101.3 | 83.1 | 102.0 | 83.7 | 102.8 | 84.4 | 103.6 | 85.0 | 104.4 | 85.6 | 105.1 | 86.3 | ½ |
| ¾ | 95.6 | 86.6 | 96.3 | 87.3 | 97.1 | 88.0 | 97.8 | 88.6 | 98.5 | 89.3 | 99.3 | 90.0 | 100.0 | 90.7 | 100.8 | 91.3 | ¼ |
| 4 | 91.2 | 91.2 | 91.9 | 91.9 | 92.6 | 92.6 | 93.3 | 93.3 | 94.0 | 94.0 | 94.8 | 94.8 | 95.5 | 95.5 | 96.2 | 96.2 | 4 |
| 1° | 129.0 | 02.3 | 130.0 | 02.3 | 131.0 | 02.3 | 132.0 | 02.3 | 133.0 | 02.3 | 134.0 | 02.3 | 135.0 | 02.4 | 136.0 | 02.4 | 89° |
| 2 | 128.9 | 04.5 | 129.9 | 04.5 | 130.9 | 04.6 | 131.9 | 04.6 | 132.9 | 04.6 | 133.9 | 04.7 | 134.9 | 04.7 | 135.9 | 04.7 | 88 |
| 3 | 128.8 | 06.8 | 129.8 | 06.8 | 130.8 | 06.9 | 131.8 | 06.9 | 132.8 | 07.0 | 133.8 | 07.0 | 134.8 | 07.1 | 135.8 | 07.1 | 87 |
| 4 | 128.7 | 09.0 | 129.7 | 09.1 | 130.7 | 09.1 | 131.7 | 09.2 | 132.7 | 09.3 | 133.7 | 09.3 | 134.7 | 09.4 | 135.7 | 09.5 | 86 |
| 5 | 128.5 | 11.2 | 129.5 | 11.3 | 130.5 | 11.4 | 131.5 | 11.5 | 132.5 | 11.6 | 133.5 | 11.7 | 134.5 | 11.8 | 135.5 | 11.9 | 85 |
| 6 | 128.3 | 13.5 | 129.3 | 13.6 | 130.3 | 13.7 | 131.3 | 13.8 | 132.3 | 13.9 | 133.3 | 14.0 | 134.3 | 14.1 | 135.3 | 14.2 | 84 |
| 7 | 128.0 | 15.7 | 129.0 | 15.8 | 130.0 | 16.0 | 131.0 | 16.1 | 132.0 | 16.2 | 133.0 | 16.3 | 134.0 | 16.5 | 135.0 | 16.6 | 83 |
| 8 | 127.7 | 18.0 | 128.7 | 18.1 | 129.7 | 18.2 | 130.7 | 18.4 | 131.7 | 18.5 | 132.7 | 18.6 | 133.7 | 18.8 | 134.7 | 18.9 | 82 |
| 9 | 127.4 | 20.2 | 128.4 | 20.3 | 129.4 | 20.5 | 130.4 | 20.6 | 131.4 | 20.8 | 132.4 | 21.0 | 133.3 | 21.1 | 134.3 | 21.3 | 81 |
| 10 | 127.0 | 22.4 | 128.0 | 22.6 | 129.0 | 22.7 | 130.0 | 22.9 | 131.0 | 23.1 | 132.0 | 23.3 | 132.9 | 23.4 | 133.9 | 23.6 | 80 |
| 11 | 126.6 | 24.6 | 127.6 | 24.8 | 128.6 | 25.0 | 129.6 | 25.2 | 130.6 | 25.4 | 131.5 | 25.6 | 132.5 | 25.8 | 133.5 | 26.0 | 79 |
| 12 | 126.2 | 26.8 | 127.2 | 27.0 | 128.1 | 27.2 | 129.1 | 27.4 | 130.1 | 27.7 | 131.1 | 27.9 | 132.0 | 28.1 | 133.0 | 28.3 | 78 |
| 13 | 125.7 | 29.0 | 126.7 | 29.2 | 127.6 | 29.5 | 128.6 | 29.7 | 129.6 | 29.9 | 130.6 | 30.1 | 131.5 | 30.4 | 132.5 | 30.6 | 77 |
| 14 | 125.2 | 31.2 | 126.1 | 31.4 | 127.1 | 31.7 | 128.1 | 31.9 | 129.0 | 32.2 | 130.0 | 32.4 | 131.0 | 32.7 | 132.0 | 32.9 | 76 |
| 15 | 124.6 | 33.4 | 125.6 | 33.6 | 126.5 | 33.9 | 127.5 | 34.2 | 128.5 | 34.4 | 129.4 | 34.7 | 130.4 | 34.9 | 131.4 | 35.2 | 75 |
| 16 | 124.0 | 35.6 | 125.0 | 35.8 | 125.9 | 36.1 | 126.9 | 36.4 | 127.8 | 36.7 | 128.8 | 36.9 | 129.8 | 37.2 | 130.7 | 37.5 | 74 |
| 17 | 123.4 | 37.7 | 124.3 | 38.0 | 125.3 | 38.3 | 126.2 | 38.6 | 127.2 | 38.9 | 128.1 | 39.2 | 129.1 | 39.5 | 130.1 | 39.8 | 73 |
| 18 | 122.7 | 39.9 | 123.6 | 40.2 | 124.6 | 40.5 | 125.5 | 40.8 | 126.5 | 41.1 | 127.4 | 41.4 | 128.4 | 41.7 | 129.3 | 42.0 | 72 |
| 19 | 122.0 | 42.0 | 122.9 | 42.3 | 123.9 | 42.6 | 124.8 | 43.0 | 125.8 | 43.3 | 126.7 | 43.6 | 127.6 | 44.0 | 128.6 | 44.3 | 71 |
| 20 | 121.2 | 44.1 | 122.2 | 44.5 | 123.1 | 44.8 | 124.0 | 45.1 | 125.0 | 45.5 | 125.9 | 45.8 | 126.9 | 46.2 | 127.8 | 46.5 | 70 |
| 21 | 120.4 | 46.2 | 121.4 | 46.6 | 122.3 | 46.9 | 123.2 | 47.3 | 124.2 | 47.7 | 125.1 | 48.0 | 126.0 | 48.4 | 127.0 | 48.7 | 69 |
| 22 | 119.6 | 48.3 | 120.5 | 48.7 | 121.5 | 49.1 | 122.4 | 49.4 | 123.3 | 49.8 | 124.2 | 50.2 | 125.2 | 50.6 | 126.1 | 50.9 | 68 |
| 23 | 118.7 | 50.4 | 119.7 | 50.8 | 120.6 | 51.2 | 121.5 | 51.6 | 122.4 | 52.0 | 123.3 | 52.4 | 124.3 | 52.7 | 125.2 | 53.1 | 67 |
| 24 | 117.8 | 52.5 | 118.8 | 52.9 | 119.7 | 53.3 | 120.6 | 53.7 | 121.5 | 54.1 | 122.4 | 54.5 | 123.3 | 54.9 | 124.2 | 55.3 | 66 |
| 25 | 116.9 | 54.5 | 117.8 | 54.9 | 118.7 | 55.4 | 119.6 | 55.8 | 120.5 | 56.2 | 121.4 | 56.6 | 122.4 | 57.1 | 123.3 | 57.5 | 65 |
| 26 | 115.9 | 56.5 | 116.8 | 57.0 | 117.7 | 57.4 | 118.6 | 57.9 | 119.5 | 58.3 | 120.4 | 58.7 | 121.3 | 59.2 | 122.2 | 59.6 | 64 |
| 27 | 114.9 | 58.6 | 115.8 | 59.0 | 116.7 | 59.5 | 117.6 | 59.9 | 118.5 | 60.4 | 119.4 | 60.8 | 120.3 | 61.3 | 121.2 | 61.7 | 63 |
| 28 | 113.9 | 60.6 | 114.8 | 61.0 | 115.7 | 61.5 | 116.5 | 62.0 | 117.4 | 62.4 | 118.3 | 62.9 | 119.2 | 63.4 | 120.1 | 63.8 | 62 |
| 29 | 112.8 | 62.5 | 113.7 | 63.0 | 114.6 | 63.5 | 115.4 | 64.0 | 116.3 | 64.5 | 117.2 | 65.0 | 118.1 | 65.4 | 118.9 | 65.9 | 61 |
| 30 | 111.7 | 64.5 | 112.6 | 65.0 | 113.4 | 65.5 | 114.3 | 66.0 | 115.2 | 66.5 | 116.0 | 67.0 | 116.9 | 67.5 | 117.8 | 68.0 | 60 |
| 31 | 110.6 | 66.4 | 111.4 | 67.0 | 112.3 | 67.5 | 113.1 | 68.0 | 114.0 | 68.5 | 114.9 | 69.0 | 115.7 | 69.5 | 116.6 | 70.0 | 59 |
| 32 | 109.4 | 68.4 | 110.2 | 68.9 | 111.1 | 69.4 | 111.9 | 69.9 | 112.8 | 70.5 | 113.6 | 71.0 | 114.5 | 71.5 | 115.3 | 72.1 | 58 |
| 33 | 108.2 | 70.3 | 109.0 | 70.8 | 109.9 | 71.3 | 110.7 | 71.9 | 111.5 | 72.4 | 112.4 | 73.0 | 113.2 | 73.5 | 114.1 | 74.1 | 57 |
| 34 | 106.9 | 72.1 | 107.8 | 72.7 | 108.6 | 73.3 | 109.4 | 73.8 | 110.3 | 74.4 | 111.1 | 74.9 | 111.9 | 75.5 | 112.7 | 76.1 | 56 |
| 35 | 105.7 | 74.0 | 106.5 | 74.6 | 107.3 | 75.1 | 108.1 | 75.7 | 108.9 | 76.3 | 109.8 | 76.9 | 110.6 | 77.4 | 111.4 | 78.0 | 55 |
| 36 | 104.4 | 75.8 | 105.2 | 76.4 | 106.0 | 77.0 | 106.8 | 77.6 | 107.6 | 78.2 | 108.4 | 78.8 | 109.2 | 79.4 | 110.0 | 79.9 | 54 |
| 37 | 103.0 | 77.6 | 103.8 | 78.2 | 104.6 | 78.8 | 105.4 | 79.4 | 106.2 | 80.0 | 107.0 | 80.6 | 107.8 | 81.2 | 108.6 | 81.8 | 53 |
| 38 | 101.7 | 79.4 | 102.4 | 80.0 | 103.2 | 80.7 | 104.0 | 81.3 | 104.8 | 81.9 | 105.6 | 82.5 | 106.4 | 83.1 | 107.2 | 83.7 | 52 |
| 39 | 100.3 | 81.2 | 101.0 | 81.8 | 101.8 | 82.4 | 102.6 | 83.1 | 103.4 | 83.7 | 104.1 | 84.3 | 104.9 | 85.0 | 105.7 | 85.6 | 51 |
| 40 | 98.8 | 82.9 | 99.6 | 83.6 | 100.4 | 84.2 | 101.1 | 84.8 | 101.9 | 85.5 | 102.6 | 86.1 | 103.4 | 86.8 | 104.2 | 87.4 | 50 |
| 41 | 97.4 | 84.6 | 98.1 | 85.3 | 98.9 | 85.9 | 99.6 | 86.6 | 100.4 | 87.3 | 101.1 | 87.9 | 101.9 | 88.6 | 102.6 | 89.2 | 49 |
| 42 | 95.9 | 86.3 | 96.6 | 87.0 | 97.4 | 87.7 | 98.1 | 88.3 | 98.8 | 89.0 | 99.6 | 89.7 | 100.3 | 90.3 | 101.1 | 91.0 | 48 |
| 43 | 94.3 | 88.0 | 95.1 | 88.7 | 95.8 | 89.3 | 96.5 | 90.0 | 97.3 | 90.7 | 98.0 | 91.4 | 98.7 | 92.1 | 99.5 | 92.8 | 47 |
| 44 | 92.8 | 89.6 | 93.5 | 90.3 | 94.2 | 91.0 | 95.0 | 91.7 | 95.7 | 92.4 | 96.4 | 93.1 | 97.1 | 93.8 | 97.8 | 94.5 | 46 |
| 45 | 91.2 | 91.2 | 91.9 | 91.9 | 92.6 | 92.6 | 93.3 | 93.3 | 94.0 | 94.0 | 94.8 | 94.8 | 95.5 | 95.5 | 96.2 | 96.2 | 45 |
| Cros. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Cros. |

(x.)

## Traverse Table.

| Distance. | 137 | | 138 | | 139 | | 140 | | 141 | | 142 | | 143 | | 144 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cras. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Cras. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 136.8 | 06.7 | 137.8 | 06.8 | 138.8 | 06.8 | 139.8 | 06.9 | 140.8 | 06.9 | 141.8 | 07.0 | 142.8 | 07.0 | 143.8 | 07.1 | ¼ |
| ½ | 136.3 | 13.4 | 137.3 | 13.5 | 138.3 | 13.6 | 139.3 | 13.7 | 140.3 | 13.8 | 141.3 | 13.9 | 142.3 | 14.0 | 143.3 | 14.1 | ½ |
| ¾ | 135.5 | 20.1 | 136.5 | 20.2 | 137.5 | 20.4 | 138.5 | 20.5 | 139.5 | 20.7 | 140.5 | 20.8 | 141.4 | 21.0 | 142.4 | 21.1 | ¾ |
| 1 | 134.4 | 26.7 | 135.3 | 26.9 | 136.3 | 27.1 | 137.3 | 27.3 | 138.3 | 27.5 | 139.3 | 27.7 | 140.2 | 27.9 | 141.2 | 28.1 | 7 |
| ¼ | 132.9 | 33.3 | 133.9 | 33.5 | 134.8 | 33.8 | 135.8 | 34.0 | 136.8 | 34.3 | 137.7 | 34.5 | 138.7 | 34.7 | 139.7 | 35.0 | ¼ |
| ½ | 131.1 | 39.8 | 132.1 | 40.1 | 133.0 | 40.3 | 134.0 | 40.6 | 134.9 | 40.9 | 135.9 | 41.2 | 136.8 | 41.5 | 137.8 | 41.8 | ½ |
| ¾ | 129.0 | 46.1 | 129.9 | 46.5 | 130.9 | 46.8 | 131.8 | 47.2 | 132.8 | 47.5 | 133.7 | 47.8 | 134.6 | 48.2 | 135.6 | 48.5 | ¾ |
| 2 | 126.6 | 52.4 | 127.5 | 52.8 | 128.4 | 53.2 | 129.3 | 53.6 | 130.3 | 54.0 | 131.2 | 54.3 | 132.1 | 54.7 | 133.0 | 55.1 | 6 |
| ¼ | 123.8 | 58.6 | 124.7 | 59.0 | 125.7 | 59.4 | 126.6 | 59.9 | 127.5 | 60.3 | 128.4 | 60.7 | 129.3 | 61.2 | 130.2 | 61.6 | ¼ |
| ½ | 120.8 | 64.6 | 121.7 | 65.0 | 122.6 | 65.5 | 123.5 | 66.0 | 124.4 | 66.5 | 125.2 | 66.9 | 126.1 | 67.4 | 127.0 | 67.9 | ½ |
| ¾ | 117.5 | 70.4 | 118.4 | 70.9 | 119.2 | 71.5 | 120.1 | 72.0 | 120.9 | 72.5 | 121.8 | 73.0 | 122.7 | 73.5 | 123.5 | 74.0 | ¾ |
| 3 | 113.9 | 76.1 | 114.7 | 76.7 | 115.6 | 77.2 | 116.4 | 77.8 | 117.2 | 78.3 | 118.1 | 78.9 | 118.9 | 79.4 | 119.7 | 80.0 | 5 |
| ¼ | 110.0 | 81.6 | 110.8 | 82.2 | 111.6 | 82.8 | 112.4 | 83.4 | 113.2 | 84.0 | 114.0 | 84.6 | 114.9 | 85.2 | 115.7 | 85.8 | ¼ |
| ½ | 105.9 | 86.9 | 106.7 | 87.5 | 107.4 | 88.2 | 108.2 | 88.8 | 109.0 | 89.4 | 109.8 | 90.1 | 110.5 | 90.7 | 111.3 | 91.3 | ½ |
| ¾ | 101.5 | 92.0 | 102.2 | 92.7 | 103.0 | 93.3 | 103.7 | 94.0 | 104.5 | 94.7 | 105.2 | 95.4 | 106.0 | 96.0 | 106.7 | 96.7 | ¾ |
| 4 | 96.9 | 96.9 | 97.6 | 97.6 | 98.3 | 98.3 | 99.0 | 99.0 | 99.7 | 99.7 | 100.4 | 100.4 | 101.1 | 101.1 | 101.8 | 101.8 | 4 |
| 1° | 137.0 | 02.4 | 138.0 | 02.4 | 139.0 | 02.4 | 140.0 | 02.4 | 141.0 | 02.5 | 142.0 | 02.5 | 143.0 | 02.5 | 144.0 | 02.5 | 89° |
| 2 | 136.9 | 04.8 | 137.9 | 04.8 | 138.9 | 04.9 | 139.9 | 04.9 | 140.9 | 04.9 | 141.9 | 05.0 | 142.9 | 05.0 | 143.9 | 05.0 | 88 |
| 3 | 136.8 | 07.2 | 137.8 | 07.2 | 138.8 | 07.3 | 139.8 | 07.3 | 140.8 | 07.4 | 141.8 | 07.4 | 142.8 | 07.5 | 143.8 | 07.5 | 87 |
| 4 | 136.7 | 09.6 | 137.7 | 09.6 | 138.7 | 09.7 | 139.7 | 09.8 | 140.7 | 09.8 | 141.7 | 09.9 | 142.7 | 10.0 | 143.6 | 10.0 | 86 |
| 5 | 136.5 | 11.9 | 137.5 | 12.0 | 138.5 | 12.1 | 139.5 | 12.2 | 140.5 | 12.3 | 141.5 | 12.4 | 142.5 | 12.5 | 143.5 | 12.6 | 85 |
| 6 | 136.2 | 14.3 | 137.2 | 14.4 | 138.2 | 14.5 | 139.2 | 14.6 | 140.2 | 14.7 | 141.2 | 14.8 | 142.2 | 14.9 | 143.2 | 15.1 | 84 |
| 7 | 136.0 | 16.7 | 137.0 | 16.8 | 138.0 | 16.9 | 139.0 | 17.1 | 139.9 | 17.2 | 140.9 | 17.3 | 141.9 | 17.4 | 142.9 | 17.5 | 83 |
| 8 | 135.7 | 19.1 | 136.7 | 19.2 | 137.7 | 19.3 | 138.6 | 19.5 | 139.6 | 19.6 | 140.6 | 19.8 | 141.6 | 19.9 | 142.6 | 20.0 | 82 |
| 9 | 135.3 | 21.4 | 136.3 | 21.6 | 137.3 | 21.7 | 138.3 | 21.9 | 139.3 | 22.1 | 140.3 | 22.2 | 141.2 | 22.4 | 142.2 | 22.5 | 81 |
| 10 | 134.9 | 23.8 | 135.9 | 24.0 | 136.9 | 24.1 | 137.9 | 24.3 | 138.9 | 24.5 | 139.8 | 24.7 | 140.8 | 24.8 | 141.8 | 25.0 | 80 |
| 11 | 134.5 | 26.1 | 135.5 | 26.3 | 136.4 | 26.5 | 137.4 | 26.7 | 138.4 | 26.9 | 139.4 | 27.1 | 140.4 | 27.3 | 141.4 | 27.5 | 79 |
| 12 | 134.0 | 28.5 | 135.0 | 28.7 | 136.0 | 28.9 | 136.9 | 29.1 | 137.9 | 29.3 | 138.9 | 29.5 | 139.9 | 29.7 | 140.9 | 29.9 | 78 |
| 13 | 133.5 | 30.8 | 134.5 | 31.0 | 135.4 | 31.3 | 136.4 | 31.5 | 137.4 | 31.7 | 138.4 | 31.9 | 139.3 | 32.2 | 140.3 | 32.4 | 77 |
| 14 | 132.9 | 33.1 | 133.9 | 33.4 | 134.9 | 33.6 | 135.8 | 33.9 | 136.8 | 34.1 | 137.8 | 34.4 | 138.8 | 34.6 | 139.7 | 34.8 | 76 |
| 15 | 132.3 | 35.5 | 133.3 | 35.7 | 134.3 | 36.0 | 135.2 | 36.2 | 136.2 | 36.5 | 137.2 | 36.8 | 138.1 | 37.0 | 139.1 | 37.3 | 75 |
| 16 | 131.7 | 37.8 | 132.7 | 38.0 | 133.6 | 38.3 | 134.6 | 38.6 | 135.5 | 38.9 | 136.5 | 39.1 | 137.5 | 39.4 | 138.4 | 39.7 | 74 |
| 17 | 131.0 | 40.1 | 132.0 | 40.3 | 132.9 | 40.6 | 133.9 | 40.9 | 134.8 | 41.2 | 135.8 | 41.5 | 136.8 | 41.8 | 137.7 | 42.1 | 73 |
| 18 | 130.3 | 42.3 | 131.2 | 42.6 | 132.2 | 43.0 | 133.1 | 43.3 | 134.1 | 43.6 | 135.1 | 43.9 | 136.0 | 44.2 | 137.0 | 44.5 | 72 |
| 19 | 129.5 | 44.6 | 130.5 | 44.9 | 131.4 | 45.3 | 132.4 | 45.6 | 133.3 | 45.9 | 134.3 | 46.2 | 135.2 | 46.6 | 136.2 | 46.9 | 71 |
| 20 | 128.7 | 46.9 | 129.7 | 47.2 | 130.6 | 47.5 | 131.6 | 47.9 | 132.5 | 48.2 | 133.4 | 48.6 | 134.4 | 48.9 | 135.3 | 49.3 | 70 |
| 21 | 127.9 | 49.1 | 128.8 | 49.5 | 129.8 | 49.8 | 130.7 | 50.2 | 131.6 | 50.5 | 132.6 | 50.9 | 133.5 | 51.2 | 134.4 | 51.6 | 69 |
| 22 | 127.0 | 51.3 | 128.0 | 51.7 | 128.9 | 52.1 | 129.8 | 52.4 | 130.7 | 52.8 | 131.7 | 53.2 | 132.6 | 53.6 | 133.5 | 53.9 | 68 |
| 23 | 126.1 | 53.5 | 127.0 | 53.9 | 128.0 | 54.3 | 128.9 | 54.7 | 129.8 | 55.1 | 130.7 | 55.5 | 131.6 | 55.9 | 132.6 | 56.3 | 67 |
| 24 | 125.2 | 55.7 | 126.1 | 56.1 | 127.0 | 56.5 | 127.9 | 56.9 | 128.8 | 57.3 | 129.7 | 57.8 | 130.6 | 58.2 | 131.6 | 58.6 | 66 |
| 25 | 124.2 | 57.9 | 125.1 | 58.3 | 126.0 | 58.7 | 126.9 | 59.2 | 127.8 | 59.6 | 128.7 | 60.0 | 129.6 | 60.4 | 130.5 | 60.9 | 65 |
| 26 | 123.1 | 60.1 | 124.0 | 60.5 | 124.9 | 60.9 | 125.8 | 61.4 | 126.7 | 61.8 | 127.6 | 62.2 | 128.5 | 62.7 | 129.4 | 63.1 | 64 |
| 27 | 122.1 | 62.2 | 123.0 | 62.7 | 123.8 | 63.1 | 124.7 | 63.6 | 125.6 | 64.0 | 126.5 | 64.5 | 127.4 | 64.9 | 128.3 | 65.4 | 63 |
| 28 | 121.0 | 64.3 | 121.8 | 64.8 | 122.7 | 65.3 | 123.6 | 65.7 | 124.5 | 66.2 | 125.4 | 66.7 | 126.3 | 67.1 | 127.1 | 67.6 | 62 |
| 29 | 119.8 | 66.4 | 120.7 | 66.9 | 121.6 | 67.4 | 122.4 | 67.9 | 123.3 | 68.4 | 124.2 | 68.8 | 125.1 | 69.3 | 125.9 | 69.8 | 61 |
| 30 | 118.6 | 68.5 | 119.5 | 69.0 | 120.4 | 69.5 | 121.2 | 70.0 | 122.1 | 70.5 | 123.0 | 71.0 | 123.8 | 71.5 | 124.7 | 72.0 | 60 |
| 31 | 117.4 | 70.6 | 118.3 | 71.1 | 119.1 | 71.6 | 120.0 | 72.1 | 120.9 | 72.6 | 121.7 | 73.1 | 122.6 | 73.7 | 123.4 | 74.2 | 59 |
| 32 | 116.2 | 72.6 | 117.0 | 73.1 | 117.9 | 73.7 | 118.7 | 74.2 | 119.6 | 74.7 | 120.4 | 75.2 | 121.3 | 75.8 | 122.1 | 76.3 | 58 |
| 33 | 114.9 | 74.6 | 115.7 | 75.2 | 116.6 | 75.7 | 117.4 | 76.2 | 118.3 | 76.8 | 119.1 | 77.3 | 119.9 | 77.9 | 120.8 | 78.4 | 57 |
| 34 | 113.6 | 76.6 | 114.4 | 77.2 | 115.2 | 77.7 | 116.1 | 78.3 | 116.9 | 78.8 | 117.7 | 79.4 | 118.6 | 80.0 | 119.4 | 80.5 | 56 |
| 35 | 112.2 | 78.6 | 113.0 | 79.2 | 113.9 | 79.7 | 114.7 | 80.3 | 115.5 | 80.9 | 116.3 | 81.4 | 117.1 | 82.0 | 118.0 | 82.6 | 55 |
| 36 | 110.8 | 80.5 | 111.6 | 81.1 | 112.5 | 81.7 | 113.3 | 82.3 | 114.1 | 82.9 | 114.9 | 83.5 | 115.7 | 84.1 | 116.5 | 84.6 | 54 |
| 37 | 109.4 | 82.4 | 110.2 | 83.1 | 111.0 | 83.7 | 111.8 | 84.3 | 112.6 | 84.9 | 113.4 | 85.5 | 114.2 | 86.1 | 115.0 | 86.7 | 53 |
| 38 | 108.0 | 84.3 | 108.7 | 85.0 | 109.5 | 85.6 | 110.3 | 86.2 | 111.1 | 86.8 | 111.9 | 87.4 | 112.7 | 88.0 | 113.5 | 88.7 | 52 |
| 39 | 106.5 | 86.2 | 107.2 | 86.8 | 108.0 | 87.5 | 108.8 | 88.1 | 109.6 | 88.7 | 110.4 | 89.4 | 111.1 | 90.0 | 111.9 | 90.6 | 51 |
| 40 | 104.9 | 88.1 | 105.7 | 88.7 | 106.5 | 89.3 | 107.2 | 90.0 | 108.0 | 90.6 | 108.8 | 91.3 | 109.5 | 91.9 | 110.3 | 92.6 | 50 |
| 41 | 103.4 | 89.9 | 104.1 | 90.5 | 104.9 | 91.2 | 105.7 | 91.8 | 106.4 | 92.5 | 107.2 | 93.2 | 107.9 | 93.8 | 108.7 | 94.5 | 49 |
| 42 | 101.8 | 91.7 | 102.6 | 92.3 | 103.3 | 93.0 | 104.0 | 93.7 | 104.8 | 94.3 | 105.5 | 95.0 | 106.3 | 95.7 | 107.0 | 96.4 | 48 |
| 43 | 100.2 | 93.4 | 100.9 | 94.1 | 101.7 | 94.8 | 102.4 | 95.5 | 103.1 | 96.2 | 103.9 | 96.8 | 104.6 | 97.5 | 105.3 | 98.2 | 47 |
| 44 | 98.5 | 95.2 | 99.3 | 95.9 | 100.0 | 96.6 | 100.7 | 97.3 | 101.4 | 97.9 | 102.1 | 98.6 | 102.9 | 99.3 | 103.6 | 100.0 | 46 |
| 45 | 96.9 | 96.9 | 97.6 | 97.6 | 98.3 | 98.3 | 99.0 | 99.0 | 99.7 | 99.7 | 100.4 | 100.4 | 101.1 | 101.1 | 101.8 | 101.8 | 45 |
| Cras. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Cras. |

(x.)

# Traverse Table.

| Distance. | 145 | | 146 | | 147 | | 148 | | 149 | | 150 | | 151 | | 152 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 144.8 | 07.1 | 145.8 | 07.2 | 146.8 | 07.2 | 147.8 | 07.3 | 148.8 | 07.3 | 149.8 | 07.4 | 150.8 | 07.4 | 151.8 | 07.5 | ¼ |
| ½ | 144.3 | 14.2 | 145.3 | 14.3 | 146.3 | 14.4 | 147.3 | 14.5 | 148.3 | 14.6 | 149.3 | 14.7 | 150.3 | 14.8 | 151.3 | 14.9 | ½ |
| ¾ | 143.4 | 21.3 | 144.4 | 21.4 | 145.4 | 21.6 | 146.4 | 21.7 | 147.4 | 21.9 | 148.4 | 22.0 | 149.4 | 22.2 | 150.3 | 22.3 | ¾ |
| 1 | 142.2 | 28.3 | 143.2 | 28.5 | 144.2 | 28.7 | 145.2 | 28.9 | 146.1 | 29.1 | 147.1 | 29.3 | 148.1 | 29.5 | 149.1 | 29.7 | 7 |
| ¼ | 140.7 | 35.2 | 141.6 | 35.5 | 142.6 | 35.7 | 143.6 | 36.0 | 144.5 | 36.2 | 145.5 | 36.5 | 146.5 | 36.7 | 147.4 | 36.9 | ¼ |
| ½ | 138.8 | 42.1 | 139.7 | 42.4 | 140.7 | 42.7 | 141.6 | 43.0 | 142.6 | 43.2 | 143.5 | 43.5 | 144.5 | 43.8 | 145.5 | 44.1 | ½ |
| ¾ | 136.5 | 48.8 | 137.5 | 49.2 | 138.4 | 49.5 | 139.3 | 49.9 | 140.3 | 50.2 | 141.2 | 50.5 | 142.2 | 50.9 | 143.1 | 51.2 | ¾ |
| 2 | 134.0 | 55.5 | 134.9 | 55.9 | 135.8 | 56.3 | 136.7 | 56.6 | 137.7 | 57.0 | 138.6 | 57.4 | 139.5 | 57.8 | 140.4 | 58.2 | 6 |
| ¼ | 131.1 | 62.0 | 132.0 | 62.4 | 132.9 | 62.9 | 133.8 | 63.3 | 134.7 | 63.7 | 135.6 | 64.1 | 136.5 | 64.6 | 137.4 | 65.0 | ¼ |
| ½ | 127.9 | 68.3 | 128.8 | 68.8 | 129.6 | 69.3 | 130.5 | 69.8 | 131.4 | 70.2 | 132.3 | 70.7 | 133.2 | 71.2 | 134.1 | 71.6 | ½ |
| ¾ | 124.4 | 74.5 | 125.2 | 75.1 | 126.1 | 75.6 | 126.9 | 76.1 | 127.8 | 76.6 | 128.7 | 77.1 | 129.5 | 77.6 | 130.4 | 78.1 | ¾ |
| 3 | 120.6 | 80.6 | 121.4 | 81.1 | 122.2 | 81.7 | 123.1 | 82.2 | 123.9 | 82.8 | 124.7 | 83.3 | 125.5 | 83.9 | 126.4 | 84.4 | 5 |
| ¼ | 116.5 | 86.4 | 117.3 | 87.0 | 118.1 | 87.6 | 118.9 | 88.2 | 119.7 | 88.8 | 120.5 | 89.4 | 121.3 | 90.0 | 122.1 | 90.5 | ¼ |
| ½ | 112.1 | 92.0 | 112.9 | 92.6 | 113.6 | 93.3 | 114.4 | 93.9 | 115.2 | 94.5 | 115.9 | 95.2 | 116.7 | 95.8 | 117.5 | 96.4 | ½ |
| ¾ | 107.4 | 97.4 | 108.2 | 98.0 | 108.9 | 98.7 | 109.7 | 99.4 | 110.4 | 100.1 | 111.1 | 100.7 | 111.9 | 101.4 | 112.6 | 102.1 | ¾ |
| 4 | 102.5 | 102.5 | 103.2 | 103.2 | 103.9 | 103.9 | 104.7 | 104.7 | 105.4 | 105.4 | 106.1 | 106.1 | 106.8 | 106.8 | 107.5 | 107.5 | 4 |
| 1° | 145.0 | 02.5 | 146.0 | 02.5 | 147.0 | 02.6 | 148.0 | 02.6 | 149.0 | 02.6 | 150.0 | 02.6 | 151.0 | 02.6 | 152.0 | 02.7 | 89° |
| 2 | 144.9 | 05.1 | 145.9 | 05.1 | 146.9 | 05.1 | 147.9 | 05.2 | 148.9 | 05.2 | 149.9 | 05.2 | 150.9 | 05.3 | 151.9 | 05.3 | 88 |
| 3 | 144.8 | 07.6 | 145.8 | 07.6 | 146.8 | 07.7 | 147.8 | 07.7 | 148.8 | 07.8 | 149.8 | 07.9 | 150.8 | 07.9 | 151.8 | 08.0 | 87 |
| 4 | 144.6 | 10.1 | 145.6 | 10.2 | 146.6 | 10.3 | 147.6 | 10.3 | 148.6 | 10.4 | 149.6 | 10.5 | 150.6 | 10.5 | 151.6 | 10.6 | 86 |
| 5 | 144.4 | 12.6 | 145.4 | 12.7 | 146.4 | 12.8 | 147.4 | 12.9 | 148.4 | 13.0 | 149.4 | 13.1 | 150.4 | 13.2 | 151.4 | 13.2 | 85 |
| 6 | 144.2 | 15.2 | 145.2 | 15.3 | 146.2 | 15.4 | 147.2 | 15.5 | 148.2 | 15.6 | 149.2 | 15.7 | 150.2 | 15.8 | 151.2 | 15.9 | 84 |
| 7 | 143.9 | 17.7 | 144.9 | 17.8 | 145.9 | 17.9 | 146.9 | 18.0 | 147.9 | 18.2 | 148.9 | 18.3 | 149.9 | 18.4 | 150.9 | 18.5 | 83 |
| 8 | 143.6 | 20.2 | 144.6 | 20.3 | 145.6 | 20.5 | 146.6 | 20.6 | 147.5 | 20.7 | 148.5 | 20.9 | 149.5 | 21.0 | 150.5 | 21.2 | 82 |
| 9 | 143.2 | 22.7 | 144.2 | 22.8 | 145.2 | 23.0 | 146.2 | 23.2 | 147.2 | 23.3 | 148.2 | 23.5 | 149.1 | 23.6 | 150.1 | 23.8 | 81 |
| 10 | 142.8 | 25.2 | 143.8 | 25.4 | 144.8 | 25.5 | 145.8 | 25.7 | 146.7 | 25.9 | 147.7 | 26.0 | 148.7 | 26.2 | 149.7 | 26.4 | 80 |
| 11 | 142.3 | 27.7 | 143.3 | 27.9 | 144.3 | 28.0 | 145.3 | 28.2 | 146.3 | 28.4 | 147.2 | 28.6 | 148.2 | 28.8 | 149.2 | 29.0 | 79 |
| 12 | 141.8 | 30.1 | 142.8 | 30.4 | 143.8 | 30.6 | 144.8 | 30.8 | 145.7 | 31.0 | 146.7 | 31.2 | 147.7 | 31.4 | 148.7 | 31.6 | 78 |
| 13 | 141.3 | 32.6 | 142.3 | 32.8 | 143.2 | 33.1 | 144.2 | 33.3 | 145.2 | 33.5 | 146.2 | 33.7 | 147.1 | 34.0 | 148.1 | 34.2 | 77 |
| 14 | 140.7 | 35.1 | 141.7 | 35.3 | 142.6 | 35.6 | 143.6 | 35.8 | 144.6 | 36.0 | 145.5 | 36.3 | 146.5 | 36.5 | 147.5 | 36.8 | 76 |
| 15 | 140.1 | 37.5 | 141.0 | 37.8 | 142.0 | 38.0 | 143.0 | 38.3 | 143.9 | 38.6 | 144.9 | 38.8 | 145.9 | 39.1 | 146.8 | 39.3 | 75 |
| 16 | 139.4 | 40.0 | 140.3 | 40.2 | 141.3 | 40.5 | 142.3 | 40.8 | 143.2 | 41.1 | 144.2 | 41.3 | 145.2 | 41.6 | 146.1 | 41.9 | 74 |
| 17 | 138.7 | 42.4 | 139.6 | 42.7 | 140.6 | 43.0 | 141.5 | 43.3 | 142.5 | 43.6 | 143.4 | 43.9 | 144.4 | 44.1 | 145.4 | 44.4 | 73 |
| 18 | 137.9 | 44.8 | 138.9 | 45.1 | 139.8 | 45.4 | 140.8 | 45.7 | 141.7 | 46.0 | 142.7 | 46.4 | 143.6 | 46.7 | 144.6 | 47.0 | 72 |
| 19 | 137.1 | 47.2 | 138.0 | 47.5 | 139.0 | 47.9 | 139.9 | 48.2 | 140.9 | 48.5 | 141.8 | 48.8 | 142.8 | 49.2 | 143.7 | 49.5 | 71 |
| 20 | 136.3 | 49.6 | 137.2 | 49.9 | 138.1 | 50.3 | 139.1 | 50.6 | 140.0 | 51.0 | 141.0 | 51.3 | 141.9 | 51.6 | 142.8 | 52.0 | 70 |
| 21 | 135.4 | 52.0 | 136.3 | 52.3 | 137.2 | 52.7 | 138.2 | 53.0 | 139.1 | 53.4 | 140.0 | 53.8 | 141.0 | 54.1 | 141.9 | 54.5 | 69 |
| 22 | 134.4 | 54.3 | 135.4 | 54.7 | 136.3 | 55.1 | 137.2 | 55.4 | 138.2 | 55.8 | 139.1 | 56.2 | 140.0 | 56.6 | 140.9 | 56.9 | 68 |
| 23 | 133.5 | 56.7 | 134.4 | 57.0 | 135.3 | 57.4 | 136.2 | 57.8 | 137.2 | 58.2 | 138.1 | 58.6 | 139.0 | 59.0 | 139.9 | 59.4 | 67 |
| 24 | 132.5 | 59.0 | 133.4 | 59.4 | 134.3 | 59.8 | 135.2 | 60.2 | 136.1 | 60.6 | 137.0 | 61.0 | 137.9 | 61.4 | 138.9 | 61.8 | 66 |
| 25 | 131.4 | 61.3 | 132.3 | 61.7 | 133.2 | 62.1 | 134.1 | 62.5 | 135.0 | 63.0 | 135.9 | 63.4 | 136.9 | 63.8 | 137.8 | 64.2 | 65 |
| 26 | 130.3 | 63.6 | 131.2 | 64.0 | 132.1 | 64.4 | 133.0 | 64.9 | 133.9 | 65.3 | 134.8 | 65.8 | 135.7 | 66.2 | 136.6 | 66.6 | 64 |
| 27 | 129.2 | 65.8 | 130.1 | 66.3 | 131.0 | 66.7 | 131.9 | 67.2 | 132.8 | 67.6 | 133.7 | 68.1 | 134.5 | 68.6 | 135.4 | 69.0 | 63 |
| 28 | 128.0 | 68.1 | 128.9 | 68.5 | 129.8 | 69.0 | 130.7 | 69.5 | 131.6 | 70.0 | 132.4 | 70.4 | 133.3 | 70.9 | 134.2 | 71.4 | 62 |
| 29 | 126.8 | 70.3 | 127.7 | 70.8 | 128.6 | 71.3 | 129.4 | 71.8 | 130.3 | 72.2 | 131.2 | 72.7 | 132.1 | 73.2 | 132.9 | 73.7 | 61 |
| 30 | 125.6 | 72.5 | 126.4 | 73.0 | 127.3 | 73.5 | 128.2 | 74.0 | 129.0 | 74.5 | 129.9 | 75.0 | 130.8 | 75.5 | 131.6 | 76.0 | 60 |
| 31 | 124.3 | 74.7 | 125.1 | 75.2 | 126.0 | 75.7 | 126.9 | 76.2 | 127.7 | 76.7 | 128.6 | 77.3 | 129.4 | 77.8 | 130.3 | 78.3 | 59 |
| 32 | 123.0 | 76.8 | 123.8 | 77.4 | 124.7 | 77.9 | 125.5 | 78.4 | 126.4 | 79.0 | 127.2 | 79.5 | 128.1 | 80.0 | 128.9 | 80.5 | 58 |
| 33 | 121.6 | 79.0 | 122.4 | 79.5 | 123.3 | 80.1 | 124.1 | 80.6 | 125.0 | 81.2 | 125.8 | 81.7 | 126.6 | 82.2 | 127.5 | 82.8 | 57 |
| 34 | 120.2 | 81.1 | 121.0 | 81.6 | 121.9 | 82.2 | 122.7 | 82.8 | 123.5 | 83.3 | 124.4 | 83.9 | 125.2 | 84.4 | 126.0 | 85.0 | 56 |
| 35 | 118.8 | 83.2 | 119.6 | 83.7 | 120.4 | 84.3 | 121.2 | 84.9 | 122.1 | 85.5 | 122.9 | 86.0 | 123.7 | 86.6 | 124.5 | 87.2 | 55 |
| 36 | 117.3 | 85.2 | 118.1 | 85.8 | 118.9 | 86.4 | 119.7 | 87.0 | 120.5 | 87.6 | 121.4 | 88.2 | 122.2 | 88.8 | 123.0 | 89.3 | 54 |
| 37 | 115.8 | 87.3 | 116.6 | 87.9 | 117.4 | 88.5 | 118.2 | 89.1 | 119.0 | 89.7 | 119.8 | 90.3 | 120.6 | 90.9 | 121.4 | 91.5 | 53 |
| 38 | 114.3 | 89.3 | 115.0 | 89.9 | 115.8 | 90.5 | 116.6 | 91.1 | 117.4 | 91.7 | 118.2 | 92.3 | 119.0 | 93.0 | 119.8 | 93.6 | 52 |
| 39 | 112.7 | 91.3 | 113.5 | 91.9 | 114.2 | 92.5 | 115.0 | 93.1 | 115.8 | 93.8 | 116.6 | 94.4 | 117.3 | 95.0 | 118.1 | 95.7 | 51 |
| 40 | 111.1 | 93.2 | 111.8 | 93.8 | 112.6 | 94.5 | 113.4 | 95.1 | 114.1 | 95.8 | 114.9 | 96.4 | 115.7 | 97.1 | 116.4 | 97.7 | 50 |
| 41 | 109.4 | 95.1 | 110.2 | 95.8 | 110.9 | 96.4 | 111.7 | 97.1 | 112.5 | 97.8 | 113.2 | 98.4 | 114.0 | 99.1 | 114.7 | 99.7 | 49 |
| 42 | 107.8 | 97.0 | 108.5 | 97.7 | 109.2 | 98.4 | 110.0 | 99.0 | 110.7 | 99.7 | 111.5 | 100.4 | 112.2 | 101.0 | 113.0 | 101.7 | 48 |
| 43 | 106.0 | 98.9 | 106.8 | 99.6 | 107.5 | 100.3 | 108.2 | 100.9 | 109.0 | 101.6 | 109.7 | 102.3 | 110.4 | 103.0 | 111.2 | 103.7 | 47 |
| 44 | 104.3 | 100.7 | 105.0 | 101.4 | 105.7 | 102.1 | 106.5 | 102.8 | 107.2 | 103.5 | 107.9 | 104.2 | 108.6 | 104.9 | 109.3 | 105.6 | 46 |
| 45 | 102.5 | 102.5 | 103.2 | 103.2 | 103.9 | 103.9 | 104.7 | 104.7 | 105.4 | 105.4 | 106.1 | 106.1 | 106.8 | 106.8 | 107.5 | 107.5 | 45 |
| Crse. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 169 | | 170 | | 171 | | 172 | | 173 | | 174 | | 175 | | 176 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cmn. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Cmn. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 168.8 | 08.3 | 169.8 | 08.3 | 170.8 | 08.4 | 171.8 | 08.4 | 172.8 | 08.5 | 173.8 | 08.5 | 174.8 | 08.6 | 175.8 | 08.6 | ¾ |
| ½ | 168.2 | 16.6 | 169.2 | 16.7 | 170.2 | 16.8 | 171.2 | 16.9 | 172.2 | 17.0 | 173.2 | 17.1 | 174.2 | 17.2 | 175.2 | 17.3 | ½ |
| ¾ | 167.2 | 24.8 | 168.2 | 24.9 | 169.1 | 25.1 | 170.1 | 25.2 | 171.1 | 25.4 | 172.1 | 25.5 | 173.1 | 25.7 | 174.1 | 25.8 | ¼ |
| 1 | 165.7 | 33.0 | 166.7 | 33.2 | 167.7 | 33.4 | 168.7 | 33.6 | 169.7 | 33.8 | 170.7 | 34.0 | 171.6 | 34.1 | 172.6 | 34.3 | 7 |
| ¼ | 163.9 | 41.1 | 164.9 | 41.3 | 165.9 | 41.6 | 166.8 | 41.8 | 167.8 | 42.0 | 168.8 | 42.3 | 169.8 | 42.5 | 170.7 | 42.8 | ¾ |
| ½ | 161.7 | 49.1 | 162.7 | 49.3 | 163.6 | 49.6 | 164.6 | 49.9 | 165.6 | 50.2 | 166.5 | 50.5 | 167.5 | 50.8 | 168.4 | 51.1 | ½ |
| ¾ | 159.1 | 56.9 | 160.1 | 57.3 | 161.0 | 57.6 | 161.9 | 57.9 | 162.9 | 58.3 | 163.8 | 58.6 | 164.8 | 59.0 | 165.7 | 59.3 | ¼ |
| 2 | 156.1 | 64.7 | 157.1 | 65.1 | 158.0 | 65.4 | 158.9 | 65.8 | 159.8 | 66.2 | 160.8 | 66.6 | 161.7 | 67.0 | 162.6 | 67.4 | 6 |
| ¼ | 152.8 | 72.3 | 153.7 | 72.7 | 154.6 | 73.1 | 155.5 | 73.6 | 156.4 | 74.0 | 157.3 | 74.4 | 158.2 | 74.8 | 159.1 | 75.3 | ¾ |
| ½ | 149.0 | 79.7 | 149.9 | 80.1 | 150.8 | 80.6 | 151.7 | 81.1 | 152.6 | 81.5 | 153.5 | 82.0 | 154.3 | 82.5 | 155.2 | 83.0 | ½ |
| ¾ | 145.0 | 86.9 | 145.8 | 87.4 | 146.7 | 87.9 | 147.5 | 88.4 | 148.4 | 88.9 | 149.2 | 89.4 | 150.1 | 90.0 | 151.0 | 90.5 | ¼ |
| 3 | 140.5 | 93.9 | 141.3 | 94.4 | 142.2 | 95.0 | 143.0 | 95.6 | 143.8 | 96.1 | 144.7 | 96.7 | 145.5 | 97.2 | 146.3 | 97.8 | 5 |
| ¼ | 135.7 | 100.7 | 136.5 | 101.3 | 137.3 | 101.9 | 138.1 | 102.5 | 138.9 | 103.1 | 139.8 | 103.7 | 140.6 | 104.2 | 141.4 | 104.8 | ¾ |
| ½ | 130.6 | 107.2 | 131.4 | 107.8 | 132.2 | 108.5 | 133.0 | 109.1 | 133.7 | 109.7 | 134.5 | 110.4 | 135.3 | 111.0 | 136.0 | 111.6 | ½ |
| ¾ | 125.2 | 113.5 | 126.0 | 114.2 | 126.7 | 114.8 | 127.4 | 115.5 | 128.2 | 116.2 | 128.9 | 116.8 | 129.7 | 117.5 | 130.4 | 118.2 | ¼ |
| 4 | 119.5 | 119.5 | 120.2 | 120.2 | 120.9 | 120.9 | 121.6 | 121.6 | 122.3 | 122.3 | 123.0 | 123.0 | 123.7 | 123.7 | 124.4 | 124.4 | 4 |
| 1° | 169.0 | 02.9 | 170.0 | 03.0 | 171.0 | 03.0 | 172.0 | 03.0 | 173.0 | 03.0 | 174.0 | 03.0 | 175.0 | 03.1 | 176.0 | 03.1 | 89° |
| 2 | 168.9 | 05.9 | 169.9 | 05.9 | 170.9 | 06.0 | 171.9 | 06.0 | 172.9 | 06.0 | 173.9 | 06.1 | 174.9 | 06.1 | 175.9 | 06.1 | 88 |
| 3 | 168.8 | 08.8 | 169.8 | 08.9 | 170.8 | 08.9 | 171.8 | 09.0 | 172.8 | 09.1 | 173.8 | 09.1 | 174.8 | 09.2 | 175.8 | 09.2 | 87 |
| 4 | 168.6 | 11.8 | 169.6 | 11.9 | 170.6 | 11.9 | 171.6 | 12.0 | 172.6 | 12.1 | 173.6 | 12.1 | 174.6 | 12.2 | 175.6 | 12.3 | 86 |
| 5 | 168.4 | 14.7 | 169.4 | 14.8 | 170.3 | 14.9 | 171.3 | 15.0 | 172.3 | 15.1 | 173.3 | 15.2 | 174.3 | 15.3 | 175.3 | 15.3 | 85 |
| 6 | 168.1 | 17.7 | 169.1 | 17.8 | 170.1 | 17.9 | 171.1 | 18.0 | 172.1 | 18.1 | 173.0 | 18.2 | 174.0 | 18.3 | 175.0 | 18.4 | 84 |
| 7 | 167.7 | 20.6 | 168.7 | 20.7 | 169.7 | 20.8 | 170.7 | 21.0 | 171.7 | 21.1 | 172.7 | 21.2 | 173.7 | 21.3 | 174.7 | 21.4 | 83 |
| 8 | 167.4 | 23.5 | 168.3 | 23.7 | 169.3 | 23.8 | 170.3 | 23.9 | 171.3 | 24.1 | 172.3 | 24.2 | 173.3 | 24.4 | 174.3 | 24.5 | 82 |
| 9 | 166.9 | 26.4 | 167.9 | 26.6 | 168.9 | 26.8 | 169.9 | 26.9 | 170.9 | 27.1 | 171.9 | 27.2 | 172.8 | 27.4 | 173.8 | 27.5 | 81 |
| 10 | 166.4 | 29.3 | 167.4 | 29.5 | 168.4 | 29.7 | 169.4 | 29.9 | 170.4 | 30.0 | 171.4 | 30.2 | 172.3 | 30.4 | 173.3 | 30.6 | 80 |
| 11 | 165.9 | 32.2 | 166.9 | 32.4 | 167.9 | 32.6 | 168.8 | 32.8 | 169.8 | 33.0 | 170.8 | 33.2 | 171.8 | 33.4 | 172.8 | 33.6 | 79 |
| 12 | 165.3 | 35.1 | 166.3 | 35.3 | 167.3 | 35.6 | 168.2 | 35.8 | 169.2 | 36.0 | 170.2 | 36.2 | 171.2 | 36.4 | 172.2 | 36.6 | 78 |
| 13 | 164.7 | 38.0 | 165.6 | 38.2 | 166.6 | 38.5 | 167.6 | 38.7 | 168.6 | 38.9 | 169.5 | 39.1 | 170.5 | 39.4 | 171.5 | 39.6 | 77 |
| 14 | 164.0 | 40.9 | 165.0 | 41.1 | 165.9 | 41.4 | 166.9 | 41.6 | 167.9 | 41.9 | 168.8 | 42.1 | 169.8 | 42.3 | 170.8 | 42.6 | 76 |
| 15 | 163.2 | 43.7 | 164.2 | 44.0 | 165.2 | 44.3 | 166.1 | 44.5 | 167.1 | 44.8 | 168.1 | 45.0 | 169.0 | 45.3 | 170.0 | 45.6 | 75 |
| 16 | 162.5 | 46.6 | 163.4 | 46.9 | 164.4 | 47.1 | 165.3 | 47.4 | 166.3 | 47.7 | 167.3 | 48.0 | 168.2 | 48.2 | 169.2 | 48.5 | 74 |
| 17 | 161.6 | 49.4 | 162.6 | 49.7 | 163.5 | 50.0 | 164.5 | 50.3 | 165.4 | 50.6 | 166.4 | 50.9 | 167.4 | 51.2 | 168.3 | 51.5 | 73 |
| 18 | 160.7 | 52.2 | 161.7 | 52.5 | 162.6 | 52.8 | 163.6 | 53.2 | 164.5 | 53.5 | 165.5 | 53.8 | 166.4 | 54.1 | 167.4 | 54.4 | 72 |
| 19 | 159.8 | 55.0 | 160.7 | 55.3 | 161.7 | 55.7 | 162.6 | 56.0 | 163.6 | 56.3 | 164.5 | 56.6 | 165.5 | 57.0 | 166.4 | 57.3 | 71 |
| 20 | 158.8 | 57.8 | 159.7 | 58.1 | 160.7 | 58.5 | 161.6 | 58.8 | 162.6 | 59.2 | 163.5 | 59.5 | 164.4 | 59.9 | 165.4 | 60.2 | 70 |
| 21 | 157.8 | 60.6 | 158.7 | 60.9 | 159.6 | 61.3 | 160.6 | 61.6 | 161.5 | 62.0 | 162.4 | 62.4 | 163.4 | 62.7 | 164.3 | 63.1 | 69 |
| 22 | 156.7 | 63.3 | 157.6 | 63.7 | 158.5 | 64.1 | 159.5 | 64.4 | 160.4 | 64.8 | 161.3 | 65.2 | 162.3 | 65.6 | 163.2 | 65.9 | 68 |
| 23 | 155.6 | 66.0 | 156.5 | 66.4 | 157.4 | 66.8 | 158.3 | 67.2 | 159.2 | 67.6 | 160.2 | 68.0 | 161.1 | 68.4 | 162.0 | 68.8 | 67 |
| 24 | 154.4 | 68.7 | 155.3 | 69.1 | 156.2 | 69.6 | 157.1 | 70.0 | 158.0 | 70.4 | 159.0 | 70.8 | 159.9 | 71.2 | 160.8 | 71.6 | 66 |
| 25 | 153.2 | 71.4 | 154.1 | 71.8 | 155.0 | 72.3 | 155.9 | 72.7 | 156.8 | 73.1 | 157.7 | 73.5 | 158.6 | 74.0 | 159.5 | 74.4 | 65 |
| 26 | 151.9 | 74.1 | 152.8 | 74.5 | 153.7 | 75.0 | 154.6 | 75.4 | 155.5 | 75.8 | 156.4 | 76.3 | 157.3 | 76.7 | 158.2 | 77.2 | 64 |
| 27 | 150.6 | 76.7 | 151.5 | 77.2 | 152.4 | 77.6 | 153.3 | 78.1 | 154.1 | 78.5 | 155.0 | 79.0 | 155.9 | 79.4 | 156.8 | 79.9 | 63 |
| 28 | 149.2 | 79.3 | 150.1 | 79.8 | 151.0 | 80.3 | 151.9 | 80.7 | 152.7 | 81.2 | 153.6 | 81.7 | 154.5 | 82.2 | 155.4 | 82.6 | 62 |
| 29 | 147.8 | 81.9 | 148.7 | 82.4 | 149.6 | 82.9 | 150.4 | 83.4 | 151.3 | 83.9 | 152.2 | 84.4 | 153.1 | 84.8 | 153.9 | 85.3 | 61 |
| 30 | 146.4 | 84.5 | 147.2 | 85.0 | 148.1 | 85.5 | 149.0 | 86.0 | 149.8 | 86.5 | 150.7 | 87.0 | 151.6 | 87.5 | 152.4 | 88.0 | 60 |
| 31 | 144.9 | 87.0 | 145.7 | 87.6 | 146.6 | 88.1 | 147.4 | 88.6 | 148.3 | 89.1 | 149.1 | 89.6 | 150.0 | 90.1 | 150.9 | 90.6 | 59 |
| 32 | 143.3 | 89.6 | 144.2 | 90.1 | 145.0 | 90.6 | 145.9 | 91.1 | 146.7 | 91.7 | 147.6 | 92.2 | 148.4 | 92.7 | 149.3 | 93.3 | 58 |
| 33 | 141.7 | 92.0 | 142.6 | 92.6 | 143.4 | 93.1 | 144.3 | 93.7 | 145.1 | 94.2 | 145.9 | 94.8 | 146.8 | 95.3 | 147.6 | 95.9 | 57 |
| 34 | 140.1 | 94.5 | 140.9 | 95.1 | 141.8 | 95.6 | 142.6 | 96.2 | 143.4 | 96.7 | 144.3 | 97.3 | 145.1 | 97.9 | 145.9 | 98.4 | 56 |
| 35 | 138.4 | 96.9 | 139.3 | 97.5 | 140.1 | 98.1 | 140.9 | 98.7 | 141.7 | 99.2 | 142.5 | 99.8 | 143.4 | 100.4 | 144.2 | 100.9 | 55 |
| 36 | 136.7 | 99.3 | 137.5 | 99.9 | 138.3 | 100.5 | 139.2 | 101.1 | 140.0 | 101.7 | 140.8 | 102.3 | 141.6 | 102.9 | 142.4 | 103.5 | 54 |
| 37 | 135.0 | 101.7 | 135.8 | 102.3 | 136.6 | 102.9 | 137.4 | 103.5 | 138.2 | 104.1 | 139.0 | 104.7 | 139.8 | 105.3 | 140.6 | 105.9 | 53 |
| 38 | 133.2 | 104.0 | 134.0 | 104.7 | 134.7 | 105.3 | 135.5 | 105.9 | 136.3 | 106.5 | 137.1 | 107.1 | 137.9 | 107.7 | 138.7 | 108.4 | 52 |
| 39 | 131.3 | 106.4 | 132.1 | 107.0 | 132.9 | 107.6 | 133.7 | 108.2 | 134.4 | 108.9 | 135.2 | 109.5 | 136.0 | 110.1 | 136.8 | 110.8 | 51 |
| 40 | 129.5 | 108.6 | 130.2 | 109.3 | 131.0 | 109.9 | 131.8 | 110.6 | 132.5 | 111.2 | 133.3 | 111.8 | 134.1 | 112.5 | 134.8 | 113.1 | 50 |
| 41 | 127.5 | 110.9 | 128.3 | 111.5 | 129.1 | 112.2 | 129.8 | 112.8 | 130.6 | 113.5 | 131.3 | 114.2 | 132.1 | 114.8 | 132.8 | 115.5 | 49 |
| 42 | 125.6 | 113.1 | 126.3 | 113.8 | 127.1 | 114.4 | 127.8 | 115.1 | 128.6 | 115.8 | 129.3 | 116.4 | 130.1 | 117.1 | 130.8 | 117.8 | 48 |
| 43 | 123.6 | 115.3 | 124.3 | 115.9 | 125.1 | 116.6 | 125.8 | 117.3 | 126.5 | 118.0 | 127.3 | 118.7 | 128.0 | 119.3 | 128.7 | 120.0 | 47 |
| 44 | 121.6 | 117.4 | 122.3 | 118.1 | 123.0 | 118.8 | 123.7 | 119.5 | 124.4 | 120.2 | 125.2 | 120.9 | 125.9 | 121.6 | 126.6 | 122.3 | 46 |
| 45 | 119.5 | 119.5 | 120.2 | 120.2 | 120.9 | 120.9 | 121.6 | 121.6 | 122.3 | 122.3 | 123.0 | 123.0 | 123.7 | 123.7 | 124.5 | 124.5 | 45 |
| Cmn. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Cmn. |

## Traverse Table. (x.)

| Distance | 177 | | 178 | | 179 | | 180 | | 181 | | 182 | | 183 | | 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 176.8 | 08.7 | 177.8 | 08.7 | 178.8 | 08.8 | 179.8 | 08.8 | 180.8 | 08.9 | 181.8 | 08.9 | 182.8 | 09.0 | 183.8 | 09.0 | ¾ |
| ½ | 176.1 | 17.4 | 177.1 | 17.4 | 178.1 | 17.5 | 179.1 | 17.6 | 180.1 | 17.7 | 181.1 | 17.8 | 182.1 | 17.9 | 183.1 | 18.0 | ½ |
| ¾ | 175.1 | 26.0 | 176.1 | 26.1 | 177.1 | 26.3 | 178.0 | 26.4 | 179.0 | 26.6 | 180.0 | 26.7 | 181.0 | 26.8 | 182.0 | 27.0 | ¼ |
| 1 | 173.6 | 34.5 | 174.6 | 34.7 | 175.6 | 34.9 | 176.5 | 35.1 | 177.5 | 35.3 | 178.5 | 35.5 | 179.5 | 35.7 | 180.5 | 35.9 | 7 |
| ¼ | 171.7 | 43.0 | 172.7 | 43.3 | 173.6 | 43.5 | 174.6 | 43.7 | 175.6 | 44.0 | 176.5 | 44.2 | 177.5 | 44.5 | 178.5 | 44.7 | ¾ |
| ½ | 169.4 | 51.4 | 170.3 | 51.7 | 171.3 | 52.0 | 172.3 | 52.2 | 173.2 | 52.5 | 174.2 | 52.8 | 175.1 | 53.1 | 176.1 | 53.4 | ½ |
| ¾ | 166.6 | 59.6 | 167.6 | 60.0 | 168.5 | 60.3 | 169.5 | 60.6 | 170.4 | 61.0 | 171.4 | 61.3 | 172.3 | 61.6 | 173.2 | 62.0 | ¼ |
| 2 | 163.5 | 67.7 | 164.5 | 68.1 | 165.4 | 68.5 | 166.3 | 68.9 | 167.2 | 69.3 | 168.2 | 69.7 | 169.1 | 70.0 | 170.0 | 70.4 | 6 |
| ¼ | 160.0 | 75.7 | 160.9 | 76.1 | 161.8 | 76.5 | 162.7 | 77.0 | 163.6 | 77.4 | 164.5 | 77.8 | 165.4 | 78.3 | 166.3 | 78.7 | ¾ |
| ½ | 156.1 | 83.4 | 157.0 | 83.9 | 157.9 | 84.4 | 158.8 | 84.8 | 159.6 | 85.3 | 160.5 | 85.8 | 161.4 | 86.3 | 162.3 | 86.7 | ½ |
| ¾ | 151.8 | 91.0 | 152.7 | 91.5 | 153.5 | 92.0 | 154.4 | 92.5 | 155.3 | 93.0 | 156.1 | 93.6 | 157.0 | 94.1 | 157.8 | 94.6 | ¼ |
| 3 | 147.2 | 98.3 | 148.0 | 98.9 | 148.8 | 99.4 | 149.7 | 100.0 | 150.5 | 100.6 | 151.3 | 101.1 | 152.2 | 101.7 | 153.0 | 102.2 | 5 |
| ¼ | 142.2 | 105.4 | 143.0 | 106.0 | 143.8 | 106.6 | 144.6 | 107.2 | 145.4 | 107.8 | 146.2 | 108.4 | 147.0 | 109.0 | 147.8 | 109.6 | ¾ |
| ½ | 136.8 | 112.3 | 137.6 | 112.9 | 138.4 | 113.6 | 139.1 | 114.2 | 139.9 | 114.8 | 140.7 | 115.5 | 141.5 | 116.1 | 142.2 | 116.7 | ½ |
| ¾ | 131.1 | 118.9 | 131.9 | 119.5 | 132.6 | 120.2 | 133.4 | 120.9 | 134.1 | 121.5 | 134.8 | 122.2 | 135.6 | 122.9 | 136.3 | 123.6 | ¼ |
| 4 | 125.2 | 125.2 | 125.9 | 125.9 | 126.6 | 126.6 | 127.3 | 127.3 | 128.0 | 128.0 | 128.7 | 128.7 | 129.4 | 129.4 | 130.1 | 130.1 | 4 |
| 1° | 177.0 | 03.1 | 178.0 | 03.1 | 179.0 | 03.1 | 180.0 | 03.1 | 181.0 | 03.2 | 182.0 | 03.2 | 183.0 | 03.2 | 184.0 | 03.2 | 89° |
| 2 | 176.9 | 06.2 | 177.9 | 06.2 | 178.9 | 06.2 | 179.9 | 06.3 | 180.9 | 06.3 | 181.9 | 06.4 | 182.9 | 06.4 | 183.9 | 06.4 | 88 |
| 3 | 176.8 | 09.3 | 177.8 | 09.3 | 178.8 | 09.4 | 179.8 | 09.4 | 180.8 | 09.5 | 181.8 | 09.5 | 182.7 | 09.6 | 183.7 | 09.6 | 87 |
| 4 | 176.6 | 12.3 | 177.6 | 12.4 | 178.6 | 12.5 | 179.6 | 12.6 | 180.6 | 12.6 | 181.6 | 12.7 | 182.6 | 12.8 | 183.6 | 12.8 | 86 |
| 5 | 176.3 | 15.4 | 177.3 | 15.5 | 178.3 | 15.6 | 179.3 | 15.7 | 180.3 | 15.8 | 181.3 | 15.9 | 182.3 | 15.9 | 183.3 | 16.0 | 85 |
| 6 | 176.0 | 18.5 | 177.0 | 18.6 | 178.0 | 18.7 | 179.0 | 18.8 | 180.0 | 18.9 | 181.0 | 19.0 | 182.0 | 19.1 | 183.0 | 19.2 | 84 |
| 7 | 175.7 | 21.6 | 176.7 | 21.7 | 177.7 | 21.8 | 178.7 | 21.9 | 179.7 | 22.1 | 180.6 | 22.2 | 181.6 | 22.3 | 182.6 | 22.4 | 83 |
| 8 | 175.3 | 24.6 | 176.3 | 24.8 | 177.3 | 24.9 | 178.2 | 25.1 | 179.2 | 25.2 | 180.2 | 25.3 | 181.2 | 25.5 | 182.2 | 25.6 | 82 |
| 9 | 174.8 | 27.7 | 175.8 | 27.8 | 176.8 | 28.0 | 177.8 | 28.2 | 178.8 | 28.3 | 179.8 | 28.5 | 180.7 | 28.6 | 181.7 | 28.8 | 81 |
| 10 | 174.3 | 30.7 | 175.3 | 30.9 | 176.3 | 31.1 | 177.3 | 31.3 | 178.3 | 31.4 | 179.2 | 31.6 | 180.2 | 31.8 | 181.2 | 32.0 | 80 |
| 11 | 173.7 | 33.8 | 174.7 | 34.0 | 175.7 | 34.2 | 176.7 | 34.3 | 177.7 | 34.5 | 178.7 | 34.7 | 179.6 | 34.9 | 180.6 | 35.1 | 79 |
| 12 | 173.1 | 36.8 | 174.1 | 37.0 | 175.1 | 37.2 | 176.1 | 37.4 | 177.0 | 37.6 | 178.0 | 37.8 | 179.0 | 38.0 | 180.0 | 38.3 | 78 |
| 13 | 172.5 | 39.8 | 173.4 | 40.0 | 174.4 | 40.3 | 175.4 | 40.5 | 176.4 | 40.7 | 177.3 | 40.9 | 178.3 | 41.2 | 179.3 | 41.4 | 77 |
| 14 | 171.7 | 42.8 | 172.7 | 43.1 | 173.7 | 43.3 | 174.7 | 43.5 | 175.6 | 43.8 | 176.6 | 44.0 | 177.6 | 44.3 | 178.5 | 44.5 | 76 |
| 15 | 171.0 | 45.8 | 171.9 | 46.1 | 172.9 | 46.3 | 173.9 | 46.6 | 174.8 | 46.8 | 175.8 | 47.1 | 176.8 | 47.4 | 177.7 | 47.6 | 75 |
| 16 | 170.1 | 48.8 | 171.1 | 49.1 | 172.1 | 49.3 | 173.0 | 49.6 | 174.0 | 49.9 | 174.9 | 50.2 | 175.9 | 50.4 | 176.9 | 50.7 | 74 |
| 17 | 169.3 | 51.7 | 170.2 | 52.0 | 171.2 | 52.3 | 172.1 | 52.6 | 173.1 | 52.9 | 174.0 | 53.2 | 175.0 | 53.5 | 176.0 | 53.8 | 73 |
| 18 | 168.3 | 54.7 | 169.3 | 55.0 | 170.2 | 55.3 | 171.2 | 55.6 | 172.1 | 55.9 | 173.1 | 56.2 | 174.0 | 56.6 | 175.0 | 56.9 | 72 |
| 19 | 167.4 | 57.6 | 168.3 | 58.0 | 169.2 | 58.3 | 170.2 | 58.6 | 171.1 | 58.9 | 172.1 | 59.3 | 173.0 | 59.6 | 174.0 | 59.9 | 71 |
| 20 | 166.3 | 60.5 | 167.3 | 60.9 | 168.2 | 61.2 | 169.1 | 61.6 | 170.1 | 61.9 | 171.0 | 62.2 | 172.0 | 62.6 | 172.9 | 62.9 | 70 |
| 21 | 165.2 | 63.4 | 166.2 | 63.8 | 167.1 | 64.1 | 168.0 | 64.5 | 169.0 | 64.9 | 169.9 | 65.2 | 170.8 | 65.6 | 171.8 | 65.9 | 69 |
| 22 | 164.1 | 66.3 | 165.0 | 66.7 | 166.0 | 67.1 | 166.9 | 67.4 | 167.8 | 67.8 | 168.7 | 68.2 | 169.7 | 68.6 | 170.6 | 68.9 | 68 |
| 23 | 162.9 | 69.2 | 163.8 | 69.6 | 164.8 | 69.9 | 165.7 | 70.3 | 166.6 | 70.7 | 167.5 | 71.1 | 168.5 | 71.5 | 169.4 | 71,9 | 67 |
| 24 | 161.7 | 72.0 | 162.6 | 72.4 | 163.5 | 72.8 | 164.4 | 73.2 | 165.4 | 73.6 | 166.3 | 74.0 | 167.2 | 74.4 | 168.1 | 74.8 | 66 |
| 25 | 160.4 | 74.8 | 161.3 | 75.2 | 162.2 | 75.6 | 163.1 | 76.1 | 164.0 | 76.5 | 164.9 | 76.9 | 165.9 | 77.3 | 166.8 | 77.8 | 65 |
| 26 | 159.1 | 77.6 | 160.0 | 78.0 | 160.9 | 78.5 | 161.8 | 78.9 | 162.7 | 79.3 | 163.6 | 79.8 | 164.5 | 80.2 | 165.4 | 80.7 | 64 |
| 27 | 157.7 | 80.4 | 158.6 | 80.8 | 159.5 | 81.3 | 160.4 | 81.7 | 161.3 | 82.2 | 162.2 | 82.6 | 163.1 | 83.1 | 163.9 | 83.5 | 63 |
| 28 | 156.3 | 83.1 | 157.2 | 83.6 | 158.0 | 84.0 | 158.9 | 84.5 | 159.8 | 85.0 | 160.7 | 85.4 | 161.6 | 85.9 | 162.5 | 86.4 | 62 |
| 29 | 154.8 | 85.8 | 155.7 | 86.3 | 156.6 | 86.8 | 157.4 | 87.3 | 158.3 | 87.8 | 159.2 | 88.2 | 160.1 | 88.7 | 160.9 | 89.2 | 61 |
| 30 | 153.3 | 88.5 | 154.2 | 89.0 | 155.0 | 89.5 | 155.9 | 90.0 | 156.8 | 90.5 | 157.6 | 91.0 | 158.5 | 91.5 | 159.3 | 92.0 | 60 |
| 31 | 151.7 | 91.2 | 152.6 | 91.7 | 153.4 | 92.2 | 154.3 | 92.7 | 155.1 | 93.2 | 156.0 | 93.7 | 156.9 | 94.3 | 157.7 | 94.8 | 59 |
| 32 | 150.1 | 93.8 | 151.0 | 94.3 | 151.8 | 94.9 | 152.6 | 95.4 | 153.5 | 95.9 | 154.3 | 96.4 | 155.2 | 97.0 | 156.0 | 97.5 | 58 |
| 33 | 148.4 | 96.4 | 149.3 | 96.9 | 150.1 | 97.5 | 151.0 | 98.0 | 151.8 | 98.6 | 152.6 | 99.1 | 153.5 | 99.7 | 154.3 | 100.2 | 57 |
| 34 | 146.7 | 99.0 | 147.6 | 99.5 | 148.4 | 100.1 | 149.2 | 100.7 | 150.1 | 101.2 | 150.9 | 101.8 | 151.7 | 102.3 | 152.5 | 102.9 | 56 |
| 35 | 145.0 | 101.5 | 145.8 | 102.1 | 146.6 | 102.7 | 147.4 | 103.2 | 148.3 | 103.8 | 149.1 | 104.4 | 149.9 | 105.0 | 150.7 | 105.5 | 55 |
| 36 | 143.2 | 104.0 | 144.0 | 104.6 | 144.8 | 105.2 | 145.6 | 105.8 | 146.4 | 106.4 | 147.2 | 107.0 | 148.1 | 107.6 | 148.9 | 108.2 | 54 |
| 37 | 141.4 | 106.5 | 142.2 | 107.1 | 143.0 | 107.7 | 143.8 | 108.3 | 144.6 | 108.9 | 145.4 | 109.5 | 146.2 | 110.1 | 146.9 | 110.7 | 53 |
| 38 | 139.5 | 109.0 | 140.3 | 109.6 | 141.1 | 110.2 | 141.8 | 110.8 | 142.6 | 111.4 | 143.4 | 112.1 | 144.2 | 112.7 | 145.0 | 113.3 | 52 |
| 39 | 137.6 | 111.4 | 138.3 | 112.0 | 139.1 | 112.6 | 139.9 | 113.3 | 140.7 | 113.9 | 141.4 | 114.5 | 142.2 | 115.2 | 143.0 | 115.8 | 51 |
| 40 | 135.6 | 113.8 | 136.4 | 114.4 | 137.1 | 115.1 | 137.9 | 115.7 | 138.7 | 116.3 | 139.4 | 117.0 | 140.2 | 117.6 | 141.0 | 118.3 | 50 |
| 41 | 133.6 | 116.1 | 134.3 | 116.8 | 135.1 | 117.4 | 135.8 | 118.1 | 136.6 | 118.7 | 137.4 | 119.4 | 138.1 | 120.1 | 138.9 | 120.7 | 49 |
| 42 | 131.5 | 118.4 | 132.3 | 119.1 | 133.0 | 119.8 | 133.8 | 120.4 | 134.5 | 121.1 | 135.3 | 121.8 | 136.0 | 122.5 | 136.7 | 123.1 | 48 |
| 43 | 129.4 | 120.7 | 130.2 | 121.4 | 130.9 | 122.1 | 131.6 | 122.8 | 132.4 | 123.4 | 133.1 | 124.1 | 133.8 | 124.8 | 134.6 | 125.5 | 47 |
| 44 | 127.3 | 123.0 | 128.0 | 123.6 | 128.8 | 124.3 | 129.5 | 125.0 | 130.2 | 125.7 | 130.9 | 126.4 | 131.6 | 127.1 | 132.4 | 127.8 | 46 |
| 45 | 125.2 | 125.2 | 125.9 | 125.9 | 126.6 | 126.6 | 127.3 | 127.3 | 128.0 | 128.0 | 128.7 | 128.7 | 129.4 | 129.4 | 130.1 | 130.1 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x)

| Distance. | 185 | | 186 | | 187 | | 188 | | 189 | | 190 | | 191 | | 192 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cros Pts | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Cros Pts |
| ¼ | 184.8 | 09.1 | 185.8 | 09.1 | 186.8 | 09.2 | 187.8 | 09.2 | 188.8 | 09.3 | 189.8 | 09.3 | 190.8 | 09.4 | 191.8 | 09.4 | ¼ |
| ½ | 184.1 | 18.1 | 185.1 | 18.2 | 186.1 | 18.3 | 187.1 | 18.4 | 188.1 | 18.5 | 189.1 | 18.6 | 190.1 | 18.7 | 191.1 | 18.8 | ½ |
| ¾ | 183.0 | 27.1 | 184.0 | 27.3 | 185.0 | 27.4 | 186.0 | 27.6 | 186.9 | 27.7 | 187.9 | 27.9 | 188.9 | 28.0 | 189.9 | 28.2 | ¾ |
| 1 | 181.4 | 36.1 | 182.4 | 36.3 | 183.4 | 36.5 | 184.4 | 36.7 | 185.4 | 36.9 | 186.3 | 37.1 | 187.3 | 37.3 | 188.3 | 37.5 | 7 |
| ¼ | 179.5 | 45.0 | 180.4 | 45.2 | 181.4 | 45.4 | 182.4 | 45.7 | 183.3 | 45.9 | 184.3 | 46.2 | 185.3 | 46.4 | 186.2 | 46.7 | ¼ |
| ½ | 177.0 | 53.7 | 178.0 | 54.0 | 179.0 | 54.3 | 179.9 | 54.6 | 180.9 | 54.9 | 181.8 | 55.1 | 182.8 | 55.4 | 183.7 | 55.7 | ½ |
| ¾ | 174.2 | 62.3 | 175.1 | 62.7 | 176.1 | 63.0 | 177.0 | 63.3 | 177.9 | 63.7 | 178.9 | 64.0 | 179.8 | 64.3 | 180.8 | 64.7 | ¾ |
| 2 | 170.9 | 70.8 | 171.8 | 71.2 | 172.8 | 71.6 | 173.7 | 71.9 | 174.5 | 72.3 | 175.5 | 72.7 | 176.5 | 73.1 | 177.4 | 73.5 | 6 |
| ¼ | 167.2 | 79.1 | 168.1 | 79.5 | 169.0 | 80.0 | 169.9 | 80.4 | 170.9 | 80.8 | 171.8 | 81.2 | 172.7 | 81.7 | 173.6 | 82.1 | ¼ |
| ½ | 163.2 | 87.2 | 164.0 | 87.7 | 164.9 | 88.1 | 165.8 | 88.6 | 166.7 | 89.1 | 167.6 | 89.6 | 168.5 | 90.0 | 169.3 | 90.5 | ½ |
| ¾ | 158.7 | 95.1 | 159.5 | 95.6 | 160.4 | 96.1 | 161.2 | 96.6 | 162.1 | 97.2 | 163.0 | 97.7 | 163.8 | 98.2 | 164.7 | 98.7 | ¾ |
| 3 | 153.8 | 102.8 | 154.6 | 103.3 | 155.5 | 103.9 | 156.3 | 104.4 | 157.1 | 105.0 | 158.0 | 105.6 | 158.8 | 106.1 | 159.6 | 106.7 | 5 |
| ¼ | 148.6 | 110.2 | 149.4 | 110.8 | 150.2 | 111.4 | 151.0 | 112.0 | 151.8 | 112.6 | 152.6 | 113.2 | 153.4 | 113.8 | 154.2 | 114.4 | ¼ |
| ½ | 143.0 | 117.4 | 143.8 | 118.0 | 144.5 | 118.6 | 145.3 | 119.3 | 146.1 | 119.9 | 146.9 | 120.5 | 147.6 | 121.2 | 148.4 | 121.8 | ½ |
| ¾ | 137.1 | 124.2 | 137.8 | 124.9 | 138 6 | 125.6 | 139.3 | 126.2 | 140.0 | 126.9 | 140.8 | 127.6 | 141.5 | 128.3 | 142.3 | 128.9 | ¾ |
| 4 | 130.8 | 130.8 | 131.5 | 131.5 | 132.2 | 132.2 | 132.9 | 132.9 | 133.6 | 133.6 | 134.3 | 134.3 | 135.1 | 135.1 | 135.8 | 135.8 | 4 |
| 1° | 185.0 | 03.2 | 186.0 | 03.2 | 187.0 | 03.3 | 188.0 | 03.3 | 189.0 | 03.3 | 190.0 | 03.3 | 191.0 | 03.3 | 192.0 | 03.4 | 89° |
| 2 | 184.9 | 06.5 | 185.9 | 06.5 | 186.9 | 06.5 | 187.9 | 06.6 | 188.9 | 06.6 | 189.9 | 06.6 | 190.9 | 06.7 | 191.9 | 06.7 | 88 |
| 3 | 184.7 | 09.7 | 185.7 | 09.7 | 186.7 | 09.8 | 187.7 | 09.8 | 188.7 | 09.9 | 189.7 | 09.9 | 190.7 | 10.0 | 191.7 | 10.0 | 87 |
| 4 | 184.5 | 12.9 | 185.5 | 13.0 | 186.5 | 13.0 | 187.5 | 13.1 | 188.5 | 13.2 | 189.5 | 13.3 | 190.5 | 13.3 | 191.5 | 13.4 | 86 |
| 5 | 184.3 | 16.1 | 185.3 | 16.2 | 186.3 | 16.3 | 187.3 | 16.4 | 188.3 | 16.5 | 189.3 | 16.6 | 190.3 | 16.6 | 191.3 | 16.7 | 85 |
| 6 | 184.0 | 19.3 | 185.0 | 19.4 | 186.0 | 19.5 | 187.0 | 19.7 | 188.0 | 19.8 | 189.0 | 19.9 | 190.0 | 20.0 | 190.9 | 20.1 | 84 |
| 7 | 183.6 | 22.5 | 184.6 | 22.7 | 185.6 | 22.8 | 186.6 | 22.9 | 187.6 | 23.0 | 188.6 | 23.2 | 189.6 | 23.3 | 190.6 | 23.4 | 83 |
| 8 | 183.2 | 25.7 | 184.2 | 25.9 | 185.2 | 26.0 | 186.2 | 26.2 | 187.2 | 26.3 | 188.2 | 26.4 | 189.1 | 26.6 | 190.1 | 26.7 | 82 |
| 9 | 182.7 | 28.9 | 183.7 | 29.1 | 184.7 | 29.3 | 185.7 | 29.4 | 186.7 | 29.6 | 187.7 | 29.7 | 188 6 | 29.9 | 189.6 | 30.0 | 81 |
| 10 | 182.2 | 32.1 | 183.2 | 32.3 | 184.2 | 32.5 | 185.1 | 32.6 | 186.1 | 32.8 | 187.1 | 33.0 | 188.1 | 33.2 | 189.1 | 33.3 | 80 |
| 11 | 181.6 | 35.3 | 182.6 | 35.5 | 183.6 | 35.7 | 184.5 | 35.9 | 185.5 | 36.1 | 186.5 | 36.3 | 187.5 | 36.4 | 188.5 | 36.6 | 79 |
| 12 | 181.0 | 38.5 | 181.9 | 38.7 | 182.9 | 38.9 | 183.9 | 39.1 | 184.9 | 39.3 | 185.8 | 39.5 | 186.8 | 39.7 | 187.8 | 39.9 | 78 |
| 13 | 180.3 | 41.6 | 181.2 | 41.8 | 182.2 | 42.1 | 183.2 | 42.3 | 184.2 | 42.5 | 185.1 | 42.7 | 186.1 | 43.0 | 187.1 | 43.2 | 77 |
| 14 | 179.5 | 44.8 | 180.5 | 45.0 | 181.4 | 45.2 | 182.4 | 45.5 | 183.4 | 45.7 | 184.4 | 46.0 | 185.3 | 46.2 | 186.3 | 46.4 | 76 |
| 15 | 178.7 | 47.9 | 179.7 | 48.1 | 180.6 | 48.4 | 181.6 | 48.7 | 182.6 | 48.9 | 183.5 | 49.2 | 184.5 | 49.4 | 185.5 | 49.7 | 75 |
| 16 | 177.8 | 51.0 | 178.8 | 51.3 | 179.8 | 51.5 | 180.7 | 51.8 | 181.7 | 52.1 | 182.6 | 52.4 | 183.6 | 52.6 | 184.6 | 52.9 | 74 |
| 17 | 176.9 | 54.1 | 177.9 | 54.4 | 178.8 | 54.7 | 179.8 | 55.0 | 180.7 | 55.3 | 181.7 | 55.6 | 182.7 | 55.8 | 183.6 | 56.1 | 73 |
| 18 | 175.9 | 57.2 | 176.9 | 57.5 | 177.8 | 57.8 | 178.8 | 58.1 | 179.7 | 58.4 | 180.7 | 58.7 | 181.7 | 59.0 | 182.6 | 59.3 | 72 |
| 19 | 174.9 | 60.2 | 175.9 | 60.6 | 176.8 | 60.9 | 177.8 | 61.2 | 178.7 | 61.5 | 179.6 | 61.9 | 180.6 | 62.2 | 181.5 | 62.5 | 71 |
| 20 | 173.8 | 63.3 | 174.8 | 63.6 | 175.7 | 64.0 | 176.7 | 64.3 | 177.6 | 64.6 | 178.5 | 65.0 | 179.5 | 65.3 | 180.4 | 65.7 | 70 |
| 21 | 172.7 | 66.3 | 173.6 | 66.7 | 174.6 | 67.0 | 175.5 | 67.4 | 176.4 | 67.7 | 177.4 | 68.1 | 178.3 | 68.4 | 179.2 | 68.8 | 69 |
| 22 | 171.5 | 69.3 | 172.5 | 69.7 | 173.4 | 70.1 | 174.3 | 70.4 | 175.2 | 70.8 | 176.2 | 71.2 | 177.1 | 71.5 | 178.0 | 71.9 | 68 |
| 23 | 170.3 | 72.3 | 171.2 | 72.7 | 172.1 | 73.1 | 173.1 | 73.5 | 174.0 | 73.8 | 174.9 | 74.2 | 175.8 | 74.6 | 176.7 | 75.0 | 67 |
| 24 | 169.0 | 75.2 | 169.9 | 75.7 | 170.8 | 76.1 | 171.7 | 76.5 | 172.7 | 76.9 | 173.6 | 77.3 | 174.5 | 77.7 | 175.4 | 78.1 | 66 |
| 25 | 167.7 | 78.2 | 168.6 | 78.6 | 169.5 | 79.0 | 170.4 | 79.5 | 171.3 | 79.9 | 172.2 | 80.3 | 173.1 | 80.7 | 174.0 | 81.1 | 65 |
| 26 | 166.3 | 81.1 | 167.2 | 81.5 | 168.1 | 82.0 | 169.0 | 82.4 | 169.9 | 82.9 | 170.8 | 83.3 | 171.7 | 83.7 | 172.6 | 84.2 | 64 |
| 27 | 164.8 | 84.0 | 165.7 | 84.4 | 166.6 | 84.9 | 167.5 | 85.4 | 168.4 | 85.8 | 169.3 | 86.3 | 170.2 | 86.7 | 171.1 | 87.2 | 63 |
| 28 | 163.3 | 86.9 | 164.2 | 87.3 | 165.1 | 87.8 | 166.0 | 88.3 | 166.9 | 88.7 | 167.8 | 89.2 | 168.6 | 89.7 | 169.5 | 90.1 | 62 |
| 29 | 161.8 | 89.7 | 162.7 | 90.2 | 163.6 | 90.7 | 164.4 | 91.1 | 165.3 | 91.6 | 166.2 | 92.1 | 167.1 | 92.6 | 167.9 | 93.1 | 61 |
| 30 | 160.2 | 92.5 | 161.1 | 93.0 | 161.9 | 93.5 | 162.8 | 94.0 | 163.7 | 94.5 | 164.5 | 95.0 | 165.4 | 95.5 | 166.3 | 96.0 | 60 |
| 31 | 158.6 | 95.3 | 159.4 | 95.8 | 160.3 | 96.3 | 161.1 | 96.8 | 162.0 | 97.3 | 162.9 | 97.9 | 163.7 | 98.4 | 164.6 | 98.9 | 59 |
| 32 | 156.9 | 98.0 | 157.7 | 98.6 | 158.6 | 99.1 | 159.4 | 99.6 | 160.3 | 100.2 | 161.1 | 100.7 | 162.0 | 101.2 | 162.8 | 101.7 | 58 |
| 33 | 155.2 | 100.8 | 156.0 | 101.3 | 156.8 | 101.8 | 157.7 | 102.4 | 158.5 | 102.9 | 159.3 | 103.5 | 160.2 | 104.0 | 161.0 | 104.6 | 57 |
| 34 | 153.4 | 103.5 | 154.2 | 104.0 | 155.0 | 104.6 | 155.9 | 105.1 | 156.7 | 105.7 | 157.5 | 106.2 | 158.3 | 106.8 | 159.2 | 107.4 | 56 |
| 35 | 151.5 | 106.1 | 152.4 | 106.7 | 153.2 | 107.3 | 154.0 | 107.8 | 154.8 | 108.4 | 155.6 | 109.0 | 156.5 | 109.6 | 157.3 | 110.1 | 55 |
| 36 | 149.7 | 108.7 | 150.5 | 109.3 | 151.3 | 109.9 | 152.1 | 110.5 | 152.9 | 111.1 | 153.7 | 111.7 | 154.5 | 112.3 | 155.3 | 112.9 | 54 |
| 37 | 147.7 | 111.3 | 148.5 | 111.9 | 149.3 | 112.5 | 150.1 | 113.1 | 150.9 | 113.7 | 151.7 | 114.3 | 152.5 | 114 9 | 153.3 | 115.5 | 53 |
| 38 | 145.8 | 113.9 | 146.6 | 114.5 | 147.4 | 115.1 | 148.1 | 115.7 | 148.9 | 116.4 | 149.7 | 117.0 | 150.5 | 117.6 | 151.3 | 118.2 | 52 |
| 39 | 143.8 | 116.4 | 144.5 | 117.1 | 145.3 | 117.7 | 146.1 | 118.3 | 146.9 | 118.9 | 147.7 | 119.6 | 148.4 | 120.2 | 149.2 | 120.8 | 51 |
| 40 | 141.7 | 118.9 | 142.5 | 119.6 | 143.3 | 120.2 | 144.0 | 120.8 | 144.8 | 121.5 | 145.5 | 122.1 | 146.3 | 122.8 | 147.1 | 123.4 | 50 |
| 41 | 139.6 | 121.4 | 140.4 | 122.0 | 141.1 | 122.7 | 141.9 | 123.3 | 142.6 | 124.0 | 143.4 | 124.7 | 144.1 | 125.3 | 144.9 | 126.0 | 49 |
| 42 | 137.5 | 123.8 | 138.2 | 124.5 | 139.0 | 125.1 | 139.7 | 125.8 | 140.5 | 126.5 | 141.2 | 127.1 | 141.9 | 127.8 | 142.7 | 128.5 | 48 |
| 43 | 135.3 | 126.2 | 136.0 | 126.9 | 136.8 | 127.5 | 137.5 | 128.2 | 138.2 | 128.9 | 139.0 | 129.6 | 139.7 | 130.3 | 140.4 | 130.9 | 47 |
| 44 | 133.1 | 128.5 | 133.8 | 129.2 | 134.5 | 129.9 | 135.2 | 130.6 | 136.0 | 131.3 | 136.7 | 132.0 | 137.4 | 132.7 | 138.1 | 133.4 | 46 |
| 45 | 130.8 | 130.8 | 131.5 | 131.5 | 132.2 | 132.2 | 132.9 | 132.9 | 133.6 | 133.6 | 134.4 | 134.4 | 135.1 | 135.1 | 135.8 | 135.8 | 45 |
| Cros. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Cros. |

## (x.) Traverse Table.

| Distance. | 193 | | 194 | | 195 | | 196 | | 197 | | 198 | | 199 | | 200 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 192.8 | 09.5 | 193.8 | 09.5 | 194.8 | 09.6 | 195.8 | 09.6 | 196.8 | 09.7 | 197.8 | 09.7 | 198.8 | 09.8 | 199.8 | 09.8 | ¾ |
| ½ | 192.1 | 18.9 | 193.1 | 19.0 | 194.1 | 19.1 | 195.1 | 19.2 | 196.1 | 19.3 | 197.0 | 19.4 | 198.0 | 19.5 | 199.0 | 19.6 | ½ |
| ¾ | 190.9 | 28.3 | 191.9 | 28.5 | 192.9 | 28.6 | 193.9 | 28.8 | 194.9 | 28.9 | 195.9 | 29.0 | 196.8 | 29.2 | 197.8 | 29.3 | ¼ |
| 1 | 189.3 | 37.7 | 190.3 | 37.8 | 191.2 | 38.0 | 192.2 | 38.2 | 193.2 | 38.4 | 194.2 | 38.6 | 195.2 | 38.8 | 196.2 | 39.0 | 7 |
| ¼ | 187.2 | 46.9 | 188.2 | 47.1 | 189.2 | 47.4 | 190.1 | 47.6 | 191.1 | 47.9 | 192.1 | 48.1 | 193.0 | 48.4 | 194.0 | 48.6 | ¾ |
| ½ | 184.7 | 56.0 | 185.7 | 56.3 | 186.6 | 56.6 | 187.6 | 56.9 | 188.5 | 57.2 | 189.5 | 57.5 | 190.4 | 57.8 | 191.4 | 58.1 | ½ |
| ¾ | 181.7 | 65.0 | 182.7 | 65.4 | 183.6 | 65.7 | 184.5 | 66.0 | 185.5 | 66.4 | 186.4 | 66.7 | 187.4 | 67.0 | 188.3 | 67.4 | ¼ |
| 2 | 178.3 | 73.9 | 179.2 | 74.2 | 180.2 | 74.6 | 181.1 | 75.0 | 182.0 | 75.4 | 182.9 | 75.8 | 183.9 | 76.2 | 184.8 | 76.5 | 6 |
| ¼ | 174.5 | 82.5 | 175.4 | 83.0 | 176.3 | 83.4 | 177.2 | 83.8 | 178.1 | 84.2 | 179.0 | 84.7 | 179.9 | 85.1 | 180.8 | 85.5 | ¾ |
| ½ | 170.2 | 91.0 | 171.1 | 91.4 | 172.0 | 91.9 | 172.9 | 92.4 | 173.7 | 92.9 | 174.6 | 93.3 | 175.5 | 93.8 | 176.4 | 94.3 | ½ |
| ¾ | 165.5 | 99.2 | 166.4 | 99.7 | 167.3 | 100.2 | 168.1 | 100.8 | 169.0 | 101.3 | 169.8 | 101.8 | 170.7 | 102.3 | 171.5 | 102.8 | ¼ |
| 3 | 160.5 | 107.2 | 161.3 | 107.8 | 162.1 | 108.3 | 163.0 | 108.9 | 163.8 | 109.4 | 164.6 | 110.0 | 165.5 | 110.6 | 166.3 | 111.1 | 5 |
| ¼ | 155.0 | 115.0 | 155.8 | 115.6 | 156.6 | 116.2 | 157.4 | 116.8 | 158.2 | 117.4 | 159.0 | 118.0 | 159.8 | 118.5 | 160.6 | 119.1 | ¾ |
| ½ | 149.2 | 122.4 | 150.0 | 123.1 | 150.7 | 123.7 | 151.5 | 124.3 | 152.3 | 125.0 | 153.1 | 125.6 | 153.8 | 126.2 | 154.6 | 126.9 | ½ |
| ¾ | 143.0 | 129.6 | 143.7 | 130.3 | 144.5 | 130.9 | 145.2 | 131.6 | 146.0 | 132.3 | 146.7 | 133.0 | 147.4 | 133.6 | 148.2 | 134.3 | ¼ |
| 4 | 136.5 | 136.5 | 137.2 | 137.2 | 137.9 | 137.9 | 138.6 | 138.6 | 139.3 | 139.3 | 140.0 | 140.0 | 140.7 | 140.7 | 141.4 | 141.4 | 4 |
| 1° | 193.0 | 03.4 | 194.0 | 03.4 | 195.0 | 03.4 | 196.0 | 03.4 | 197.0 | 03.4 | 198.0 | 03.5 | 199.0 | 03.5 | 200.0 | 03.5 | 89° |
| 2 | 192.9 | 06.7 | 193.9 | 06.8 | 194.9 | 06.8 | 195.9 | 06.8 | 196.9 | 06.9 | 197.9 | 06.9 | 198.9 | 06.9 | 199.9 | 07.0 | 88 |
| 3 | 192.7 | 10.1 | 193.7 | 10.2 | 194.7 | 10.2 | 195.7 | 10.3 | 196.7 | 10.3 | 197.7 | 10.4 | 198.7 | 10.4 | 199.7 | 10.5 | 87 |
| 4 | 192.5 | 13.5 | 193.5 | 13.5 | 194.5 | 13.6 | 195.5 | 13.7 | 196.5 | 13.7 | 197.5 | 13.8 | 198.5 | 13.9 | 199.5 | 14.0 | 86 |
| 5 | 192.3 | 16.8 | 193.3 | 16.9 | 194.3 | 17.0 | 195.3 | 17.1 | 196.3 | 17.2 | 197.2 | 17.3 | 198.2 | 17.3 | 199.2 | 17.4 | 85 |
| 6 | 191.9 | 20.2 | 192.9 | 20.3 | 193.9 | 20.4 | 194.9 | 20.5 | 195.9 | 20.6 | 196.9 | 20.7 | 197.9 | 20.8 | 198.9 | 20.9 | 84 |
| 7 | 191.6 | 23.5 | 192.6 | 23.6 | 193.5 | 23.8 | 194.5 | 23.9 | 195.5 | 24.0 | 196.5 | 24.1 | 197.5 | 24.3 | 198.5 | 24.4 | 83 |
| 8 | 191.1 | 26.9 | 192.1 | 27.0 | 193.1 | 27.1 | 194.1 | 27.3 | 195.1 | 27.4 | 196.1 | 27.6 | 197.1 | 27.7 | 198.1 | 27.8 | 82 |
| 9 | 190.6 | 30.2 | 191.6 | 30.3 | 192.6 | 30.5 | 193.6 | 30.7 | 194.6 | 30.8 | 195.6 | 31.0 | 196.5 | 31.1 | 197.5 | 31.3 | 81 |
| 10 | 190.1 | 33.5 | 191.1 | 33.7 | 192.0 | 33.9 | 193.0 | 34.0 | 194.0 | 34.2 | 195.0 | 34.4 | 196.0 | 34.6 | 197.0 | 34.7 | 80 |
| 11 | 189.5 | 36.8 | 190.4 | 37.0 | 191.4 | 37.2 | 192.4 | 37.4 | 193.4 | 37.6 | 194.4 | 37.8 | 195.3 | 38.0 | 196.3 | 38.2 | 79 |
| 12 | 188.8 | 40.1 | 189.8 | 40.3 | 190.7 | 40.5 | 191.7 | 40.8 | 192.7 | 41.0 | 193.7 | 41.2 | 194.7 | 41.4 | 195.6 | 41.6 | 78 |
| 13 | 188.1 | 43.4 | 189.0 | 43.6 | 190.0 | 43.9 | 191.0 | 44.1 | 192.0 | 44.3 | 192.9 | 44.5 | 193.9 | 44.8 | 194.9 | 45.0 | 77 |
| 14 | 187.3 | 46.7 | 188.2 | 46.9 | 189.2 | 47.2 | 190.2 | 47.4 | 191.1 | 47.7 | 192.1 | 47.9 | 193.1 | 48.1 | 194.1 | 48.4 | 76 |
| 15 | 186.4 | 50.0 | 187.4 | 50.2 | 188.4 | 50.5 | 189.3 | 50.7 | 190.3 | 51.0 | 191.3 | 51.2 | 192.2 | 51.5 | 193.2 | 51.8 | 75 |
| 16 | 185.5 | 53.2 | 186.5 | 53.5 | 187.4 | 53.7 | 188.4 | 54.0 | 189.4 | 54.3 | 190.3 | 54.6 | 191.3 | 54.9 | 192.3 | 55.1 | 74 |
| 17 | 184.6 | 56.4 | 185.5 | 56.7 | 186.5 | 57.0 | 187.4 | 57.3 | 188.4 | 57.6 | 189.3 | 57.9 | 190.3 | 58.2 | 191.3 | 58.5 | 73 |
| 18 | 183.6 | 59.6 | 184.5 | 59.9 | 185.5 | 60.3 | 186.4 | 60.6 | 187.4 | 60.9 | 188.3 | 61.2 | 189.3 | 61.5 | 190.2 | 61.8 | 72 |
| 19 | 182.5 | 62.8 | 183.4 | 63.2 | 184.4 | 63.5 | 185.3 | 63.8 | 186.3 | 64.1 | 187.2 | 64.5 | 188.2 | 64.8 | 189.1 | 65.1 | 71 |
| 20 | 181.4 | 66.0 | 182.3 | 66.4 | 183.2 | 66.7 | 184.2 | 67.0 | 185.1 | 67.4 | 186.1 | 67.7 | 187.0 | 68.1 | 187.9 | 68.4 | 70 |
| 21 | 180.2 | 69.2 | 181.1 | 69.5 | 182.0 | 69.9 | 183.0 | 70.2 | 183.9 | 70.6 | 184.8 | 71.0 | 185.8 | 71.3 | 186.7 | 71.7 | 69 |
| 22 | 178.9 | 72.3 | 179.9 | 72.7 | 180.8 | 73.0 | 181.7 | 73.4 | 182.7 | 73.8 | 183.6 | 74.1 | 184.5 | 74.5 | 185.4 | 74.9 | 68 |
| 23 | 177.7 | 75.4 | 178.6 | 75.8 | 179.5 | 76.2 | 180.4 | 76.6 | 181.3 | 77.0 | 182.3 | 77.4 | 183.2 | 77.8 | 184.1 | 78.1 | 67 |
| 24 | 176.3 | 78.5 | 177.2 | 78.9 | 178.1 | 79.3 | 179.1 | 79.7 | 180.0 | 80.1 | 180.9 | 80.5 | 181.8 | 80.9 | 182.7 | 81.3 | 66 |
| 25 | 174.9 | 81.6 | 175.8 | 82.0 | 176.7 | 82.4 | 177.6 | 82.8 | 178.5 | 83.3 | 179.4 | 83.7 | 180.4 | 84.1 | 181.3 | 84.5 | 65 |
| 26 | 173.5 | 84.6 | 174.4 | 85.0 | 175.3 | 85.5 | 176.2 | 85.9 | 177.1 | 86.4 | 178.0 | 86.8 | 178.9 | 87.2 | 179.8 | 87.7 | 64 |
| 27 | 172.0 | 87.6 | 172.9 | 88.1 | 173.7 | 88.5 | 174.6 | 89.0 | 175.5 | 89.4 | 176.4 | 89.9 | 177.3 | 90.3 | 178.2 | 90.8 | 63 |
| 28 | 170.4 | 90.6 | 171.3 | 91.1 | 172.2 | 91.5 | 173.1 | 92.0 | 173.9 | 92.5 | 174.8 | 93.0 | 175.7 | 93.4 | 176.6 | 93.9 | 62 |
| 29 | 168.8 | 93.6 | 169.7 | 94.1 | 170.6 | 94.5 | 171.4 | 95.0 | 172.3 | 95.5 | 173.2 | 96.0 | 174.0 | 96.5 | 174.9 | 97.0 | 61 |
| 30 | 167.1 | 96.5 | 168.0 | 97.0 | 168.9 | 97.5 | 169.7 | 98.0 | 170.6 | 98.5 | 171.5 | 99.0 | 172.3 | 99.5 | 173.2 | 100.0 | 60 |
| 31 | 165.4 | 99.4 | 166.3 | 99.9 | 167.1 | 100.4 | 168.0 | 100.9 | 168.9 | 101.5 | 169.7 | 102.0 | 170.6 | 102.5 | 171.4 | 103.0 | 59 |
| 32 | 163.7 | 102.3 | 164.5 | 102.8 | 165.4 | 103.3 | 166.2 | 103.9 | 167.1 | 104.4 | 167.9 | 104.9 | 168.8 | 105.5 | 169.6 | 106.0 | 58 |
| 33 | 161.9 | 105.1 | 162.7 | 105.7 | 163.5 | 106.2 | 164.4 | 106.7 | 165.2 | 107.3 | 166.1 | 107.8 | 166.9 | 108.4 | 167.7 | 108.9 | 57 |
| 34 | 160.0 | 107.9 | 160.8 | 108.5 | 161.7 | 109.0 | 162.5 | 109.6 | 163.3 | 110.2 | 164.1 | 110.7 | 165.0 | 111.3 | 165.8 | 111.8 | 56 |
| 35 | 158.1 | 110.7 | 158.9 | 111.3 | 159.7 | 111.8 | 160.6 | 112.4 | 161.4 | 113.0 | 162.2 | 113.6 | 163.0 | 114.1 | 163.8 | 114.7 | 55 |
| 36 | 156.1 | 113.4 | 156.9 | 114.0 | 157.8 | 114.6 | 158.6 | 115.2 | 159.4 | 115.8 | 160.2 | 116.4 | 161.0 | 117.0 | 161.8 | 117.6 | 54 |
| 37 | 154.1 | 116.2 | 154.9 | 116.8 | 155.7 | 117.4 | 156.5 | 118.0 | 157.3 | 118.6 | 158.1 | 119.2 | 158.9 | 119.8 | 159.7 | 120.4 | 53 |
| 38 | 152.1 | 118.8 | 152.9 | 119.4 | 153.7 | 120.1 | 154.5 | 120.7 | 155.2 | 121.3 | 156.0 | 121.9 | 156.8 | 122.5 | 157.6 | 123.1 | 52 |
| 39 | 150.0 | 121.5 | 150.8 | 122.1 | 151.5 | 122.7 | 152.3 | 123.3 | 153.1 | 124.0 | 153.9 | 124.6 | 154.7 | 125.2 | 155.4 | 125.9 | 51 |
| 40 | 147.8 | 124.1 | 148.6 | 124.7 | 149.4 | 125.3 | 150.1 | 126.0 | 150.9 | 126.6 | 151.7 | 127.3 | 152.4 | 127.9 | 153.2 | 128.6 | 50 |
| 41 | 145.7 | 126.6 | 146.4 | 127.3 | 147.2 | 127.9 | 147.9 | 128.6 | 148.7 | 129.2 | 149.4 | 129.9 | 150.2 | 130.6 | 150.9 | 131.2 | 49 |
| 42 | 143.4 | 129.1 | 144.2 | 129.8 | 144.9 | 130.5 | 145.7 | 131.1 | 146.4 | 131.8 | 147.1 | 132.5 | 147.9 | 133.2 | 148.6 | 133.8 | 48 |
| 43 | 141.2 | 131.6 | 141.9 | 132.3 | 142.6 | 133.0 | 143.3 | 133.7 | 144.1 | 134.4 | 144.8 | 135.0 | 145.5 | 135.7 | 146.3 | 136.4 | 47 |
| 44 | 138.8 | 134.1 | 139.6 | 134.8 | 140.3 | 135.5 | 141.0 | 136.2 | 141.7 | 136.8 | 142.4 | 137.5 | 143.1 | 138.2 | 143.9 | 138.9 | 46 |
| 45 | 136.5 | 136.5 | 137.2 | 137.2 | 137.9 | 137.9 | 138.6 | 138.6 | 139.3 | 139.3 | 140.0 | 140.0 | 140.7 | 140.7 | 141.4 | 141.4 | 45 |
| Crse. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 201 | | 202 | | 203 | | 204 | | 205 | | 206 | | 207 | | 208 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 200.8 | 09.9 | 201.8 | 09.9 | 202.8 | 10.0 | 203.8 | 10.0 | 204.8 | 10.1 | 205.8 | 10.1 | 206.8 | 10.2 | 207.8 | 10.2 | 7¼ |
| ½ | 200.0 | 19.7 | 201.0 | 19.8 | 202.0 | 19.9 | 203.0 | 20.0 | 204.0 | 20.1 | 205.0 | 20.2 | 206.0 | 20.3 | 207 0 | 20.4 | ½ |
| ¾ | 198.8 | 29.5 | 199.8 | 29.6 | 200.8 | 29.8 | 201.8 | 29.9 | 202.8 | 30.1 | 203.8 | 30.2 | 204.8 | 30.4 | 205.7 | 30.5 | ¾ |
| 1 | 197.1 | 39.2 | 198.1 | 39.4 | 199.1 | 39.6 | 200.1 | 39.8 | 201.1 | 40.0 | 202.0 | 40.2 | 203.0 | 40.4 | 204.0 | 40.6 | 7 |
| ¼ | 195.0 | 48.8 | 195.9 | 49.1 | 196.9 | 49.3 | 197.9 | 49.6 | 198.9 | 49.8 | 199.8 | 50.1 | 200.8 | 50.3 | 201.8 | 50.5 | ¼ |
| ½ | 192.3 | 58.4 | 193.3 | 58.6 | 194.3 | 58.9 | 195.2 | 59.2 | 196.2 | 59.5 | 197.1 | 59.8 | 198.1 | 60.1 | 199.0 | 60.4 | ½ |
| ¾ | 189.2 | 67.7 | 190.2 | 68.0 | 191.1 | 68.4 | 192.1 | 68.7 | 193.0 | 69.1 | 194.0 | 69.4 | 194.9 | 69.7 | 195.8 | 70.1 | ¾ |
| 2 | 185.7 | 76.9 | 186.6 | 77.3 | 187.6 | 77.7 | 188.5 | 78.1 | 189.4 | 78.5 | 190.3 | 78.8 | 191.2 | 79.2 | 192.2 | 79.6 | 6 |
| ¼ | 181.7 | 85.9 | 182.6 | 86.4 | 183.5 | 86.8 | 184.4 | 87.2 | 185.3 | 87.7 | 186.2 | 88.1 | 187.1 | 88.5 | 188.0 | 88.9 | ¼ |
| ½ | 177.3 | 94.7 | 178.2 | 95.2 | 179.0 | 95.7 | 179.9 | 96.2 | 180.8 | 96.6 | 181.7 | 97.1 | 182.6 | 97.6 | 183.4 | 98.0 | ½ |
| ¾ | 172.4 | 103.3 | 173.3 | 103.8 | 174.1 | 104.4 | 175.0 | 104.9 | 175.8 | 105.4 | 176.7 | 105.9 | 177.5 | 106.4 | 178.4 | 106.9 | ¾ |
| 3 | 167.1 | 111.7 | 168.0 | 112.2 | 168.8 | 112.8 | 169.6 | 113.3 | 170.4 | 113.9 | 171.3 | 114.4 | 172.1 | 115.0 | 172.9 | 115.6 | 5 |
| ¼ | 161.4 | 119.7 | 162.2 | 120.3 | 163.0 | 120.9 | 163.9 | 121.5 | 164.7 | 122.1 | 165.5 | 122.7 | 166.3 | 123.3 | 167.1 | 123.9 | ¼ |
| ½ | 155.4 | 127.5 | 156.1 | 128 2 | 156.9 | 128.8 | 157.7 | 129.4 | 158.5 | 130.0 | 159.2 | 130.7 | 160.0 | 131.3 | 160.8 | 132.0 | ½ |
| ¾ | 148.9 | 135.0 | 149.7 | 135.6 | 150.4 | 136.3 | 151.1 | 137.0 | 151.9 | 137.7 | 152.6 | 138.3 | 153.4 | 139.0 | 154.1 | 139.7 | ¾ |
| 4 | 142.1 | 142.1 | 142.8 | 142.8 | 143.5 | 143.5 | 144 2 | 144.2 | 145.0 | 145.0 | 145.7 | 145.7 | 146.4 | 146.4 | 147.1 | 147.1 | 4 |
| 1° | 201.0 | 03.5 | 202.0 | 03.5 | 203.0 | 03.5 | 204.0 | 03.6 | 205.0 | 03.6 | 206.0 | 03.6 | 207.0 | 03.6 | 208.0 | 03.6 | 89° |
| 2 | 200.9 | 07.0 | 201.9 | 07.0 | 202.9 | 07.1 | 203.9 | 07.1 | 204.9 | 07.2 | 205.9 | 07.2 | 206.9 | 07.2 | 207.9 | 07.3 | 88 |
| 3 | 200.7 | 10.5 | 201.7 | 10.6 | 202.7 | 10.6 | 203.7 | 10.7 | 204.7 | 10.7 | 205.7 | 10.8 | 206.7 | 10.8 | 207.7 | 10.9 | 87 |
| 4 | 200.5 | 14.0 | 201.5 | 14.1 | 202.5 | 14.2 | 203.5 | 14.2 | 204.5 | 14.3 | 205.5 | 14.4 | 206.5 | 14.4 | 207.5 | 14.5 | 86 |
| 5 | 200.2 | 17.5 | 201.2 | 17.6 | 202.2 | 17.7 | 203.2 | 17.8 | 204.2 | 17.9 | 205.2 | 18.0 | 206.2 | 18.0 | 207.2 | 18.1 | 85 |
| 6 | 199.9 | 21.0 | 200.9 | 21.1 | 201.9 | 21.2 | 202.9 | 21.3 | 203.9 | 21.4 | 204.9 | 21.5 | 205.9 | 21.6 | 206.9 | 21.7 | 84 |
| 7 | 199.5 | 24.5 | 200.5 | 24.6 | 201.5 | 24.7 | 202.5 | 24.9 | 203.5 | 25.0 | 204.5 | 25.1 | 205.5 | 25.2 | 206.4 | 25.3 | 83 |
| 8 | 199.0 | 28.0 | 200.0 | 28.1 | 201.0 | 28.3 | 202.0 | 28.4 | 203.0 | 28.5 | 204.0 | 28.7 | 205.0 | 28.8 | 206.0 | 28.9 | 82 |
| 9 | 198.5 | 31.4 | 199.5 | 31.6 | 200.5 | 31.8 | 201.5 | 31.9 | 202.5 | 32.1 | 203.5 | 32.2 | 204.5 | 32.4 | 205.4 | 32.5 | 81 |
| 10 | 197.9 | 34.9 | 198.9 | 35.1 | 199.9 | 35.3 | 200.9 | 35.4 | 201.9 | 35.6 | 202.9 | 35.8 | 203.9 | 35.9 | 204.8 | 36.1 | 80 |
| 11 | 197.3 | 38.4 | 198.3 | 38.5 | 199.3 | 38.7 | 200.3 | 38.9 | 201.2 | 39.1 | 202.2 | 39.3 | 203.2 | 39.5 | 204.2 | 39.7 | 79 |
| 12 | 196.6 | 41.8 | 197.6 | 42.0 | 198.6 | 42.2 | 199.5 | 42.4 | 200.5 | 42.6 | 201.5 | 42.8 | 202.5 | 43.0 | 203.5 | 43.2 | 78 |
| 13 | 195.8 | 45.2 | 196.8 | 45.4 | 197.8 | 45.7 | 198.8 | 45.9 | 199.7 | 46.1 | 200.7 | 46.3 | 201.7 | 46.6 | 202.7 | 46.8 | 77 |
| 14 | 195.0 | 48.6 | 196.0 | 48.9 | 197.0 | 49.1 | 197.9 | 49.4 | 198.9 | 49.6 | 199.9 | 49.8 | 200.9 | 50.1 | 201.8 | 50.3 | 76 |
| 15 | 194.2 | 52.0 | 195.1 | 52.3 | 196.1 | 52.5 | 197.0 | 52.8 | 198.0 | 53.1 | 199.0 | 53.3 | 199.9 | 53.6 | 200.9 | 53.8 | 75 |
| 16 | 193.2 | 55.4 | 194.2 | 55.7 | 195.1 | 56.0 | 196.1 | 56.2 | 197.1 | 56.5 | 198.0 | 56.8 | 199.0 | 57.1 | 199.9 | 57.3 | 74 |
| 17 | 192.2 | 58.8 | 193.2 | 59.1 | 194.1 | 59.4 | 195.1 | 59.6 | 196.0 | 59.9 | 197.0 | 60.2 | 198.0 | 60.5 | 198.9 | 60.8 | 73 |
| 18 | 191.2 | 62.1 | 192.1 | 62.4 | 193.1 | 62.7 | 194.0 | 63.0 | 195.0 | 63.3 | 195.9 | 63.7 | 196.9 | 64.0 | 197.8 | 64.3 | 72 |
| 19 | 190.0 | 65.4 | 191.0 | 65.8 | 191.9 | 66.1 | 192.9 | 66.4 | 193.8 | 66.7 | 194.8 | 67.1 | 195.7 | 67.4 | 196.7 | 67.7 | 71 |
| 20 | 188.9 | 68.7 | 189.8 | 69.1 | 190.8 | 69.4 | 191.7 | 69.8 | 192.6 | 70.1 | 193.6 | 70.5 | 194.5 | 70.8 | 195.5 | 71.1 | 70 |
| 21 | 187.6 | 72.0 | 188.6 | 72.4 | 189.5 | 72.7 | 190.5 | 73.1 | 191.4 | 73.5 | 192.3 | 73.8 | 193.3 | 74.2 | 194.2 | 74.5 | 69 |
| 22 | 186.4 | 75.3 | 187.3 | 75.7 | 188.2 | 76.0 | 189.1 | 76.4 | 190.1 | 76.8 | 191.0 | 77.2 | 191.9 | 77.5 | 192.9 | 77.9 | 68 |
| 23 | 185.0 | 78.5 | 185.9 | 78.9 | 186.9 | 79.3 | 187.8 | 79.7 | 188.7 | 80.1 | 189.6 | 80.5 | 190.5 | 80.9 | 191.5 | 81.3 | 67 |
| 24 | 183.6 | 81.8 | 184.5 | 82.2 | 185.4 | 82.6 | 186.4 | 83.0 | 187.3 | 83.4 | 188.2 | 83.8 | 189.1 | 84.2 | 190.0 | 84.6 | 66 |
| 25 | 182.2 | 84.9 | 183.1 | 85.4 | 184.0 | 85.8 | 184.9 | 86.2 | 185.8 | 86.6 | 186.7 | 87.1 | 187.6 | 87.5 | 188.5 | 87.9 | 65 |
| 26 | 180.7 | 88.1 | 181.6 | 88.6 | 182.5 | 89.0 | 183.4 | 89.4 | 184.3 | 89.9 | 185.2 | 90.3 | 186.1 | 90.7 | 186.9 | 91.2 | 64 |
| 27 | 179.1 | 91.3 | 180.0 | 91.7 | 180.9 | 92.2 | 181.8 | 92.6 | 182.7 | 93.1 | 183.5 | 93.5 | 184.4 | 94.0 | 185.3 | 94.4 | 63 |
| 28 | 177.5 | 94.4 | 178.4 | 94.8 | 179.2 | 95.3 | 180.1 | 95.8 | 181.0 | 96.2 | 181.9 | 96.7 | 182.8 | 97.2 | 183.7 | 97.7 | 62 |
| 29 | 175.8 | 97.4 | 176.7 | 97.9 | 177.5 | 98.4 | 178.4 | 98.9 | 179.3 | 99.4 | 180.2 | 99.9 | 181.0 | 100.4 | 181.9 | 100.8 | 61 |
| 30 | 174.1 | 100.5 | 174.9 | 101.0 | 175.8 | 101.5 | 176.7 | 102.0 | 177.5 | 102.5 | 178.4 | 103.0 | 179.3 | 103.5 | 180.1 | 104.0 | 60 |
| 31 | 172.3 | 103.5 | 173.1 | 104.0 | 174.0 | 104.6 | 174.9 | 105.1 | 175.7 | 105.6 | 176.6 | 106.1 | 177.4 | 106.6 | 178.3 | 107.1 | 59 |
| 32 | 170.5 | 106.5 | 171.3 | 107.0 | 172.2 | 107.6 | 173.0 | 108.1 | 173.8 | 108.6 | 174.7 | 109.2 | 175.5 | 109.7 | 176.4 | 110.2 | 58 |
| 33 | 168.6 | 109.5 | 169.4 | 110.0 | 170.3 | 110.6 | 171.1 | 111.1 | 171.9 | 111.7 | 172.8 | 112.2 | 173.6 | 112.7 | 174.4 | 113.3 | 57 |
| 34 | 166.6 | 112.4 | 167.5 | 113.0 | 168.3 | 113.5 | 169.1 | 114.1 | 170.0 | 114.6 | 170.8 | 115.2 | 171.6 | 115.8 | 172.4 | 116.3 | 56 |
| 35 | 164.6 | 115.3 | 165.5 | 115.9 | 166.3 | 116.4 | 167.1 | 117.0 | 167.9 | 117.6 | 168.7 | 118.2 | 169.6 | 118.7 | 170.4 | 119.3 | 55 |
| 36 | 162.6 | 118.1 | 163.4 | 118.7 | 164.2 | 119.3 | 165.0 | 119.9 | 165.8 | 120.5 | 166.7 | 121.1 | 167.5 | 121.7 | 168.3 | 122.3 | 54 |
| 37 | 160.5 | 121.0 | 161.3 | 121.6 | 162.1 | 122.2 | 162.9 | 122.8 | 163.7 | 123.4 | 164.5 | 124.0 | 165.3 | 124.6 | 166.1 | 125.2 | 53 |
| 38 | 158.4 | 123.7 | 159.2 | 124.4 | 160.0 | 125.0 | 160.8 | 125.6 | 161.5 | 126.2 | 162.3 | 126.8 | 163.1 | 127.4 | 163.9 | 128.1 | 52 |
| 39 | 156.2 | 126.5 | 157.0 | 127.1 | 157.8 | 127.8 | 158.5 | 128.4 | 159.3 | 129.0 | 160.1 | 129.6 | 160.9 | 130.3 | 161.6 | 130.9 | 51 |
| 40 | 154.0 | 129.2 | 154.7 | 129 8 | 155.5 | 130.5 | 156.3 | 131.1 | 157.0 | 131.8 | 157.8 | 132.4 | 158.6 | 133.1 | 159.3 | 133.7 | 50 |
| 41 | 151.7 | 131.9 | 152.5 | 132.5 | 153.2 | 133.2 | 154.0 | 133.8 | 154.7 | 134.5 | 155.5 | 135.1 | 156.2 | 135.8 | 157.0 | 136.5 | 49 |
| 42 | 149.4 | 134.5 | 150.1 | 135.2 | 150.9 | 135.8 | 151.6 | 136.5 | 152.3 | 137.2 | 153.1 | 137.8 | 153.8 | 138.5 | 154 6 | 139.2 | 48 |
| 43 | 147.0 | 137.1 | 147.7 | 137.8 | 148.5 | 138.4 | 149.2 | 139.1 | 149.9 | 139.8 | 150.7 | 140.5 | 151.4 | 141.2 | 152.1 | 141.9 | 47 |
| 44 | 144.6 | 139.6 | 145.3 | 140.3 | 146.0 | 141.0 | 146.7 | 141.7 | 147.5 | 142.4 | 148.2 | 143.1 | 148.9 | 143.8 | 149.6 | 144.5 | 46 |
| 45 | 142.1 | 142.1 | 142.8 | 142.8 | 143.5 | 143.5 | 144.2 | 144.2 | 145.0 | 145.0 | 145.7 | 145.7 | 146.4 | 146.4 | 147.1 | 147.1 | 45 |
| | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 209 | | 210 | | 211 | | 212 | | 213 | | 214 | | 215 | | 216 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts | | | | | | | | | | | | | | | | | Pts |
| ¼ | 208.8 | 10.3 | 209.8 | 10.3 | 210.7 | 10.4 | 211.7 | 10.4 | 212.7 | 10.5 | 213.7 | 10.5 | 214.7 | 10.6 | 215.7 | 10.6 | ¼ |
| ½ | 208.0 | 20.5 | 209.0 | 20.6 | 210.0 | 20.7 | 211.0 | 20.8 | 212.0 | 20.9 | 213.0 | 21.0 | 214.0 | 21.1 | 215.0 | 21.2 | ½ |
| ¾ | 206.7 | 30.7 | 207.7 | 30.8 | 208.7 | 30.9 | 209.7 | 31.1 | 210.7 | 31.2 | 211.7 | 31.4 | 212.7 | 31.5 | 213.7 | 31.7 | ¾ |
| 1 | 205.0 | 40.8 | 206.0 | 41.0 | 206.9 | 41.2 | 207.9 | 41.4 | 208.9 | 41.6 | 209.9 | 41.7 | 210.9 | 41.9 | 211.8 | 42.1 | 1 |
| ¼ | 202.7 | 50.8 | 203.7 | 51.0 | 204.7 | 51.3 | 205.6 | 51.5 | 206.6 | 51.8 | 207.6 | 52.0 | 208.6 | 52.2 | 209.5 | 52.5 | ¼ |
| ½ | 200.0 | 60.7 | 201.0 | 61.0 | 201.9 | 61.2 | 202.9 | 61.5 | 203.8 | 61.8 | 204.8 | 62.1 | 205.7 | 62.4 | 206.7 | 62.7 | ½ |
| ¾ | 196.8 | 70.4 | 197.7 | 70.7 | 198.7 | 71.1 | 199.6 | 71.4 | 200.5 | 71.8 | 201.5 | 72.1 | 202.4 | 72.4 | 203.4 | 72.8 | ¾ |
| 2 | 193.1 | 80.0 | 194.0 | 80.4 | 194.9 | 80.8 | 195.9 | 81.1 | 196.8 | 81.5 | 197.7 | 81.9 | 198.6 | 82.3 | 199.6 | 82.7 | 2 |
| ¼ | 188.9 | 89.4 | 189.8 | 89.8 | 190.7 | 90.2 | 191.6 | 90.6 | 192.6 | 91.1 | 193.5 | 91.5 | 194.4 | 91.9 | 195.3 | 92.4 | ¼ |
| ½ | 184.3 | 98.5 | 185.2 | 99.0 | 186.1 | 99.5 | 187.0 | 99.9 | 187.8 | 100.4 | 188.7 | 100.9 | 189.6 | 101.3 | 190.5 | 101.8 | ½ |
| ¾ | 179.2 | 107.4 | 180.1 | 108.0 | 181.0 | 108.5 | 181.8 | 109.0 | 182.7 | 109.5 | 183.5 | 110.0 | 184.4 | 110.5 | 185.3 | 111.0 | ¾ |
| 3 | 173.8 | 116.1 | 174.6 | 116.7 | 175.4 | 117.2 | 176.3 | 117.8 | 177.1 | 118.3 | 177.9 | 118.9 | 178.8 | 119.4 | 179.6 | 120.0 | 3 |
| ¼ | 167.9 | 124.5 | 168.7 | 125.1 | 169.5 | 125.7 | 170.3 | 126.3 | 171.1 | 126.9 | 171.9 | 127.5 | 172.7 | 128.1 | 173.5 | 128.7 | ¼ |
| ½ | 161.6 | 132.6 | 162.3 | 133.2 | 163.1 | 133.9 | 163.9 | 134.5 | 164.6 | 135.1 | 165.4 | 135.8 | 166.2 | 136.4 | 167.0 | 137.0 | ½ |
| ¾ | 154.9 | 140.3 | 155.6 | 141.0 | 156.3 | 141.7 | 157.1 | 142.4 | 157.8 | 143.0 | 158.6 | 143.7 | 159.3 | 144.4 | 160.0 | 145.0 | ¾ |
| 4 | 147.8 | 147.8 | 148.5 | 148.5 | 149.2 | 149.2 | 149.9 | 149.9 | 150.6 | 150.6 | 151.3 | 151.3 | 152.0 | 152.0 | 152.7 | 152.7 | 4 |
| 1° | 209.0 | 03.6 | 210.0 | 03.7 | 211.0 | 03.7 | 212.0 | 03.7 | 213.0 | 03.7 | 214.0 | 03.7 | 215.0 | 03.8 | 216.0 | 03.8 | 89° |
| 2 | 208.9 | 07.3 | 209.9 | 07.3 | 210.9 | 07.4 | 211.9 | 07.4 | 212.9 | 07.4 | 213.9 | 07.5 | 214.9 | 07.5 | 215.9 | 07.5 | 88 |
| 3 | 208.7 | 10.9 | 209.7 | 11.0 | 210.7 | 11.0 | 211.7 | 11.1 | 212.7 | 11.1 | 213.7 | 11.2 | 214.7 | 11.3 | 215.7 | 11.3 | 87 |
| 4 | 208.5 | 14.6 | 209.5 | 14.6 | 210.5 | 14.7 | 211.5 | 14.8 | 212.5 | 14.9 | 213.5 | 14.9 | 214.5 | 15.0 | 215.5 | 15.1 | 86 |
| 5 | 208.2 | 18.2 | 209.2 | 18.3 | 210.2 | 18.4 | 211.2 | 18.5 | 212.2 | 18.6 | 213.2 | 18.7 | 214.2 | 18.7 | 215.2 | 18.8 | 85 |
| 6 | 207.9 | 21.8 | 208.8 | 22.0 | 209.8 | 22.1 | 210.8 | 22.2 | 211.8 | 22.3 | 212.8 | 22.4 | 213.8 | 22.5 | 214.8 | 22.6 | 84 |
| 7 | 207.4 | 25.5 | 208.4 | 25.6 | 209.4 | 25.7 | 210.4 | 25.8 | 211.4 | 26.0 | 212.4 | 26.1 | 213.4 | 26.2 | 214.4 | 26.3 | 83 |
| 8 | 207.0 | 29.1 | 208.0 | 29.2 | 208.9 | 29.4 | 209.9 | 29.5 | 210.9 | 29.6 | 211.9 | 29.8 | 212.9 | 29.9 | 213.9 | 30.1 | 82 |
| 9 | 206.4 | 32.7 | 207.4 | 32.9 | 208.4 | 33.0 | 209.4 | 33.2 | 210.4 | 33.3 | 211.4 | 33.5 | 212.4 | 33.6 | 213.3 | 33.8 | 81 |
| 10 | 205.8 | 36.3 | 206.8 | 36.5 | 207.8 | 36.6 | 208.8 | 36.8 | 209.8 | 37.0 | 210.7 | 37.2 | 211.7 | 37.3 | 212.7 | 37.5 | 80 |
| 11 | 205.2 | 39.9 | 206.1 | 40.1 | 207.1 | 40.3 | 208.1 | 40.5 | 209.1 | 40.6 | 210.1 | 40.8 | 211.0 | 41.0 | 212.0 | 41.2 | 79 |
| 12 | 204.4 | 43.5 | 205.4 | 43.7 | 206.4 | 43.9 | 207.4 | 44.1 | 208.3 | 44.3 | 209.3 | 44.5 | 210.3 | 44.7 | 211.3 | 44.9 | 78 |
| 13 | 203.6 | 47.0 | 204.6 | 47.2 | 205.6 | 47.5 | 206.6 | 47.7 | 207.5 | 47.9 | 208.5 | 48.1 | 209.5 | 48.4 | 210.5 | 48.6 | 77 |
| 14 | 202.8 | 50.6 | 203.8 | 50.8 | 204.7 | 51.0 | 205.7 | 51.3 | 206.7 | 51.5 | 207.6 | 51.8 | 208.6 | 52.0 | 209.6 | 52.3 | 76 |
| 15 | 201.9 | 54.1 | 202.8 | 54.4 | 203.8 | 54.6 | 204.8 | 54.9 | 205.7 | 55.1 | 206.7 | 55.4 | 207.7 | 55.6 | 208.6 | 55.9 | 75 |
| 16 | 200.9 | 57.6 | 201.9 | 57.9 | 202.8 | 58.2 | 203.8 | 58.4 | 204.7 | 58.7 | 205.7 | 59.0 | 206.7 | 59.3 | 207.6 | 59.5 | 74 |
| 17 | 199.9 | 61.1 | 200.8 | 61.4 | 201.8 | 61.7 | 202.7 | 62.0 | 203.7 | 62.3 | 204.6 | 62.6 | 205.6 | 62.9 | 206.6 | 63.2 | 73 |
| 18 | 198.8 | 64.6 | 199.7 | 64.9 | 200.7 | 65.2 | 201.6 | 65.5 | 202.6 | 65.8 | 203.5 | 66.1 | 204.5 | 66.4 | 205.4 | 66.7 | 72 |
| 19 | 197.6 | 68.0 | 198.6 | 68.4 | 199.5 | 68.7 | 200.4 | 69.0 | 201.4 | 69.3 | 202.3 | 69.7 | 203.3 | 70.0 | 204.2 | 70.3 | 71 |
| 20 | 196.4 | 71.5 | 197.3 | 71.8 | 198.3 | 72.2 | 199.2 | 72.5 | 200.2 | 72.9 | 201.1 | 73.2 | 202.0 | 73.5 | 203.0 | 73.9 | 70 |
| 21 | 195.1 | 74.9 | 196.1 | 75.3 | 197.0 | 75.6 | 197.9 | 76.0 | 198.9 | 76.3 | 199.8 | 76.7 | 200.7 | 77.0 | 201.7 | 77.4 | 69 |
| 22 | 193.8 | 78.3 | 194.7 | 78.7 | 195.6 | 79.0 | 196.6 | 79.4 | 197.5 | 79.8 | 198.4 | 80.2 | 199.3 | 80.5 | 200.3 | 80.9 | 68 |
| 23 | 192.4 | 81.7 | 193.3 | 82.1 | 194.2 | 82.4 | 195.1 | 82.8 | 196.1 | 83.2 | 197.0 | 83.6 | 197.9 | 84.0 | 198.8 | 84.4 | 67 |
| 24 | 190.9 | 85.0 | 191.8 | 85.4 | 192.8 | 85.8 | 193.7 | 86.2 | 194.6 | 86.6 | 195.5 | 87.0 | 196.4 | 87.4 | 197.3 | 87.9 | 66 |
| 25 | 189.4 | 88.3 | 190.3 | 88.7 | 191.2 | 89.2 | 192.1 | 89.6 | 193.0 | 90.0 | 193.9 | 90.4 | 194.9 | 90.9 | 195.8 | 91.3 | 65 |
| 26 | 187.8 | 91.6 | 188.7 | 92.1 | 189.6 | 92.5 | 190.5 | 92.9 | 191.4 | 93.4 | 192.3 | 93.8 | 193.2 | 94.2 | 194.1 | 94.7 | 64 |
| 27 | 186.2 | 94.9 | 187.1 | 95.3 | 188.0 | 95.8 | 188.9 | 96.2 | 189.8 | 96.7 | 190.7 | 97.2 | 191.6 | 97.6 | 192.5 | 98.1 | 63 |
| 28 | 184.5 | 98.1 | 185.4 | 98.6 | 186.3 | 99.1 | 187.2 | 99.5 | 188.1 | 100.0 | 189.0 | 100.5 | 189.8 | 100.9 | 190.7 | 101.4 | 62 |
| 29 | 182.8 | 101.3 | 183.7 | 101.8 | 184.5 | 102.3 | 185.4 | 102.8 | 186.3 | 103.3 | 187.2 | 103.7 | 188.0 | 104.2 | 188.9 | 104.7 | 61 |
| 30 | 181.0 | 104.5 | 181.9 | 105.0 | 182.7 | 105.5 | 183.6 | 106.0 | 184.5 | 106.5 | 185.3 | 107.0 | 186.2 | 107.5 | 187.1 | 108.0 | 60 |
| 31 | 179.1 | 107.6 | 180.0 | 108.2 | 180.9 | 108.7 | 181.7 | 109.2 | 182.6 | 109.7 | 183.4 | 110.2 | 184.3 | 110.7 | 185.1 | 111.2 | 59 |
| 32 | 177.2 | 110.8 | 178.1 | 111.3 | 178.9 | 111.8 | 179.8 | 112.3 | 180.6 | 112.9 | 181.5 | 113.4 | 182.3 | 113.9 | 183.2 | 114.5 | 58 |
| 33 | 175.3 | 113.8 | 176.1 | 114.4 | 177.0 | 114.9 | 177.8 | 115.5 | 178.6 | 116.0 | 179.5 | 116.6 | 180.3 | 117.1 | 181.2 | 117.6 | 57 |
| 34 | 173.3 | 116.9 | 174.1 | 117.4 | 174.9 | 118.0 | 175.8 | 118.5 | 176.6 | 119.1 | 177.4 | 119.7 | 178.2 | 120.2 | 179.1 | 120.8 | 56 |
| 35 | 171.2 | 119.9 | 172.0 | 120.5 | 172.8 | 121.0 | 173.7 | 121.6 | 174.5 | 122.2 | 175.3 | 122.7 | 176.1 | 123.3 | 176.9 | 123.9 | 55 |
| 36 | 169.1 | 122.8 | 169.9 | 123.4 | 170.7 | 124.0 | 171.5 | 124.6 | 172.3 | 125.2 | 173.1 | 125.8 | 173.9 | 126.4 | 174.7 | 127.0 | 54 |
| 37 | 166.9 | 125.8 | 167.7 | 126.4 | 168.5 | 127.0 | 169.3 | 127.6 | 170.1 | 128.2 | 170.9 | 128.8 | 171.7 | 129.4 | 172.5 | 130.0 | 53 |
| 38 | 164.7 | 128.7 | 165.5 | 129.3 | 166.3 | 129.9 | 167.1 | 130.5 | 167.8 | 131.1 | 168.6 | 131.8 | 169.4 | 132.4 | 170.2 | 133.0 | 52 |
| 39 | 162.4 | 131.5 | 163.2 | 132.2 | 164.0 | 132.8 | 164.8 | 133.4 | 165.5 | 134.0 | 166.3 | 134.7 | 167.1 | 135.3 | 167.9 | 135.9 | 51 |
| 40 | 160.1 | 134.3 | 160.9 | 135.0 | 161.6 | 135.6 | 162.4 | 136.3 | 163.2 | 136.9 | 163.9 | 137.6 | 164.7 | 138.2 | 165.5 | 138.8 | 50 |
| 41 | 157.7 | 137.1 | 158.5 | 137.8 | 159.2 | 138.4 | 160.0 | 139.1 | 160.8 | 139.7 | 161.5 | 140.4 | 162.3 | 141.1 | 163.0 | 141.7 | 49 |
| 42 | 155.3 | 139.8 | 156.1 | 140.5 | 156.8 | 141.2 | 157.5 | 141.9 | 158.3 | 142.5 | 159.0 | 143.2 | 159.8 | 143.9 | 160.5 | 144.5 | 48 |
| 43 | 152.9 | 142.5 | 153.6 | 143.2 | 154.3 | 143.9 | 155.0 | 144.6 | 155.8 | 145.3 | 156.5 | 145.9 | 157.2 | 146.6 | 158.0 | 147.3 | 47 |
| 44 | 150.3 | 145.2 | 151.1 | 145.9 | 151.8 | 146.6 | 152.5 | 147.3 | 153.2 | 148.0 | 153.9 | 148.7 | 154.7 | 149.4 | 155.4 | 150.0 | 46 |
| 45 | 147.8 | 147.8 | 148.5 | 148.5 | 149.2 | 149.2 | 149.9 | 149.9 | 150.6 | 150.6 | 151.3 | 151.3 | 152.0 | 152.0 | 152.7 | 152.7 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 217 | | 218 | | 219 | | 220 | | 221 | | 222 | | 223 | | 224 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Course. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Course. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 216.7 | 10.7 | 217.7 | 10.7 | 218.7 | 10.8 | 219.7 | 10.8 | 220.7 | 10.8 | 221.7 | 10.9 | 222.7 | 10.9 | 223.7 | 11.0 | 7¾ |
| ½ | 216.0 | 21.3 | 216.9 | 21.4 | 217.9 | 21.5 | 218.9 | 21.6 | 219.9 | 21.7 | 220.9 | 21.8 | 221.9 | 21.9 | 222.9 | 22.0 | ½ |
| ¾ | 214.6 | 31.8 | 215.6 | 32.0 | 216.6 | 32.1 | 217.6 | 32.3 | 218.6 | 32.4 | 219.6 | 32.6 | 220.6 | 32.7 | 221.6 | 32.9 | ¼ |
| 1 | 212.8 | 42.3 | 213.8 | 42.5 | 214.8 | 42.7 | 215.8 | 42.9 | 216.7 | 43.1 | 217.7 | 43.3 | 218.7 | 43.5 | 219.7 | 43.7 | 7 |
| ¼ | 210.5 | 52.7 | 211.5 | 53.0 | 212.4 | 53.2 | 213.4 | 53.5 | 214.4 | 53.7 | 215.4 | 53.9 | 216.3 | 54.2 | 217.3 | 54.4 | ¾ |
| ½ | 207.7 | 63.0 | 208.6 | 63.3 | 209.6 | 63.6 | 210.5 | 63.9 | 211.5 | 64.1 | 212.4 | 64.4 | 213.4 | 64.7 | 214.4 | 65.0 | ½ |
| ¾ | 204.3 | 73.1 | 205.3 | 73.4 | 206.2 | 73.8 | 207.1 | 74.1 | 208.1 | 74.4 | 209.0 | 74.8 | 210.0 | 75.1 | 210.9 | 75.5 | ¼ |
| 2 | 200.5 | 83.0 | 201.4 | 83.4 | 202.3 | 83.8 | 203.3 | 84.2 | 204.2 | 84.6 | 205.1 | 85.0 | 206.0 | 85.3 | 207.0 | 85.7 | 6 |
| ¼ | 196.2 | 92.8 | 197.1 | 93.2 | 198.0 | 93.6 | 198.9 | 94.1 | 199.8 | 94.5 | 200.7 | 94.9 | 201.6 | 95.4 | 202.5 | 95.8 | ¾ |
| ½ | 191.4 | 102.3 | 192.3 | 102.8 | 193.1 | 103.2 | 194.0 | 103.7 | 194.9 | 104.2 | 195.8 | 104.6 | 196.7 | 105.1 | 197 6 | 105.6 | ½ |
| ¾ | 186.1 | 111.6 | 187.0 | 112.1 | 187.8 | 112.6 | 188.7 | 113.1 | 189.6 | 113.6 | 190.4 | 114.1 | 191.3 | 114.6 | 192.1 | 115.2 | ¼ |
| 3 | 180.4 | 120.6 | 181.3 | 121.1 | 182.1 | 121.7 | 182.9 | 122.2 | 183.7 | 122.8 | 184.6 | 123.3 | 185.4 | 123.9 | 186.2 | 124.4 | 5 |
| ¼ | 174.3 | 129.3 | 175.1 | 129.9 | 175.9 | 130.5 | 176.7 | 131.1 | 177.5 | 131.7 | 178.3 | 132.2 | 179.1 | 132.8 | 179.9 | 133.4 | ¾ |
| ½ | 167.7 | 137.7 | 168.5 | 138.3 | 169.3 | 138.9 | 170.1 | 139.6 | 170.8 | 140.2 | 171.6 | 140.8 | 172.4 | 141.5 | 173.1 | 142.1 | ½ |
| ¾ | 160.8 | 145.7 | 161.5 | 146.4 | 162.3 | 147.1 | 163.0 | 147.7 | 163.7 | 148.4 | 164.5 | 149.1 | 165.2 | 149.7 | 166.0 | 150.4 | ¼ |
| 4 | 153.4 | 153.4 | 154.1 | 154.1 | 154.9 | 154.9 | 155.6 | 155.6 | 156.3 | 156.3 | 157.0 | 157.0 | 157.7 | 157.7 | 158.4 | 158.4 | 4 |
| 1° | 217.0 | 03.8 | 218.0 | 03.8 | 219.0 | 03.8 | 220.0 | 03.8 | 221.0 | 03.9 | 222.0 | 03.9 | 223.0 | 03.9 | 224.0 | 03.9 | 89° |
| 2 | 216.9 | 07.6 | 217.9 | 07.6 | 218.9 | 07.6 | 219.9 | 07.7 | 220.9 | 07.7 | 221.9 | 07.7 | 222.9 | 07.8 | 223.9 | 07.8 | 88 |
| 3 | 216.7 | 11.4 | 217.7 | 11.4 | 218.7 | 11.5 | 219.7 | 11.5 | 220.7 | 11.6 | 221.7 | 11.6 | 222.7 | 11.7 | 223.7 | 11.7 | 87 |
| 4 | 216.5 | 15.1 | 217.5 | 15.2 | 218.5 | 15.3 | 219.5 | 15.3 | 220.5 | 15.4 | 221.5 | 15.5 | 222.5 | 15.6 | 223.5 | 15.6 | 86 |
| 5 | 216.2 | 18.9 | 217.2 | 19.0 | 218.2 | 19.1 | 219.2 | 19.2 | 220.2 | 19.3 | 221.2 | 19.3 | 222.2 | 19.4 | 223.1 | 19.5 | 85 |
| 6 | 215.8 | 22.7 | 216.8 | 22.8 | 217.8 | 22.9 | 218.8 | 23.0 | 219.8 | 23.1 | 220.8 | 23.2 | 221.8 | 23.3 | 222.8 | 23.4 | 84 |
| 7 | 215.4 | 26.4 | 216.4 | 26.6 | 217.4 | 26.7 | 218.4 | 26.8 | 219.4 | 26.9 | 220.3 | 27.1 | 221.3 | 27.2 | 222.3 | 27.3 | 83 |
| 8 | 214.9 | 30.2 | 215.9 | 30.3 | 216.9 | 30.5 | 217.9 | 30.6 | 218.8 | 30.8 | 219.8 | 30.9 | 220.8 | 31.0 | 221.8 | 31.2 | 82 |
| 9 | 214.3 | 33.9 | 215.3 | 34.1 | 216.3 | 34.3 | 217.3 | 34.4 | 218.3 | 34.6 | 219.3 | 34.7 | 220.3 | 34.9 | 221.2 | 35.0 | 81 |
| 10 | 213.7 | 37.7 | 214.7 | 37.9 | 215.7 | 38.0 | 216.7 | 38.2 | 217.6 | 38.4 | 218.6 | 38.5 | 219.6 | 38.7 | 220 6 | 38.9 | 80 |
| 11 | 213.0 | 41.4 | 214.0 | 41.6 | 215.0 | 41.8 | 216.0 | 42.0 | 216.9 | 42.2 | 217.9 | 42.4 | 218.9 | 42.6 | 219.9 | 42.7 | 79 |
| 12 | 212.3 | 45.1 | 213.2 | 45.3 | 214.2 | 45.5 | 215.2 | 45.7 | 216.2 | 45.9 | 217.1 | 46.2 | 218.1 | 46.4 | 219.1 | 46.6 | 78 |
| 13 | 211.4 | 48.8 | 212.4 | 49.0 | 213.4 | 49.3 | 214.4 | 49.5 | 215.3 | 49.7 | 216.3 | 49.9 | 217.3 | 50.2 | 218.3 | 50.4 | 77 |
| 14 | 210.6 | 52.5 | 211.5 | 52.7 | 212.5 | 53.0 | 213.5 | 53.2 | 214.4 | 53.5 | 215.4 | 53.7 | 216.4 | 53.9 | 217.3 | 54.2 | 76 |
| 15 | 209.6 | 56.2 | 210.6 | 56.4 | 211.5 | 56.7 | 212.5 | 56.9 | 213.5 | 57.2 | 214.4 | 57.5 | 215.4 | 57.7 | 216.4 | 58.0 | 75 |
| 16 | 208.6 | 59.8 | 209.6 | 60.1 | 210.5 | 60.4 | 211.5 | 60.6 | 212.4 | 60.9 | 213.4 | 61.2 | 214.4 | 61.5 | 215.3 | 61.7 | 74 |
| 17 | 207.5 | 63.4 | 208.5 | 63.7 | 209.4 | 64.0 | 210.4 | 64.3 | 211.3 | 64.6 | 212.3 | 64.9 | 213.3 | 65.2 | 214.2 | 65.5 | 73 |
| 18 | 206.4 | 67.1 | 207.3 | 67.4 | 208.3 | 67.7 | 209.2 | 68.0 | 210.2 | 68.3 | 211.1 | 68.6 | 212.1 | 68.9 | 213.0 | 69.2 | 72 |
| 19 | 205.2 | 70.6 | 206.1 | 71.0 | 207.1 | 71.3 | 208.0 | 71.6 | 209.0 | 72.0 | 209.9 | 72.3 | 210.9 | 72.6 | 211.8 | 72.9 | 71 |
| 20 | 203.9 | 74.2 | 204.9 | 74.6 | 205.8 | 74.9 | 206.7 | 75.2 | 207.7 | 75.6 | 208.6 | 75.9 | 209.6 | 76.3 | 210.5 | 76.6 | 70 |
| 21 | 202.6 | 77.8 | 203.5 | 78.1 | 204.5 | 78.5 | 205.4 | 78.8 | 206.3 | 79.2 | 207.3 | 79.6 | 208.2 | 79.9 | 209.1 | 80.3 | 69 |
| 22 | 201.2 | 81.3 | 202.1 | 81.7 | 203.1 | 82.0 | 204.0 | 82.4 | 204.9 | 82.8 | 205.8 | 83.2 | 206.8 | 83.5 | 207.7 | 83.9 | 68 |
| 23 | 199.7 | 84.8 | 200.7 | 85.2 | 201.6 | 85.6 | 202.5 | 86.0 | 203.4 | 86.4 | 204.4 | 86.7 | 205.3 | 87.1 | 206.2 | 87.5 | 67 |
| 24 | 198.2 | 88.3 | 199.2 | 88.7 | 200.1 | 89.1 | 201.0 | 89.5 | 201.9 | 89.9 | 202.8 | 90.3 | 203.7 | 90.7 | 204.6 | 91.1 | 66 |
| 25 | 196.7 | 91.7 | 197.6 | 92.1 | 198.5 | 92.6 | 199.4 | 93.0 | 200.3 | 93.4 | 201.2 | 93.8 | 202.1 | 94.2 | 203.0 | 94.7 | 65 |
| 26 | 195.0 | 95.1 | 195.9 | 95.6 | 196.8 | 96.0 | 197.7 | 96.4 | 198.6 | 96.9 | 199.5 | 97.3 | 200.4 | 97.8 | 201.3 | 98.2 | 64 |
| 27 | 193.3 | 98.5 | 194.2 | 99.0 | 195.1 | 99.4 | 196.0 | 99.9 | 196.9 | 100.3 | 197.8 | 100.8 | 198.7 | 101.2 | 199.6 | 101.7 | 63 |
| 28 | 191.6 | 101.9 | 192.5 | 102.3 | 193.4 | 102.8 | 194.2 | 103.3 | 195.1 | 103.8 | 196.0 | 104.2 | 196.9 | 104.7 | 197.8 | 105.2 | 62 |
| 29 | 189.8 | 105.2 | 190.7 | 105.7 | 191.5 | 106.2 | 192.4 | 106.7 | 193.3 | 107.1 | 194.2 | 107.6 | 195.0 | 108.1 | 195.9 | 108.6 | 61 |
| 30 | 187.9 | 108.5 | 188.8 | 109.0 | 189.7 | 109.5 | 190.5 | 110.0 | 191.4 | 110.5 | 192 3 | 111.0 | 193.1 | 111.5 | 194.0 | 112.0 | 60 |
| 31 | 186.0 | 111.8 | 186.9 | 112.3 | 187.7 | 112.8 | 188.6 | 113.3 | 189.4 | 113.8 | 190.3 | 114.3 | 191.1 | 114.9 | 192.0 | 115.4 | 59 |
| 32 | 184.0 | 115.0 | 184.9 | 115.5 | 185.7 | 116.1 | 186.6 | 116.6 | 187.4 | 117.1 | 188.3 | 117.6 | 189.1 | 118.2 | 190.0 | 118.7 | 58 |
| 33 | 182.0 | 118.2 | 182.8 | 118.7 | 183.7 | 119.3 | 184.5 | 119.8 | 185.3 | 120.4 | 186.2 | 120.9 | 187.0 | 121.5 | 187.9 | 122.0 | 57 |
| 34 | 179.9 | 121.3 | 180.7 | 121.9 | 181.6 | 122.5 | 182.4 | 123.0 | 183.2 | 123.6 | 184.0 | 124.1 | 184.9 | 124.7 | 185.7 | 125.3 | 56 |
| 35 | 177.8 | 124.5 | 178.6 | 125.0 | 179.4 | 125.6 | 180.2 | 126.2 | 181.0 | 126.8 | 181.9 | 127.3 | 182.7 | 127.9 | 183.5 | 128.5 | 55 |
| 36 | 175.6 | 127.5 | 176.4 | 128.1 | 177.2 | 128.7 | 178.0 | 129.3 | 178.8 | 129.9 | 179.6 | 130.5 | 180.4 | 131.1 | 181.2 | 131.7 | 54 |
| 37 | 173.3 | 130.6 | 174.1 | 131.2 | 174.9 | 131.8 | 175.7 | 132.4 | 176 5 | 133.0 | 177.3 | 133.6 | 178.1 | 134.2 | 178.9 | 134.8 | 53 |
| 38 | 171.0 | 133.6 | 171.8 | 134.2 | 172.6 | 134.8 | 173.4 | 135.4 | 174.2 | 136.1 | 174.9 | 136.7 | 175.7 | 137.3 | 176.5 | 137.9 | 52 |
| 39 | 168.6 | 136.6 | 169.4 | 137.2 | 170.2 | 137.8 | 171.0 | 138.5 | 171.7 | 139.1 | 172.5 | 139 7 | 173 3 | 140.3 | 174.1 | 141.0 | 51 |
| 40 | 166.2 | 139.5 | 167.0 | 140.1 | 167.8 | 140.8 | 168.5 | 141.4 | 169.3 | 142.1 | 170.1 | 142.7 | 170.8 | 143.3 | 171.6 | 144.0 | 50 |
| 41 | 163.8 | 142.4 | 164.5 | 143.0 | 165.3 | 143.7 | 166.0 | 144.3 | 166.8 | 145.0 | 167.5 | 145 6 | 168.3 | 146.3 | 169.1 | 147.0 | 49 |
| 42 | 161.3 | 145.2 | 162.0 | 145.9 | 162.7 | 146.5 | 163.5 | 147.2 | 164.2 | 147.9 | 165.0 | 148.5 | 165.7 | 149.2 | 166.5 | 149.9 | 48 |
| 43 | 158.7 | 148.0 | 159.4 | 148.7 | 160.2 | 149.4 | 160.9 | 150.0 | 161.6 | 150.7 | 162.4 | 151.4 | 163.1 | 152.1 | 163 8 | 152.8 | 47 |
| 44 | 156.1 | 150.7 | 156.8 | 151.4 | 157.5 | 152.1 | 158.3 | 152.8 | 159.0 | 153.5 | 159.7 | 154.2 | 160.4 | 154.9 | 161.1 | 155.6 | 46 |
| 45 | 153.4 | 153.4 | 154.1 | 154.1 | 154.9 | 154.9 | 155.6 | 155.6 | 156.3 | 156.3 | 157.0 | 157.0 | 157.7 | 157.7 | 158.4 | 158.4 | 45 |
| Course. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff Lat | Dep. | Diff.Lat | Dep. | Diff La | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff Lat. | Course. |

## Traverse Table. (x.)

| Distance. | 225 | | 226 | | 227 | | 228 | | 229 | | 230 | | 231 | | 232 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse | Diff.Lat. | Dep. | Diff.Lat. | Dep | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse |
| Pts | | | | | | | | | | | | | | | | | Pts |
| ¼ | 224.7 | 11.0 | 225.7 | 11.1 | 226.7 | 11.1 | 227.7 | 11.2 | 228.7 | 11.2 | 229.7 | 11.3 | 230.7 | 11.3 | 231.7 | 11.4 | ¾ |
| ½ | 223.9 | 22.1 | 224.9 | 22.2 | 225.9 | 22.2 | 226.9 | 22.3 | 227.9 | 22.4 | 228.9 | 22.5 | 229.9 | 22.6 | 230.9 | 22.7 | ½ |
| ¾ | 222.6 | 33.0 | 223.5 | 33.2 | 224.5 | 33.3 | 225.5 | 33.4 | 226.5 | 33.6 | 227.5 | 33.7 | 228.5 | 33.9 | 229.5 | 34.0 | ¼ |
| 1 | 220.7 | 43.9 | 221.7 | 44.1 | 222.6 | 44.3 | 223.6 | 44.5 | 224.6 | 44.7 | 225.6 | 44.9 | 226.6 | 45.1 | 227.5 | 45.3 | 7 |
| ¼ | 218.3 | 54.7 | 219.2 | 54.9 | 220.2 | 55.2 | 221.2 | 55.4 | 222.1 | 55.6 | 223.1 | 55.9 | 224.1 | 56.1 | 225.1 | 56.4 | ¾ |
| ½ | 215.3 | 65.3 | 216.3 | 65.6 | 217.2 | 65.9 | 218.2 | 66.2 | 219.1 | 66.5 | 220.1 | 66.8 | 221.1 | 67.0 | 222.0 | 67.3 | ½ |
| ¾ | 211.8 | 75.8 | 212.8 | 76.1 | 213.7 | 76.5 | 214.7 | 76.8 | 215.6 | 77.1 | 216.5 | 77.5 | 217.5 | 77.8 | 218.4 | 78.2 | ¼ |
| 2 | 207.9 | 86.1 | 208.8 | 86.5 | 209.7 | 86.9 | 210.6 | 87.3 | 211.6 | 87.6 | 212.5 | 88.0 | 213.4 | 88.4 | 214.3 | 88.8 | 6 |
| ¼ | 203.4 | 96.2 | 204.3 | 96.6 | 205.2 | 97.1 | 206.1 | 97.5 | 207.0 | 97.9 | 207.9 | 98.3 | 208.8 | 98.8 | 209.7 | 99.2 | ¾ |
| ½ | 198.4 | 106.1 | 199.3 | 106.5 | 200.2 | 107.0 | 201.1 | 107.5 | 202.0 | 107.9 | 202.8 | 108.4 | 203.7 | 108.9 | 204.6 | 109.4 | ½ |
| ¾ | 193.0 | 115.7 | 193.8 | 116.2 | 194.7 | 116.7 | 195.6 | 117.2 | 196.4 | 117.7 | 197.3 | 118.2 | 198.1 | 118.8 | 199.0 | 119.3 | ¼ |
| 3 | 187.1 | 125.0 | 187.9 | 125.6 | 188.7 | 126.1 | 189.6 | 126.7 | 190.4 | 127.2 | 191.2 | 127.8 | 192.1 | 128.3 | 192.9 | 128.9 | 5 |
| ¼ | 180.7 | 134.0 | 181.5 | 134.6 | 182.3 | 135.2 | 183.1 | 135.8 | 183.9 | 136.4 | 184.7 | 137.0 | 185.5 | 137.6 | 186.3 | 138.2 | ¾ |
| ½ | 173.9 | 142.7 | 174.7 | 143.4 | 175.5 | 144.0 | 176.2 | 144.6 | 177.0 | 145.3 | 177.8 | 145.9 | 178.6 | 146.5 | 179.3 | 147.2 | ½ |
| ¾ | 166.7 | 151.1 | 167.4 | 151.8 | 168.2 | 152.4 | 168.9 | 153.1 | 169.7 | 153.8 | 170.4 | 154.5 | 171.2 | 155.1 | 171.9 | 155.8 | ¼ |
| 4 | 159.1 | 159.1 | 159.8 | 159.8 | 160.5 | 160.5 | 161.2 | 161.2 | 161.9 | 161.9 | 162.6 | 162.6 | 163.3 | 163.3 | 164.0 | 164.0 | 4 |
| 1° | 225.0 | 03.9 | 226.0 | 03.9 | 227.0 | 04.0 | 228.0 | 04.0 | 229.0 | 04.0 | 230.0 | 04.0 | 231.0 | 04.0 | 232.0 | 04.0 | 89° |
| 2 | 224.9 | 07.9 | 225.9 | 07.9 | 226.9 | 07.9 | 227.9 | 08.0 | 228.9 | 08.0 | 229.9 | 08.0 | 230.9 | 08.1 | 231.9 | 08.1 | 88 |
| 3 | 224.7 | 11.8 | 225.7 | 11.8 | 226.7 | 11.9 | 227.7 | 11.9 | 228.7 | 12.0 | 229.7 | 12.0 | 230.7 | 12.1 | 231.7 | 12.1 | 87 |
| 4 | 224.5 | 15.7 | 225.4 | 15.8 | 226.4 | 15.8 | 227.4 | 15.9 | 228.4 | 16.0 | 229.4 | 16.0 | 230.4 | 16.1 | 231.4 | 16.2 | 86 |
| 5 | 224.1 | 19.6 | 225.1 | 19.7 | 226.1 | 19.8 | 227.1 | 19.9 | 228.1 | 20.0 | 229.1 | 20.0 | 230.1 | 20.1 | 231.1 | 20.2 | 85 |
| 6 | 223.8 | 23.5 | 224.8 | 23.6 | 225.8 | 23.7 | 226.8 | 23.8 | 227.7 | 23.9 | 228.7 | 24.0 | 229.7 | 24.1 | 230.7 | 24.3 | 84 |
| 7 | 223.3 | 27.4 | 224.3 | 27.5 | 225.3 | 27.7 | 226.3 | 27.8 | 227.3 | 27.9 | 228.3 | 28.0 | 229.3 | 28.1 | 230.3 | 28.3 | 83 |
| 8 | 222.8 | 31.3 | 223.8 | 31.5 | 224.8 | 31.6 | 225.8 | 31.7 | 226.8 | 31.9 | 227.8 | 32.0 | 228.8 | 32.1 | 229.7 | 32.3 | 82 |
| 9 | 222.2 | 35.2 | 223.2 | 35.4 | 224.2 | 35.5 | 225.2 | 35.7 | 226.2 | 35.8 | 227.2 | 36.0 | 228.2 | 36.1 | 229.1 | 36.3 | 81 |
| 10 | 221.6 | 39.1 | 222.6 | 39.2 | 223.6 | 39.4 | 224.5 | 39.6 | 225.5 | 39.8 | 226.5 | 39.9 | 227.5 | 40.1 | 228.5 | 40.3 | 80 |
| 11 | 220.9 | 42.9 | 221.8 | 43.1 | 222.8 | 43.3 | 223.8 | 43.5 | 224.8 | 43.7 | 225.8 | 43.9 | 226.8 | 44.1 | 227.7 | 44.3 | 79 |
| 12 | 220.1 | 46.8 | 221.1 | 47.0 | 222.0 | 47.2 | 223.0 | 47.4 | 224.0 | 47.6 | 225.0 | 47.8 | 226.0 | 48.0 | 226.9 | 48.2 | 78 |
| 13 | 219.2 | 50.6 | 220.2 | 50.8 | 221.2 | 51.1 | 222.2 | 51.3 | 223.1 | 51.5 | 224.1 | 51.7 | 225.1 | 52.0 | 226.1 | 52.2 | 77 |
| 14 | 218.3 | 54.4 | 219.3 | 54.7 | 220.3 | 54.9 | 221.2 | 55.2 | 222.2 | 55.4 | 223.2 | 55.6 | 224.1 | 55.9 | 225.1 | 56.1 | 76 |
| 15 | 217.3 | 58.2 | 218.3 | 58.5 | 219.3 | 58.8 | 220.2 | 59.0 | 221.2 | 59.3 | 222.2 | 59.5 | 223.1 | 59.8 | 224.1 | 60.0 | 75 |
| 16 | 216.3 | 62.0 | 217.2 | 62.3 | 218.2 | 62.6 | 219.2 | 62.8 | 220.1 | 63.1 | 221.1 | 63.4 | 222.1 | 63.7 | 223.0 | 63.9 | 74 |
| 17 | 215.2 | 65.8 | 216.1 | 66.1 | 217.1 | 66.4 | 218.0 | 66.7 | 219.0 | 67.0 | 220.0 | 67.2 | 220.9 | 67.5 | 221.9 | 67.8 | 73 |
| 18 | 214.0 | 69.5 | 214.9 | 69.8 | 215.9 | 70.1 | 216.8 | 70.5 | 217.8 | 70.8 | 218.7 | 71.1 | 219.7 | 71.4 | 220.6 | 71.7 | 72 |
| 19 | 212.7 | 73.3 | 213.7 | 73.6 | 214.6 | 73.9 | 215.6 | 74.2 | 216.5 | 74.6 | 217.5 | 74.9 | 218.4 | 75.2 | 219.4 | 75.5 | 71 |
| 20 | 211.4 | 77.0 | 212.4 | 77.3 | 213.3 | 77.6 | 214.2 | 78.0 | 215.2 | 78.3 | 216.1 | 78.7 | 217.1 | 79.0 | 218.0 | 79.3 | 70 |
| 21 | 210.1 | 80.6 | 211.0 | 81.0 | 211.9 | 81.3 | 212.9 | 81.7 | 213.8 | 82.1 | 214.7 | 82.4 | 215.7 | 82.8 | 216.6 | 83.1 | 69 |
| 22 | 208.6 | 84.3 | 209.5 | 84.7 | 210.5 | 85.0 | 211.4 | 85.4 | 212.3 | 85.8 | 213.3 | 86.2 | 214.2 | 86.5 | 215.1 | 86.9 | 68 |
| 23 | 207.1 | 87.9 | 208.0 | 88.3 | 209.0 | 88.7 | 209.9 | 89.1 | 210.8 | 89.5 | 211.7 | 89.9 | 212.6 | 90.3 | 213.6 | 90.6 | 67 |
| 24 | 205.5 | 91.5 | 206.5 | 91.9 | 207.4 | 92.3 | 208.3 | 92.7 | 209.2 | 93.1 | 210.1 | 93.5 | 211.0 | 94.0 | 211.9 | 94.4 | 66 |
| 25 | 203.9 | 95.1 | 204.8 | 95.5 | 205.7 | 95.9 | 206.6 | 96.4 | 207.5 | 96.8 | 208.5 | 97.2 | 209.4 | 97.6 | 210.3 | 98.0 | 65 |
| 26 | 202.2 | 98.6 | 203.1 | 99.1 | 204.0 | 99.5 | 204.9 | 99.9 | 205.8 | 100.4 | 206.7 | 100.8 | 207.6 | 101.3 | 208.5 | 101.7 | 64 |
| 27 | 200.5 | 102.1 | 201.4 | 102.6 | 202.3 | 103.1 | 203.1 | 103.5 | 204.0 | 104.0 | 204.9 | 104.4 | 205.8 | 104.9 | 206.7 | 105.3 | 63 |
| 28 | 198.7 | 105.6 | 199.5 | 106.1 | 200.4 | 106.6 | 201.3 | 107.0 | 202.2 | 107.5 | 203.1 | 108.0 | 204.0 | 108.4 | 204.8 | 108.9 | 62 |
| 29 | 196.8 | 109.1 | 197.7 | 109.6 | 198.5 | 110.1 | 199.4 | 110.5 | 200.3 | 111.0 | 201.2 | 111.5 | 202.0 | 112.0 | 202.9 | 112.5 | 61 |
| 30 | 194.9 | 112.5 | 195.7 | 113.0 | 196.6 | 113.5 | 197.5 | 114.0 | 198.3 | 114.5 | 199.2 | 115.0 | 200.1 | 115.5 | 200.9 | 116.0 | 60 |
| 31 | 192.9 | 115.9 | 193.7 | 116.4 | 194.6 | 116.9 | 195.4 | 117.4 | 196.3 | 117.9 | 197.1 | 118.5 | 198.0 | 119.0 | 198.9 | 119.5 | 59 |
| 32 | 190.8 | 119.2 | 191.7 | 119.8 | 192.5 | 120.3 | 193.4 | 120.8 | 194.2 | 121.4 | 195.1 | 121.9 | 195.9 | 122.4 | 196.7 | 122.9 | 58 |
| 33 | 188.7 | 122.5 | 189.5 | 123.1 | 190.4 | 123.6 | 191.2 | 124.2 | 192.1 | 124.7 | 192.9 | 125.3 | 193.7 | 125.8 | 194.6 | 126.4 | 57 |
| 34 | 186.5 | 125.8 | 187.4 | 126.4 | 188.2 | 126.9 | 189.0 | 127.5 | 189.8 | 128.1 | 190.7 | 128.6 | 191.5 | 129.2 | 192.3 | 129.7 | 56 |
| 35 | 184.3 | 129.1 | 185.1 | 129.6 | 185.9 | 130.2 | 186.8 | 130.8 | 187.6 | 131.3 | 188.4 | 131.9 | 189.2 | 132.5 | 190.0 | 133.1 | 55 |
| 36 | 182.0 | 132.3 | 182.8 | 132.8 | 183.6 | 133.4 | 184.5 | 134.0 | 185.3 | 134.6 | 186.1 | 135.2 | 186.9 | 135.8 | 187.7 | 136.4 | 54 |
| 37 | 179.7 | 135.4 | 180.5 | 136.0 | 181.3 | 136.6 | 182.1 | 137.2 | 182.9 | 137.8 | 183.7 | 138.4 | 184.5 | 139.0 | 185.3 | 139.6 | 53 |
| 38 | 177.3 | 138.5 | 178.1 | 139.1 | 178.9 | 139.8 | 179.7 | 140.4 | 180.5 | 141.0 | 181.2 | 141.6 | 182.0 | 142.2 | 182.8 | 142.8 | 52 |
| 39 | 174.9 | 141.6 | 175.6 | 142.2 | 176.4 | 142.9 | 177.2 | 143.5 | 178.0 | 144.1 | 178.7 | 144.7 | 179.5 | 145.4 | 180.3 | 46.0 | 51 |
| 40 | 172.4 | 144.6 | 173.1 | 145.3 | 173.9 | 145.9 | 174.7 | 146.6 | 175.4 | 147.2 | 176.2 | 147.8 | 177.0 | 148.5 | 177.7 | 149.1 | 50 |
| 41 | 169.8 | 147.6 | 170.6 | 148.3 | 171.3 | 148.9 | 172.1 | 149.6 | 172.8 | 150.2 | 173.6 | 150.9 | 174.3 | 151.5 | 175.1 | 152.2 | 49 |
| 42 | 167.2 | 150.6 | 168.0 | 151.2 | 168.7 | 151.9 | 169.4 | 152.6 | 170.2 | 153.2 | 170.9 | 153.9 | 171.7 | 154.6 | 172.4 | 155.2 | 48 |
| 43 | 164.6 | 153.4 | 165.3 | 154.1 | 166.0 | 154.8 | 166.7 | 155.5 | 167.5 | 156.2 | 168.2 | 156.9 | 168.9 | 157.5 | 169.7 | 158.2 | 47 |
| 44 | 161.9 | 156.3 | 162.6 | 157.0 | 163.3 | 157.7 | 164.0 | 158.4 | 164.7 | 159.1 | 165.4 | 159.8 | 166.2 | 160.5 | 166.9 | 161.2 | 46 |
| 45 | 159.1 | 159.1 | 159.8 | 159.8 | 160.5 | 160.5 | 161.2 | 161.2 | 161.9 | 161.9 | 162.6 | 162.6 | 163.3 | 163.3 | 164.0 | 164.0 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 233 | | 234 | | 235 | | 236 | | 237 | | 238 | | 239 | | 240 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cmss. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Cmss. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 232.7 | 11.4 | 233.7 | 11.5 | 234.7 | 11.5 | 235.7 | 11.6 | 236.7 | 11.6 | 237.7 | 11.7 | 238.7 | 11.7 | 239.7 | 11.8 | 7¾ |
| ½ | 231.9 | 22.8 | 232.9 | 22.9 | 233.9 | 23.0 | 234.9 | 23.1 | 235.9 | 23.2 | 236.9 | 23.3 | 237.8 | 23.4 | 238.8 | 23.5 | ½ |
| ¾ | 230.5 | 34.2 | 231.5 | 34.3 | 232.4 | 34.5 | 233.4 | 34.6 | 234.4 | 34.8 | 235.4 | 34.9 | 236.4 | 35.1 | 237.4 | 35.2 | ¼ |
| 1 | 228.5 | 45.5 | 229.5 | 45.7 | 230.5 | 45.8 | 231.5 | 46.0 | 232.4 | 46.2 | 233.4 | 46.4 | 234.4 | 46.6 | 235.4 | 46.8 | 7 |
| ¼ | 226.0 | 56.6 | 227.0 | 56.9 | 228.0 | 57.1 | 228.9 | 57.3 | 229.9 | 57.6 | 230.9 | 57.8 | 231.8 | 58.1 | 232.8 | 58.3 | ¾ |
| ½ | 223.0 | 67.6 | 223.9 | 67.9 | 224.9 | 68.2 | 225.8 | 68.5 | 226.8 | 68.8 | 227.8 | 69.1 | 228.7 | 69.4 | 229.7 | 69.7 | ½ |
| ¾ | 219.4 | 78.5 | 220.3 | 78.8 | 221.3 | 79.2 | 222.2 | 79.5 | 223.1 | 79.8 | 224.1 | 80.2 | 225.0 | 80.5 | 226.0 | 80.8 | ¼ |
| 2 | 215.3 | 89.2 | 216.2 | 89.6 | 217.1 | 89.9 | 218.0 | 90.3 | 219.0 | 90.7 | 219.9 | 91.1 | 220.8 | 91.5 | 221.7 | 91.8 | 6 |
| ¼ | 210.6 | 99.6 | 211.5 | 100.1 | 212.4 | 100.5 | 213.3 | 100.9 | 214.2 | 101.3 | 215.1 | 101.8 | 216.1 | 102.2 | 217.0 | 102.6 | ¾ |
| ½ | 205.5 | 109.8 | 206.4 | 110.3 | 207.3 | 110.8 | 208.1 | 111.2 | 209.0 | 111.7 | 209.9 | 112.2 | 210.8 | 112.7 | 211.7 | 113.1 | ½ |
| ¾ | 199.8 | 119.8 | 200.7 | 120.3 | 201.6 | 120.8 | 202.4 | 121.3 | 203.3 | 121.8 | 204.1 | 122.4 | 205.0 | 122.9 | 205.9 | 123.4 | ¼ |
| 3 | 193.7 | 129.4 | 194.6 | 130.0 | 195.4 | 130.6 | 196.2 | 131.1 | 197.1 | 131.7 | 197.9 | 132.2 | 198.7 | 132.8 | 199.5 | 133.3 | 5 |
| ¼ | 187.1 | 138.8 | 187.9 | 139.4 | 188.8 | 140.0 | 189.6 | 140.6 | 190.4 | 141.2 | 191.2 | 141.8 | 192.0 | 142.4 | 192.8 | 143.0 | ¾ |
| ½ | 180.1 | 147.8 | 180.9 | 148.4 | 181.7 | 149.1 | 182.4 | 149.7 | 183.2 | 150.3 | 184.0 | 151.0 | 184.7 | 151.6 | 185.5 | 152.3 | ½ |
| ¾ | 172.6 | 156.5 | 173.4 | 157.1 | 174.1 | 157.8 | 174.9 | 158.5 | 175.6 | 159.1 | 176.3 | 159.8 | 177.1 | 160.5 | 177.8 | 161.2 | ¼ |
| 4 | 164.8 | 164.8 | 165.5 | 165.5 | 166.2 | 166.2 | 166.9 | 166.9 | 167.6 | 167.6 | 168.3 | 168.3 | 169.0 | 169.0 | 169.7 | 169.7 | 4 |
| 1° | 233.0 | 04.1 | 234.0 | 04.1 | 235.0 | 04.1 | 236.0 | 04.1 | 237.0 | 04.1 | 238.0 | 04.2 | 239.0 | 04.2 | 240.0 | 04.2 | 89° |
| 2 | 232.9 | 08.1 | 233.9 | 08.2 | 234.9 | 08.2 | 235.9 | 08.2 | 236.9 | 08.3 | 237.9 | 08.3 | 238.9 | 08.3 | 239.9 | 08.4 | 88 |
| 3 | 232.7 | 12.2 | 233.7 | 12.2 | 234.7 | 12.3 | 235.7 | 12.4 | 236.7 | 12.4 | 237.7 | 12.5 | 238.7 | 12.5 | 239.7 | 12.6 | 87 |
| 4 | 232.4 | 16.3 | 233.4 | 16.3 | 234.4 | 16.4 | 235.4 | 16.5 | 236.4 | 16.5 | 237.4 | 16.6 | 238.4 | 16.7 | 239.4 | 16.7 | 86 |
| 5 | 232.1 | 20.3 | 233.1 | 20.4 | 234.1 | 20.5 | 235.1 | 20.6 | 236.1 | 20.7 | 237.1 | 20.7 | 238.1 | 20.8 | 239.1 | 20.9 | 85 |
| 6 | 231.7 | 24.4 | 232.7 | 24.5 | 233.7 | 24.6 | 234.7 | 24.7 | 235.7 | 24.8 | 236.7 | 24.9 | 237.7 | 25.0 | 238.7 | 25.1 | 84 |
| 7 | 231.3 | 28.4 | 232.3 | 28.5 | 233.2 | 28.6 | 234.2 | 28.8 | 235.2 | 28.9 | 236.2 | 29.0 | 237.2 | 29.1 | 238.2 | 29.2 | 83 |
| 8 | 230.7 | 32.4 | 231.7 | 32.6 | 232.7 | 32.7 | 233.7 | 32.8 | 234.7 | 33.0 | 235.7 | 33.1 | 236.7 | 33.3 | 237.7 | 33.4 | 82 |
| 9 | 230.1 | 36.4 | 231.1 | 36.6 | 232.1 | 36.8 | 233.1 | 36.9 | 234.1 | 37.1 | 235.1 | 37.2 | 236.1 | 37.4 | 237.0 | 37.5 | 81 |
| 10 | 229.5 | 40.5 | 230.4 | 40.6 | 231.4 | 40.8 | 232.4 | 41.0 | 233.4 | 41.2 | 234.4 | 41.3 | 235.4 | 41.5 | 236.4 | 41.7 | 80 |
| 11 | 228.7 | 44.5 | 229.7 | 44.6 | 230.7 | 44.8 | 231.7 | 45.0 | 232.6 | 45.2 | 233.6 | 45.4 | 234.6 | 45.6 | 235.6 | 45.8 | 79 |
| 12 | 227.9 | 48.4 | 228.9 | 48.7 | 229.9 | 48.9 | 230.8 | 49.1 | 231.8 | 49.3 | 232.8 | 49.5 | 233.8 | 49.7 | 234.8 | 49.9 | 78 |
| 13 | 227.0 | 52.4 | 228.0 | 52.6 | 229.0 | 52.9 | 230.0 | 53.1 | 230.9 | 53.3 | 231.9 | 53.5 | 232.9 | 53.8 | 233.8 | 54.0 | 77 |
| 14 | 226.1 | 56.4 | 227.0 | 56.6 | 228.0 | 56.9 | 229.0 | 57.1 | 230.0 | 57.3 | 230.9 | 57.6 | 231.9 | 57.8 | 232.9 | 58.1 | 76 |
| 15 | 225.1 | 60.3 | 226.0 | 60.6 | 227.0 | 60.8 | 228.0 | 61.1 | 228.9 | 61.3 | 229.9 | 61.6 | 230.9 | 61.9 | 231.8 | 62.1 | 75 |
| 16 | 224.0 | 64.2 | 224.9 | 64.5 | 225.9 | 64.8 | 226.9 | 65.1 | 227.8 | 65.3 | 228.8 | 65.6 | 229.7 | 65.9 | 230.7 | 66.2 | 74 |
| 17 | 222.8 | 68.1 | 223.8 | 68.4 | 224.7 | 68.7 | 225.7 | 69.0 | 226.6 | 69.3 | 227.6 | 69.6 | 228.6 | 69.9 | 229.5 | 70.2 | 73 |
| 18 | 221.6 | 72.0 | 222.5 | 72.3 | 223.5 | 72.6 | 224.4 | 72.9 | 225.4 | 73.2 | 226.4 | 73.5 | 227.3 | 73.9 | 228.3 | 74.2 | 72 |
| 19 | 220.3 | 75.9 | 221.3 | 76.2 | 222.2 | 76.5 | 223.1 | 76.8 | 224.1 | 77.2 | 225.0 | 77.5 | 226.0 | 77.8 | 226.9 | 78.1 | 71 |
| 20 | 218.9 | 79.7 | 219.9 | 80.0 | 220.8 | 80.4 | 221.8 | 80.7 | 222.7 | 81.1 | 223.6 | 81.4 | 224.6 | 81.7 | 225.5 | 82.1 | 70 |
| 21 | 217.5 | 83.5 | 218.5 | 83.9 | 219.4 | 84.2 | 220.3 | 84.6 | 221.3 | 84.9 | 222.2 | 85.3 | 223.1 | 85.6 | 224.1 | 86.0 | 69 |
| 22 | 216.0 | 87.3 | 217.0 | 87.7 | 217.9 | 88.0 | 218.8 | 88.4 | 219.7 | 88.8 | 220.7 | 89.2 | 221.6 | 89.5 | 222.5 | 89.9 | 68 |
| 23 | 214.5 | 91.0 | 215.4 | 91.4 | 216.3 | 91.8 | 217.2 | 92.2 | 218.2 | 92.6 | 219.1 | 93.0 | 220.0 | 93.4 | 220.9 | 93.8 | 67 |
| 24 | 212.9 | 94.8 | 213.8 | 95.2 | 214.7 | 95.6 | 215.6 | 96.0 | 216.5 | 96.4 | 217.4 | 96.8 | 218.3 | 97.2 | 219.3 | 97.6 | 66 |
| 25 | 211.2 | 98.5 | 212.1 | 98.9 | 213.0 | 99.3 | 213.9 | 99.7 | 214.8 | 100.2 | 215.7 | 100.6 | 216.6 | 101.0 | 217.5 | 101.4 | 65 |
| 26 | 209.4 | 102.1 | 210.3 | 102.6 | 211.2 | 103.0 | 212.1 | 103.5 | 213.0 | 103.9 | 213.9 | 104.3 | 214.8 | 104.8 | 215.7 | 105.2 | 64 |
| 27 | 207.6 | 105.8 | 208.5 | 106.2 | 209.4 | 106.7 | 210.3 | 107.1 | 211.2 | 107.6 | 212.1 | 108.0 | 213.0 | 108.5 | 213.8 | 109.0 | 63 |
| 28 | 205.7 | 109.4 | 206.6 | 109.9 | 207.5 | 110.3 | 208.4 | 110.8 | 209.3 | 111.3 | 210.1 | 111.7 | 211.0 | 112.2 | 211.9 | 112.7 | 62 |
| 29 | 203.8 | 113.0 | 204.7 | 113.4 | 205.5 | 113.9 | 206.4 | 114.4 | 207.3 | 114.9 | 208.2 | 115.4 | 209.0 | 115.9 | 209.9 | 116.4 | 61 |
| 30 | 201.8 | 116.5 | 202.6 | 117.0 | 203.5 | 117.5 | 204.4 | 118.0 | 205.2 | 118.5 | 206.1 | 119.0 | 207.0 | 119.5 | 207.8 | 120.0 | 60 |
| 31 | 199.7 | 120.0 | 200.6 | 120.5 | 201.4 | 121.0 | 202.3 | 121.5 | 203.1 | 122.1 | 204.0 | 122.6 | 204.9 | 123.1 | 205.7 | 123.6 | 59 |
| 32 | 197.6 | 123.5 | 198.4 | 124.0 | 199.3 | 124.5 | 200.1 | 125.1 | 201.0 | 125.6 | 201.8 | 126.1 | 202.7 | 126.7 | 203.5 | 127.2 | 58 |
| 33 | 195.4 | 126.9 | 196.2 | 127.4 | 197.1 | 128.0 | 197.9 | 128.5 | 198.8 | 129.1 | 199.6 | 129.6 | 200.4 | 130.2 | 201.3 | 130.7 | 57 |
| 34 | 193.2 | 130.3 | 194.0 | 130.9 | 194.8 | 131.4 | 195.7 | 132.0 | 196.5 | 132.5 | 197.3 | 133.1 | 198.1 | 133.6 | 199.0 | 134.2 | 56 |
| 35 | 190.9 | 133.6 | 191.7 | 134.2 | 192.5 | 134.8 | 193.3 | 135.4 | 194.1 | 135.9 | 195.0 | 136.5 | 195.8 | 137.1 | 196.6 | 137.7 | 55 |
| 36 | 188.5 | 137.0 | 189.3 | 137.5 | 190.1 | 138.1 | 190.9 | 138.7 | 191.7 | 139.3 | 192.5 | 139.9 | 193.4 | 140.5 | 194.2 | 141.1 | 54 |
| 37 | 186.1 | 140.2 | 186.9 | 140.8 | 187.7 | 141.4 | 188.5 | 142.0 | 189.3 | 142.6 | 190.1 | 143.2 | 190.9 | 143.8 | 191.7 | 144.4 | 53 |
| 38 | 183.6 | 143.4 | 184.4 | 144.1 | 185.2 | 144.7 | 186.0 | 145.3 | 186.8 | 145.9 | 187.5 | 146.5 | 188.3 | 147.1 | 189.1 | 147.8 | 52 |
| 39 | 181.1 | 146.6 | 181.9 | 147.3 | 182.6 | 147.9 | 183.4 | 148.5 | 184.2 | 149.1 | 185.0 | 149.8 | 185.7 | 150.4 | 186.5 | 151.0 | 51 |
| 40 | 178.5 | 149.8 | 179.3 | 150.4 | 180.0 | 151.1 | 180.8 | 151.7 | 181.6 | 152.3 | 182.3 | 153.0 | 183.1 | 153.6 | 183.9 | 154.3 | 50 |
| 41 | 175.8 | 152.9 | 176.6 | 153.5 | 177.4 | 154.2 | 178.1 | 154.8 | 178.9 | 155.5 | 179.6 | 156.1 | 180.4 | 156.8 | 181.1 | 157.5 | 49 |
| 42 | 173.2 | 155.9 | 173.9 | 156.6 | 174.6 | 157.2 | 175.4 | 157.9 | 176.1 | 158.6 | 176.9 | 159.3 | 177.6 | 159.9 | 178.4 | 160.6 | 48 |
| 43 | 170.4 | 158.9 | 171.1 | 159.6 | 171.9 | 160.3 | 172.6 | 161.0 | 173.3 | 161.6 | 174.1 | 162.3 | 174.8 | 163.0 | 175.5 | 163.7 | 47 |
| 44 | 167.6 | 161.9 | 168.3 | 162.6 | 169.0 | 163.2 | 169.8 | 163.9 | 170.5 | 164.6 | 171.2 | 165.3 | 171.9 | 166.0 | 172.6 | 166.7 | 46 |
| 45 | 164.8 | 164.8 | 165.5 | 165.5 | 166.2 | 166.2 | 166.9 | 166.9 | 167.6 | 167.6 | 168.3 | 168.3 | 169.0 | 169.0 | 169.7 | 169.7 | 45 |
| Cmss. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Cmss. |

(x.) Traverse Table.

| Distance. | 241 | | 242 | | 243 | | 244 | | 245 | | 246 | | 247 | | 248 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep | Crse |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 240.7 | 11.8 | 241.7 | 11.9 | 242.7 | 11.9 | 243.7 | 12.0 | 244.7 | 12.0 | 245.7 | 12.1 | 246.7 | 12.1 | 247.7 | 12.2 | ¾ |
| ½ | 239.8 | 23.6 | 240.8 | 23.7 | 241.8 | 23.8 | 242.8 | 23.9 | 243.8 | 24.0 | 244.8 | 24.1 | 245.8 | 24.2 | 246.8 | 24.3 | ½ |
| ¾ | 238.4 | 35.4 | 239.4 | 35.5 | 240.4 | 35.7 | 241.4 | 35.8 | 242.3 | 35.9 | 243.3 | 36.1 | 244.3 | 36.2 | 245.3 | 36.4 | ¼ |
| 1 | 236.4 | 47.0 | 237.3 | 47.2 | 238.3 | 47.4 | 239.3 | 47.6 | 240.3 | 47.8 | 241.3 | 48.0 | 242.3 | 48.2 | 243.2 | 48.4 | 7 |
| ¼ | 233.8 | 58.6 | 234.7 | 58.8 | 235.7 | 59.0 | 236.7 | 59.3 | 237.7 | 59.5 | 238.6 | 59.8 | 239.6 | 60.0 | 240.6 | 60.3 | ¾ |
| ½ | 230.6 | 70.0 | 231.6 | 70.2 | 232.5 | 70.5 | 233.5 | 70.8 | 234.5 | 71.1 | 235.4 | 71.4 | 236.4 | 71.7 | 237.3 | 72.0 | ½ |
| ¾ | 226.9 | 81.2 | 227.8 | 81.5 | 228.8 | 81.9 | 229.7 | 82.2 | 230.7 | 82.5 | 231.6 | 82.9 | 232.6 | 83.2 | 233.5 | 83.5 | ¼ |
| 2 | 222.7 | 92.2 | 223.6 | 92.6 | 224.5 | 93.0 | 225.4 | 93.4 | 226.4 | 93.8 | 227.3 | 94.1 | 228.2 | 94.5 | 229.1 | 94.9 | 6 |
| ¼ | 217.9 | 103.0 | 218.8 | 103.5 | 219.7 | 103.9 | 220.6 | 104.3 | 221.5 | 104.8 | 222.4 | 105.2 | 223.3 | 105.6 | 224.2 | 106.0 | ¾ |
| ½ | 212.5 | 113.6 | 213.4 | 114.1 | 214.3 | 114.6 | 215.2 | 115.0 | 216.1 | 115.5 | 217.0 | 116.0 | 217.8 | 116.4 | 218.7 | 116.9 | ½ |
| ¾ | 206.7 | 123.9 | 207.6 | 124.4 | 208.4 | 124.9 | 209.3 | 125.4 | 210.1 | 125.9 | 211.0 | 126.5 | 211.9 | 127.0 | 212.7 | 127.5 | ¼ |
| 3 | 200.4 | 133.9 | 201.2 | 134.4 | 202.0 | 135.0 | 202.9 | 135.6 | 203.7 | 136.1 | 204.5 | 136.7 | 205.4 | 137.2 | 206.2 | 137.8 | 5 |
| ¼ | 193.6 | 143.6 | 194.4 | 144.2 | 195.2 | 144.8 | 196.0 | 145.4 | 196.8 | 146.0 | 197.6 | 146.5 | 198.4 | 147.1 | 199.2 | 147.7 | ¾ |
| ½ | 186.3 | 152.9 | 187.1 | 153.5 | 187.8 | 154.2 | 188.6 | 154.8 | 189.4 | 155.4 | 190.2 | 156.1 | 190.9 | 156.7 | 191.7 | 157.3 | ½ |
| ¾ | 178.6 | 161.8 | 179.3 | 162.5 | 180.0 | 163.2 | 180.8 | 163.8 | 181.5 | 164.5 | 182.3 | 165.2 | 183.0 | 165.9 | 183.8 | 166.5 | ¼ |
| 4 | 170.4 | 170.4 | 171.1 | 171.1 | 171.8 | 171.8 | 172.5 | 172.5 | 173.2 | 173.2 | 173.9 | 173.9 | 174.7 | 174.7 | 175.4 | 175.4 | 4 |
| 1° | 241.0 | 04.2 | 242.0 | 04.2 | 243.0 | 04.2 | 244.0 | 04.3 | 245.0 | 04.3 | 246.0 | 04.3 | 247.0 | 04.3 | 248.0 | 04.3 | 89° |
| 2 | 240.9 | 08.4 | 241.9 | 08.4 | 242.9 | 08.5 | 243.9 | 08.5 | 244.9 | 08.6 | 245.9 | 08.6 | 246.8 | 08.6 | 247.8 | 08.7 | 88 |
| 3 | 240.7 | 12.6 | 241.7 | 12.7 | 242.7 | 12.7 | 243.7 | 12.8 | 244.7 | 12.8 | 245.7 | 12.9 | 246.7 | 12.9 | 247.7 | 13.0 | 87 |
| 4 | 240.4 | 16.8 | 241.4 | 16.9 | 242.4 | 17.0 | 243.4 | 17.0 | 244.4 | 17.1 | 245.4 | 17.2 | 246.4 | 17.2 | 247.4 | 17.3 | 86 |
| 5 | 240.1 | 21.0 | 241.1 | 21.1 | 242.1 | 21.2 | 243.1 | 21.3 | 244.1 | 21.4 | 245.1 | 21.4 | 246.1 | 21.5 | 247.1 | 21.6 | 85 |
| 6 | 239.7 | 25.2 | 240.7 | 25.3 | 241.7 | 25.4 | 242.7 | 25.5 | 243.7 | 25.6 | 244.7 | 25.7 | 245.6 | 25.8 | 246.6 | 25.9 | 84 |
| 7 | 239.2 | 29.4 | 240.2 | 29.5 | 241.2 | 29.6 | 242.2 | 29.7 | 243.2 | 29.9 | 244.2 | 30.0 | 245.2 | 30.1 | 246.2 | 30.2 | 83 |
| 8 | 238.7 | 33.5 | 239.6 | 33.7 | 240.6 | 33.8 | 241.6 | 34.0 | 242.6 | 34.1 | 243.6 | 34.2 | 244.6 | 34.4 | 245.6 | 34.5 | 82 |
| 9 | 238.0 | 37.7 | 239.0 | 37.9 | 240.0 | 38.0 | 241.0 | 38.2 | 242.0 | 38.3 | 243.0 | 38.5 | 244.0 | 38.6 | 244.9 | 38.8 | 81 |
| 10 | 237.3 | 41.8 | 238.3 | 42.0 | 239.3 | 42.2 | 240.3 | 42.4 | 241.3 | 42.5 | 242.3 | 42.7 | 243.2 | 42.9 | 244.2 | 43.1 | 80 |
| 11 | 236.6 | 46.0 | 237.6 | 46.2 | 238.5 | 46.4 | 239.5 | 46.6 | 240.5 | 46.7 | 241.5 | 46.9 | 242.5 | 47.1 | 243.4 | 47.3 | 79 |
| 12 | 235.7 | 50.1 | 236.7 | 50.3 | 237.7 | 50.5 | 238.7 | 50.7 | 239.6 | 50.9 | 240.6 | 51.1 | 241.6 | 51.4 | 242.6 | 51.6 | 78 |
| 13 | 234.8 | 54.2 | 235.8 | 54.4 | 236.8 | 54.7 | 237.7 | 54.9 | 238.7 | 55.1 | 239.7 | 55.3 | 240.7 | 55.6 | 241.6 | 55.8 | 77 |
| 14 | 233.8 | 58.3 | 234.8 | 58.5 | 235.8 | 58.8 | 236.8 | 59.0 | 237.7 | 59.3 | 238.7 | 59.5 | 239.7 | 59.8 | 240.6 | 60.0 | 76 |
| 15 | 232.8 | 62.4 | 233.8 | 62.6 | 234.7 | 62.9 | 235.7 | 63.2 | 236.7 | 63.4 | 237.6 | 63.7 | 238.6 | 63.9 | 239.5 | 64.2 | 75 |
| 16 | 231.7 | 66.4 | 232.6 | 66.7 | 233.6 | 67.0 | 234.5 | 67.3 | 235.5 | 67.5 | 236.5 | 67.8 | 237.4 | 68.1 | 238.4 | 68.4 | 74 |
| 17 | 230.5 | 70.5 | 231.4 | 70.8 | 232.4 | 71.0 | 233.3 | 71.3 | 234.3 | 71.6 | 235.3 | 71.9 | 236.2 | 72.2 | 237.2 | 72.5 | 73 |
| 18 | 229.2 | 74.5 | 230.2 | 74.8 | 231.1 | 75.1 | 232.1 | 75.4 | 233.0 | 75.7 | 234.0 | 76.0 | 234.9 | 76.3 | 235.9 | 76.6 | 72 |
| 19 | 227.9 | 78.5 | 228.8 | 78.8 | 229.8 | 79.1 | 230.7 | 79.4 | 231.7 | 79.8 | 232.6 | 80.1 | 233.5 | 80.4 | 234.5 | 80.7 | 71 |
| 20 | 226.5 | 82.4 | 227.4 | 82.8 | 228.3 | 83.1 | 229.3 | 83.5 | 230.2 | 83.8 | 231.2 | 84.1 | 232.1 | 84.5 | 233.0 | 84.8 | 70 |
| 21 | 225.0 | 86.4 | 225.9 | 86.7 | 226.9 | 87.1 | 227.8 | 87.4 | 228.7 | 87.8 | 229.7 | 88.2 | 230.6 | 88.5 | 231.5 | 88.9 | 69 |
| 22 | 223.5 | 90.3 | 224.4 | 90.7 | 225.3 | 91.0 | 226.2 | 91.4 | 227.2 | 91.8 | 228.1 | 92.2 | 229.0 | 92.5 | 229.9 | 92.9 | 68 |
| 23 | 221.8 | 94.2 | 222.8 | 94.6 | 223.7 | 94.9 | 224.6 | 95.3 | 225.5 | 95.7 | 226.4 | 96.1 | 227.4 | 96.5 | 228.3 | 96.9 | 67 |
| 24 | 220.2 | 98.0 | 221.1 | 98.4 | 222.0 | 98.8 | 222.9 | 99.2 | 223.8 | 99.7 | 224.7 | 100.1 | 225.6 | 100.5 | 226.6 | 100.9 | 66 |
| 25 | 218.4 | 101.9 | 219.3 | 102.3 | 220.2 | 102.7 | 221.1 | 103.1 | 222.0 | 103.5 | 223.0 | 104.0 | 223.9 | 104.4 | 224.8 | 104.8 | 65 |
| 26 | 216.6 | 105.6 | 217.5 | 106.1 | 218.4 | 106.5 | 219.3 | 107.0 | 220.2 | 107.4 | 221.1 | 107.8 | 222.0 | 108.3 | 222.9 | 108.7 | 64 |
| 27 | 214.7 | 109.4 | 215.6 | 109.9 | 216.5 | 110.3 | 217.4 | 110.8 | 218.3 | 111.2 | 219.2 | 111.7 | 220.1 | 112.1 | 221.0 | 112.6 | 63 |
| 28 | 212.8 | 113.1 | 213.7 | 113.6 | 214.6 | 114.1 | 215.4 | 114.6 | 216.3 | 115.0 | 217.2 | 115.5 | 218.1 | 116.0 | 219.0 | 116.4 | 62 |
| 29 | 210.8 | 116.8 | 211.7 | 117.3 | 212.5 | 117.8 | 213.4 | 118.3 | 214.3 | 118.8 | 215.2 | 119.3 | 216.0 | 119.7 | 216.9 | 120.2 | 61 |
| 30 | 208.7 | 120.5 | 209.6 | 121.0 | 210.4 | 121.5 | 211.3 | 122.0 | 212.2 | 122.5 | 213.0 | 123.0 | 213.9 | 123.5 | 214.8 | 124.0 | 60 |
| 31 | 206.6 | 124.1 | 207.4 | 124.6 | 208.3 | 125.2 | 209.1 | 125.7 | 210.0 | 126.2 | 210.9 | 126.7 | 211.7 | 127.2 | 212.6 | 127.7 | 59 |
| 32 | 204.4 | 127.7 | 205.2 | 128.2 | 206.1 | 128.8 | 206.9 | 129.3 | 207.8 | 129.8 | 208.6 | 130.4 | 209.5 | 130.9 | 210.3 | 131.4 | 58 |
| 33 | 202.1 | 131.3 | 203.0 | 131.8 | 203.8 | 132.3 | 204.6 | 132.9 | 205.5 | 133.4 | 206.3 | 134.0 | 207.2 | 134.5 | 208.0 | 135.1 | 57 |
| 34 | 199.8 | 134.8 | 200.6 | 135.3 | 201.5 | 135.9 | 202.3 | 136.4 | 203.1 | 137.0 | 203.9 | 137.6 | 204.8 | 138.1 | 205.6 | 138.7 | 56 |
| 35 | 197.4 | 138.2 | 198.2 | 138.8 | 199.1 | 139.4 | 199.9 | 140.0 | 200.7 | 140.5 | 201.5 | 141.1 | 202.3 | 141.7 | 203.1 | 142.2 | 55 |
| 36 | 195.0 | 141.7 | 195.8 | 142.2 | 196.6 | 142.8 | 197.4 | 143.4 | 198.2 | 144.0 | 199.0 | 144.6 | 199.8 | 145.2 | 200.6 | 145.8 | 54 |
| 37 | 192.5 | 145.0 | 193.3 | 145.6 | 194.1 | 146.2 | 194.9 | 146.8 | 195.7 | 147.4 | 196.5 | 148.0 | 197.3 | 148.6 | 198.1 | 149.3 | 53 |
| 38 | 189.9 | 148.4 | 190.7 | 149.0 | 191.5 | 149.6 | 192.3 | 150.2 | 193.1 | 150.8 | 193.9 | 151.5 | 194.6 | 152.1 | 195.4 | 152.7 | 52 |
| 39 | 187.3 | 151.7 | 188.1 | 152.3 | 188.8 | 152.9 | 189.6 | 153.6 | 190.4 | 154.2 | 191.2 | 154.8 | 192.0 | 155.4 | 192.7 | 156.1 | 51 |
| 40 | 184.6 | 154.9 | 185.4 | 155.6 | 186.1 | 156.2 | 186.9 | 156.8 | 187.7 | 157.5 | 188.4 | 158.1 | 189.2 | 158.8 | 190.0 | 159.4 | 50 |
| 41 | 181.9 | 158.1 | 182.6 | 158.8 | 183.4 | 159.4 | 184.1 | 160.1 | 184.9 | 160.7 | 185.7 | 161.4 | 186.4 | 162.0 | 187.2 | 162.7 | 49 |
| 42 | 179.1 | 161.3 | 179.8 | 161.9 | 180.6 | 162.6 | 181.3 | 163.3 | 182.1 | 163.9 | 182.8 | 164.6 | 183.6 | 165.3 | 184.3 | 165.9 | 48 |
| 43 | 176.3 | 164.4 | 177.0 | 165.0 | 177.7 | 165.7 | 178.5 | 166.4 | 179.2 | 167.1 | 179.9 | 167.8 | 180.6 | 168.5 | 181.4 | 169.1 | 47 |
| 44 | 173.4 | 167.4 | 174.1 | 168.1 | 174.8 | 168.8 | 175.5 | 169.5 | 176.2 | 170.2 | 177.0 | 170.9 | 177.7 | 171.6 | 178.4 | 172.3 | 46 |
| 45 | 170.4 | 170.4 | 171.1 | 171.1 | 171.8 | 171.8 | 172.5 | 172.5 | 173.2 | 173.2 | 173.9 | 173.9 | 174.7 | 174.7 | 175.4 | 175.4 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 249 | | 250 | | 251 | | 252 | | 253 | | 254 | | 255 | | 256 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 248.7 | 12.2 | 249.7 | 12.3 | 250.7 | 12.3 | 251.7 | 12.4 | 252.7 | 12.4 | 253.7 | 12.5 | 254.7 | 12.5 | 255.7 | 12.6 | 7¾ |
| ½ | 247.8 | 24.4 | 248.8 | 24.5 | 249.8 | 24.6 | 250.8 | 24.7 | 251.8 | 24.8 | 252.8 | 24.9 | 253.8 | 25.0 | 254.8 | 25.1 | ½ |
| ¾ | 246.3 | 36.5 | 247.3 | 36.7 | 248.3 | 36.8 | 249.3 | 37.0 | 250.3 | 37.1 | 251.2 | 37.3 | 252.2 | 37.4 | 253.2 | 37.6 | ¼ |
| 1 | 244.2 | 48.6 | 245.2 | 48.8 | 246.2 | 49.0 | 247.2 | 49.2 | 248.1 | 49.4 | 249.1 | 49.6 | 250.1 | 49.7 | 251.1 | 49.9 | 7 |
| ¼ | 241.5 | 60.5 | 242.5 | 60.7 | 243.5 | 61.0 | 244.5 | 61.2 | 245.4 | 61.5 | 246.4 | 61.7 | 247.4 | 62.0 | 248.3 | 62.2 | ¾ |
| ½ | 238.3 | 72.3 | 239.2 | 72.6 | 240.2 | 72.9 | 241.2 | 73.1 | 242.1 | 73.4 | 243.1 | 73.7 | 244.0 | 74.0 | 245.0 | 74.3 | ½ |
| ¾ | 234.4 | 83.9 | 235.4 | 84.2 | 236.3 | 84.6 | 237.3 | 84.9 | 238.2 | 85.2 | 239.1 | 85.6 | 240.1 | 85.9 | 241.0 | 86.2 | ¼ |
| 2 | 230.1 | 95.3 | 231.0 | 95.7 | 231.9 | 96.1 | 232.8 | 96.4 | 233.7 | 96.8 | 234.7 | 97.2 | 235.6 | 97.6 | 236.5 | 98.0 | 6 |
| ¼ | 225.1 | 106.5 | 226.0 | 106.9 | 226.9 | 107.3 | 227.8 | 107.8 | 228.7 | 108.2 | 229.6 | 108.6 | 230.5 | 109.0 | 231.4 | 109.5 | ¾ |
| ½ | 219.6 | 117.4 | 220.5 | 117.8 | 221.4 | 118.3 | 222.2 | 118.8 | 223.1 | 119.3 | 224.0 | 119.7 | 224.9 | 120.2 | 225.8 | 120.7 | ½ |
| ¾ | 213.6 | 128.0 | 214.4 | 128.5 | 215.3 | 129.0 | 216.1 | 129.5 | 217.0 | 130.1 | 217.9 | 130.6 | 218.7 | 131.1 | 219.6 | 131.6 | ¼ |
| 3 | 207.0 | 138.3 | 207.9 | 138.9 | 208.7 | 139.4 | 209.5 | 140.0 | 210.4 | 140.6 | 211.2 | 141.1 | 212.0 | 141.7 | 212.9 | 142.2 | 5 |
| ¼ | 200.0 | 148.3 | 200.8 | 148.9 | 201.6 | 149.5 | 202.4 | 150.1 | 203.2 | 150.7 | 204.0 | 151.3 | 204.8 | 151.9 | 205.6 | 152.5 | ¾ |
| ½ | 192.5 | 158.0 | 193.2 | 158.6 | 194.0 | 159.2 | 194.8 | 159.9 | 195.6 | 160.5 | 196.3 | 161.1 | 197.1 | 161.8 | 197.9 | 162.4 | ½ |
| ¾ | 184.5 | 167.2 | 185.2 | 167.9 | 186.0 | 168.5 | 186.7 | 169.2 | 187.5 | 169.9 | 188.2 | 170.6 | 188.9 | 171.2 | 189.7 | 171.9 | ¼ |
| 4 | 176.1 | 176.1 | 176.8 | 176.8 | 177.5 | 177.5 | 178.2 | 178.2 | 178.9 | 178.9 | 179.6 | 179.6 | 180.3 | 180.3 | 181.0 | 181.0 | 4 |
| 1° | 249.0 | 04.3 | 250.0 | 04.4 | 251.0 | 04.4 | 252.0 | 04.4 | 253.0 | 04.4 | 254.0 | 04.4 | 255.0 | 04.5 | 256.0 | 04.5 | 89° |
| 2 | 248.8 | 08.7 | 249.8 | 08.7 | 250.8 | 08.8 | 251.8 | 08.8 | 252.8 | 08.8 | 253.8 | 08.9 | 254.8 | 08.9 | 255.8 | 08.9 | 88 |
| 3 | 248.7 | 13.0 | 249.7 | 13.1 | 250.7 | 13.1 | 251.7 | 13.2 | 252.7 | 13.2 | 253.7 | 13.3 | 254.7 | 13.3 | 255.6 | 13.4 | 87 |
| 4 | 248.4 | 17.4 | 249.4 | 17.4 | 250.4 | 17.5 | 251.4 | 17.6 | 252.4 | 17.6 | 253.4 | 17.7 | 254.4 | 17.8 | 255.4 | 17.9 | 86 |
| 5 | 248.1 | 21.7 | 249.0 | 21.8 | 250.0 | 21.9 | 251.0 | 22.0 | 252.0 | 22.1 | 253.0 | 22.1 | 254.0 | 22.2 | 255.0 | 22.3 | 85 |
| 6 | 247.6 | 26.0 | 248.6 | 26.1 | 249.6 | 26.2 | 250.6 | 26.3 | 251.6 | 26.4 | 252.6 | 26.6 | 253.6 | 26.7 | 254.6 | 26.8 | 84 |
| 7 | 247.1 | 30.3 | 248.1 | 30.5 | 249.1 | 30.6 | 250.1 | 30.7 | 251.1 | 30.8 | 252.1 | 31.0 | 253.1 | 31.1 | 254.1 | 31.2 | 83 |
| 8 | 246.6 | 34.7 | 247.6 | 34.8 | 248.6 | 34.9 | 249.5 | 35.1 | 250.5 | 35.2 | 251.5 | 35.3 | 252.5 | 35.5 | 253.5 | 35.6 | 82 |
| 9 | 245.9 | 39.0 | 246.9 | 39.1 | 247.9 | 39.3 | 248.9 | 39.4 | 249.9 | 39.6 | 250.9 | 39.7 | 251.9 | 39.9 | 252.8 | 40.0 | 81 |
| 10 | 245.2 | 43.2 | 246.2 | 43.4 | 247.2 | 43.6 | 248.2 | 43.8 | 249.2 | 43.9 | 250.1 | 44.1 | 251.1 | 44.3 | 252.1 | 44.5 | 80 |
| 11 | 244.4 | 47.5 | 245.4 | 47.7 | 246.4 | 47.9 | 247.4 | 48.1 | 248.4 | 48.3 | 249.3 | 48.5 | 250.3 | 48.7 | 251.3 | 48.8 | 79 |
| 12 | 243.6 | 51.8 | 244.5 | 52.0 | 245.5 | 52.2 | 246.5 | 52.4 | 247.5 | 52.6 | 248.4 | 52.8 | 249.4 | 53.0 | 250.4 | 53.2 | 78 |
| 13 | 242.6 | 56.0 | 243.6 | 56.2 | 244.6 | 56.5 | 245.5 | 56.7 | 246.5 | 56.9 | 247.5 | 57.1 | 248.5 | 57.4 | 249.4 | 57.6 | 77 |
| 14 | 241.6 | 60.2 | 242.6 | 60.5 | 243.5 | 60.7 | 244.5 | 61.0 | 245.5 | 61.2 | 246.5 | 61.4 | 247.4 | 61.7 | 248.4 | 61.9 | 76 |
| 15 | 240.5 | 64.4 | 241.5 | 64.7 | 242.4 | 65.0 | 243.4 | 65.2 | 244.4 | 65.5 | 245.3 | 65.7 | 246.3 | 66.0 | 247.3 | 66.3 | 75 |
| 16 | 239.4 | 68.6 | 240.3 | 68.9 | 241.3 | 69.2 | 242.2 | 69.5 | 243.2 | 69.7 | 244.2 | 70.0 | 245.1 | 70.3 | 246.1 | 70.6 | 74 |
| 17 | 238.1 | 72.8 | 239.1 | 73.1 | 240.0 | 73.4 | 241.0 | 73.7 | 241.9 | 74.0 | 242.9 | 74.3 | 243.9 | 74.6 | 244.8 | 74.8 | 73 |
| 18 | 236.8 | 76.9 | 237.8 | 77.3 | 238.7 | 77.6 | 239.7 | 77.9 | 240.6 | 78.2 | 241.6 | 78.5 | 242.5 | 78.8 | 243.5 | 79.1 | 72 |
| 19 | 235.4 | 81.1 | 236.4 | 81.4 | 237.3 | 81.7 | 238.3 | 82.0 | 239.2 | 82.4 | 240.2 | 82.7 | 241.1 | 83.0 | 242.1 | 83.3 | 71 |
| 20 | 234.0 | 85.2 | 234.9 | 85.5 | 235.9 | 85.8 | 236.8 | 86.2 | 237.7 | 86.5 | 238.7 | 86.9 | 239.6 | 87.2 | 240.6 | 87.6 | 70 |
| 21 | 232.5 | 89.2 | 233.4 | 89.6 | 234.3 | 90.0 | 235.3 | 90.3 | 236.2 | 90.7 | 237.1 | 91.0 | 238.1 | 91.4 | 239.0 | 91.7 | 69 |
| 22 | 230.9 | 93.3 | 231.8 | 93.7 | 232.7 | 94.0 | 233.7 | 94.4 | 234.6 | 94.8 | 235.5 | 95.2 | 236.4 | 95.5 | 237.4 | 95.9 | 68 |
| 23 | 229.2 | 97.3 | 230.1 | 97.7 | 231.0 | 98.1 | 232.0 | 98.5 | 232.9 | 98.9 | 233.8 | 99.2 | 234.7 | 99.6 | 235.6 | 100.0 | 67 |
| 24 | 227.5 | 101.3 | 228.4 | 101.7 | 229.3 | 102.1 | 230.2 | 102.5 | 231.1 | 102.9 | 232.0 | 103.3 | 233.0 | 103.7 | 233.9 | 104.1 | 66 |
| 25 | 225.7 | 105.2 | 226.6 | 105.7 | 227.5 | 106.1 | 228.4 | 106.5 | 229.3 | 106.9 | 230.2 | 107.3 | 231.1 | 107.8 | 232.0 | 108.2 | 65 |
| 26 | 223.8 | 109.2 | 224.7 | 109.6 | 225.6 | 110.0 | 226.5 | 110.5 | 227.4 | 110.9 | 228.3 | 111.3 | 229.2 | 111.8 | 230.1 | 112.2 | 64 |
| 27 | 221.9 | 113.0 | 222.8 | 113.5 | 223.6 | 114.0 | 224.5 | 114.4 | 225.4 | 114.9 | 226.3 | 115.3 | 227.2 | 115.8 | 228.1 | 116.2 | 63 |
| 28 | 219.9 | 116.9 | 220.7 | 117.4 | 221.6 | 117.8 | 222.5 | 118.3 | 223.4 | 118.8 | 224.3 | 119.2 | 225.2 | 119.7 | 226.0 | 120.2 | 62 |
| 29 | 217.8 | 120.7 | 218.7 | 121.2 | 219.5 | 121.7 | 220.4 | 122.2 | 221.3 | 122.7 | 222.2 | 123.1 | 223.0 | 123.6 | 223.9 | 124.1 | 61 |
| 30 | 215.6 | 124.5 | 216.5 | 125.0 | 217.4 | 125.5 | 218.2 | 126.0 | 219.1 | 126.5 | 220.0 | 127.0 | 220.8 | 127.5 | 221.7 | 128.0 | 60 |
| 31 | 213.4 | 128.2 | 214.3 | 128.8 | 215.1 | 129.3 | 216.0 | 129.8 | 216.9 | 130.3 | 217.7 | 130.8 | 218.6 | 131.3 | 219.4 | 131.8 | 59 |
| 32 | 211.2 | 131.9 | 212.0 | 132.5 | 212.9 | 133.0 | 213.7 | 133.5 | 214.6 | 134.1 | 215.4 | 134.6 | 216.3 | 135.1 | 217.1 | 135.7 | 58 |
| 33 | 208.8 | 135.6 | 209.7 | 136.2 | 210.5 | 136.7 | 211.3 | 137.2 | 212.2 | 137.8 | 213.0 | 138.3 | 213.9 | 138.9 | 214.7 | 139.4 | 57 |
| 34 | 206.4 | 139.2 | 207.3 | 139.8 | 208.1 | 140.4 | 208.9 | 140.9 | 209.7 | 141.5 | 210.6 | 142.0 | 211.4 | 142.6 | 212.2 | 143.2 | 56 |
| 35 | 204.0 | 142.8 | 204.8 | 143.4 | 205.6 | 144.0 | 206.4 | 144.5 | 207.2 | 145.1 | 208.1 | 145.7 | 208.9 | 146.3 | 209.7 | 146.8 | 55 |
| 36 | 201.4 | 146.4 | 202.3 | 146.9 | 203.1 | 147.5 | 203.9 | 148.1 | 204.7 | 148.7 | 205.5 | 149.3 | 206.3 | 149.9 | 207.1 | 150.5 | 54 |
| 37 | 198.9 | 149.9 | 199.7 | 150.5 | 200.5 | 151.1 | 201.3 | 151.7 | 202.1 | 152.3 | 202.9 | 152.9 | 203.7 | 153.5 | 204.5 | 154.1 | 53 |
| 38 | 196.2 | 153.3 | 197.0 | 153.9 | 197.8 | 154.5 | 198.6 | 155.1 | 199.4 | 155.8 | 200.2 | 156.4 | 200.9 | 157.0 | 201.7 | 157.6 | 52 |
| 39 | 193.5 | 156.7 | 194.3 | 157.3 | 195.1 | 158.0 | 195.8 | 158.6 | 196.6 | 159.2 | 197.4 | 159.8 | 198.2 | 160.5 | 198.9 | 161.1 | 51 |
| 40 | 190.7 | 160.1 | 191.5 | 160.7 | 192.3 | 161.3 | 193.0 | 162.0 | 193.8 | 162.6 | 194.6 | 163.3 | 195.3 | 163.9 | 196.1 | 164.6 | 50 |
| 41 | 187.9 | 163.4 | 188.7 | 164.0 | 189.4 | 164.7 | 190.2 | 165.3 | 190.9 | 166.0 | 191.7 | 166.6 | 192.5 | 167.3 | 193.2 | 168.0 | 49 |
| 42 | 185.0 | 166.6 | 185.8 | 167.3 | 186.5 | 168.0 | 187.3 | 168.6 | 188.0 | 169.3 | 188.8 | 170.0 | 189.5 | 170.6 | 190.2 | 171.3 | 48 |
| 43 | 182.1 | 169.8 | 182.8 | 170.5 | 183.6 | 171.2 | 184.3 | 171.9 | 185.0 | 172.5 | 185.8 | 173.2 | 186.5 | 173.9 | 187.2 | 174.6 | 47 |
| 44 | 179.1 | 173.0 | 179.8 | 173.7 | 180.6 | 174.4 | 181.3 | 175.1 | 182.0 | 175.7 | 182.7 | 176.4 | 183.4 | 177.1 | 184.2 | 177.8 | 46 |
| 45 | 176.1 | 176.1 | 176.8 | 176.8 | 177.5 | 177.5 | 178.2 | 178.2 | 178.9 | 178.9 | 179.6 | 179.6 | 180.3 | 180.3 | 181.0 | 181.0 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table (x.)

| Distance. | 257 | | 258 | | 259 | | 260 | | 261 | | 262 | | 263 | | 264 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 256.7 | 12.6 | 257.7 | 12.7 | 258.7 | 12.7 | 259.7 | 12.8 | 260.7 | 12.8 | 261.7 | 12.9 | 262.7 | 12.9 | 263.7 | 13.0 | ¾ |
| ½ | 255.8 | 25.2 | 256.8 | 25.3 | 257.8 | 25.4 | 258.7 | 25.5 | 259.7 | 25.6 | 260.7 | 25.7 | 261.7 | 25.8 | 262.7 | 25.9 | ½ |
| ¾ | 254.2 | 37.7 | 255.2 | 37.9 | 256.2 | 38.0 | 257.2 | 38.1 | 258.2 | 38.3 | 259.2 | 38.4 | 260.1 | 38.6 | 261.1 | 38.7 | ¼ |
| 1 | 252.1 | 50.1 | 253.0 | 50.3 | 254.0 | 50.5 | 255.0 | 50.7 | 256.0 | 50.9 | 257.0 | 51.1 | 257.9 | 51.3 | 258.9 | 51.5 | 7 |
| ¼ | 249.3 | 62.5 | 250.3 | 62.7 | 251.2 | 62.9 | 252.2 | 63.2 | 253.2 | 63.4 | 254.2 | 63.7 | 255.1 | 63.9 | 256.1 | 64.2 | ¾ |
| ½ | 245.9 | 74.6 | 246.9 | 74.9 | 247.9 | 75.2 | 248.8 | 75.5 | 249.8 | 75.8 | 250.7 | 76.0 | 251.7 | 76.3 | 252.6 | 76.6 | ½ |
| ¾ | 242.0 | 86.6 | 242.9 | 86.9 | 243.9 | 87.2 | 244.8 | 87.6 | 245.7 | 87.9 | 246.7 | 88.3 | 247.6 | 88.6 | 248.6 | 88.9 | ¼ |
| 2 | 237.4 | 98.4 | 238.4 | 98.7 | 239.3 | 99.1 | 240.2 | 99.5 | 241.1 | 99.9 | 242.1 | 100.3 | 243.0 | 100.6 | 243.9 | 101.0 | 6 |
| ¼ | 232.3 | 109.9 | 233.2 | 110.3 | 234.1 | 110.7 | 235.0 | 111.2 | 235.9 | 111.6 | 236.8 | 112.0 | 237.7 | 112.5 | 238.7 | 112.9 | ¾ |
| ½ | 226.7 | 121.1 | 227.5 | 121.6 | 228.4 | 122.1 | 229.3 | 122.6 | 230.2 | 123.0 | 231.1 | 123.5 | 231.9 | 124.0 | 232.8 | 124.4 | ½ |
| ¾ | 220.4 | 132.1 | 221.3 | 132.6 | 222.1 | 133.1 | 223.0 | 133.7 | 223.9 | 134.2 | 224.7 | 134.7 | 225.6 | 135.2 | 226.4 | 135.7 | ¼ |
| 3 | 213.7 | 142.8 | 214.5 | 143.3 | 215.3 | 143.9 | 216.2 | 144.4 | 217.0 | 145.0 | 217.8 | 145.6 | 218.7 | 146.1 | 219.5 | 146.7 | 5 |
| ¼ | 206.4 | 153.1 | 207.2 | 153.7 | 208.0 | 154.3 | 208.8 | 154.9 | 209.6 | 155.5 | 210.4 | 156.1 | 211.2 | 156.7 | 212.0 | 157.3 | ¾ |
| ½ | 198.7 | 163.0 | 199.4 | 163.7 | 200.2 | 164.3 | 201.0 | 164.9 | 201.8 | 165.6 | 202.5 | 166.2 | 203.3 | 166.8 | 204.1 | 167.5 | ½ |
| ¾ | 190.4 | 172.6 | 191.2 | 173.2 | 191.9 | 173.9 | 192.6 | 174.6 | 193.4 | 175.3 | 194.1 | 175.9 | 194.9 | 176.6 | 195.6 | 177.3 | ¼ |
| 4 | 181.7 | 181.7 | 182.4 | 182.4 | 183.1 | 183.1 | 183.8 | 183.8 | 184.6 | 184.6 | 185.3 | 185.3 | 186.0 | 186.0 | 186.7 | 186.7 | 4 |
| 1° | 257.0 | 04.5 | 258.0 | 04.5 | 259.0 | 04.5 | 260.0 | 04.5 | 261.0 | 04.6 | 262.0 | 04.6 | 263.0 | 04.6 | 264.0 | 04.6 | 89° |
| 2 | 256.8 | 09.0 | 257.8 | 09.0 | 258.8 | 09.0 | 259.8 | 09.1 | 260.8 | 09.1 | 261.8 | 09.1 | 262.8 | 09.2 | 263.8 | 09.2 | 88 |
| 3 | 256.6 | 13.5 | 257.6 | 13.5 | 258.6 | 13.6 | 259.6 | 13.6 | 260.6 | 13.7 | 261.6 | 13.7 | 262.6 | 13.8 | 263.6 | 13.8 | 87 |
| 4 | 256.4 | 17.9 | 257.4 | 18.0 | 258.4 | 18.1 | 259.4 | 18.1 | 260.4 | 18.2 | 261.4 | 18.3 | 262.4 | 18.3 | 263.4 | 18.4 | 86 |
| 5 | 256.0 | 22.4 | 257.0 | 22.5 | 258.0 | 22.6 | 259.0 | 22.7 | 260.0 | 22.7 | 261.0 | 22.8 | 262.0 | 22.9 | 263.0 | 23.0 | 85 |
| 6 | 255.6 | 26.9 | 256.6 | 27.0 | 257.6 | 27.1 | 258.6 | 27.2 | 259.6 | 27.3 | 260.6 | 27.4 | 261.6 | 27.5 | 262.6 | 27.6 | 84 |
| 7 | 255.1 | 31.3 | 256.1 | 31.4 | 257.1 | 31.6 | 258.1 | 31.7 | 259.1 | 31.8 | 260.0 | 31.9 | 261.0 | 32.1 | 262.0 | 32.2 | 83 |
| 8 | 254.5 | 35.8 | 255.5 | 35.9 | 256.5 | 36.0 | 257.5 | 36.2 | 258.5 | 36.3 | 259.5 | 36.5 | 260.4 | 36.6 | 261.4 | 36.7 | 82 |
| 9 | 253.8 | 40.2 | 254.8 | 40.4 | 255.8 | 40.5 | 256.8 | 40.7 | 257.8 | 40.8 | 258.8 | 41.0 | 259.8 | 41.1 | 260.7 | 41.3 | 81 |
| 10 | 253.1 | 44.6 | 254.1 | 44.8 | 255.1 | 45.0 | 256.1 | 45.1 | 257.0 | 45.3 | 258.0 | 45.5 | 259.0 | 45.7 | 260.0 | 45.8 | 80 |
| 11 | 252.3 | 49.0 | 253.3 | 49.2 | 254.2 | 49.4 | 255.2 | 49.6 | 256.2 | 49.8 | 257.2 | 50.0 | 258.2 | 50.2 | 259.1 | 50.4 | 79 |
| 12 | 251.4 | 53.4 | 252.4 | 53.6 | 253.3 | 53.8 | 254.3 | 54.1 | 255.3 | 54.3 | 256.3 | 54.5 | 257.3 | 54.7 | 258.2 | 54.9 | 78 |
| 13 | 250.4 | 57.8 | 251.4 | 58.0 | 252.4 | 58.3 | 253.3 | 58.5 | 254.3 | 58.7 | 255.3 | 58.9 | 256.3 | 59.2 | 257.2 | 59.4 | 77 |
| 14 | 249.4 | 62.2 | 250.3 | 62.4 | 251.3 | 62.7 | 252.3 | 62.9 | 253.2 | 63.1 | 254.2 | 63.4 | 255.2 | 63.6 | 256.2 | 63.9 | 76 |
| 15 | 248.2 | 66.5 | 249.2 | 66.8 | 250.2 | 67.0 | 251.1 | 67.3 | 252.1 | 67.6 | 253.1 | 67.8 | 254.0 | 68.1 | 255.0 | 68.3 | 75 |
| 16 | 247.0 | 70.8 | 248.0 | 71.1 | 249.0 | 71.4 | 249.9 | 71.7 | 250.9 | 71.9 | 251.9 | 72.2 | 252.8 | 72.5 | 253.8 | 72.8 | 74 |
| 17 | 245.8 | 75.1 | 246.7 | 75.4 | 247.7 | 75.7 | 248.6 | 76.0 | 249.6 | 76.3 | 250.6 | 76.6 | 251.5 | 76.9 | 252.5 | 77.2 | 73 |
| 18 | 244.4 | 79.4 | 245.4 | 79.7 | 246.3 | 80.0 | 247.3 | 80.3 | 248.2 | 80.7 | 249.2 | 81.0 | 250.1 | 81.3 | 251.1 | 81.6 | 72 |
| 19 | 243.0 | 83.7 | 243.9 | 84.0 | 244.9 | 84.3 | 245.8 | 84.6 | 246.8 | 85.0 | 247.7 | 85.3 | 248.7 | 85.6 | 249.6 | 86.0 | 71 |
| 20 | 241.5 | 87.9 | 242.4 | 88.2 | 243.4 | 88.6 | 244.3 | 88.9 | 245.3 | 89.3 | 246.2 | 89.6 | 247.1 | 90.0 | 248.1 | 90.3 | 70 |
| 21 | 239.9 | 92.1 | 240.9 | 92.5 | 241.8 | 92.8 | 242.7 | 93.2 | 243.7 | 93.5 | 244.6 | 93.9 | 245.5 | 94.3 | 246.5 | 94.6 | 69 |
| 22 | 238.3 | 96.3 | 239.2 | 96.6 | 240.1 | 97.0 | 241.1 | 97.4 | 242.0 | 97.8 | 242.9 | 98.1 | 243.8 | 98.5 | 244.8 | 98.9 | 68 |
| 23 | 236.6 | 100.4 | 237.5 | 100.8 | 238.4 | 101.2 | 239.3 | 101.6 | 240.3 | 102.0 | 241.2 | 102.4 | 242.1 | 102.8 | 243.0 | 103.2 | 67 |
| 24 | 234.8 | 104.5 | 235.7 | 104.9 | 236.6 | 105.3 | 237.5 | 105.8 | 238.4 | 106.2 | 239.3 | 106.6 | 240.3 | 107.0 | 241.2 | 107.4 | 66 |
| 25 | 232.9 | 108.6 | 233.8 | 109.0 | 234.7 | 109.5 | 235.6 | 109.9 | 236.5 | 110.3 | 237.5 | 110.7 | 238.4 | 111.1 | 239.3 | 111.6 | 65 |
| 26 | 231.0 | 112.7 | 231.9 | 113.1 | 232.8 | 113.5 | 233.7 | 114.0 | 234.6 | 114.4 | 235.5 | 114.9 | 236.4 | 115.3 | 237.3 | 115.7 | 64 |
| 27 | 229.0 | 116.7 | 229.9 | 117.1 | 230.8 | 117.6 | 231.7 | 118.0 | 232.6 | 118.5 | 233.4 | 118.9 | 234.3 | 119.4 | 235.2 | 119.9 | 63 |
| 28 | 226.9 | 120.7 | 227.8 | 121.1 | 228.7 | 121.6 | 229.6 | 122.1 | 230.4 | 122.5 | 231.3 | 123.0 | 232.2 | 123.5 | 233.1 | 123.9 | 62 |
| 29 | 224.8 | 124.6 | 225.7 | 125.1 | 226.5 | 125.6 | 227.4 | 126.1 | 228.3 | 126.5 | 229.2 | 127.0 | 230.0 | 127.5 | 230.9 | 128.0 | 61 |
| 30 | 222.6 | 128.5 | 223.4 | 129.0 | 224.3 | 129.5 | 225.2 | 130.0 | 226.0 | 130.5 | 226.9 | 131.0 | 227.8 | 131.5 | 228.6 | 132.0 | 60 |
| 31 | 220.3 | 132.4 | 221.1 | 132.9 | 222.0 | 133.4 | 222.9 | 133.9 | 223.7 | 134.4 | 224.6 | 134.9 | 225.4 | 135.5 | 226.3 | 136.0 | 59 |
| 32 | 217.9 | 136.2 | 218.8 | 136.7 | 219.6 | 137.2 | 220.5 | 137.8 | 221.3 | 138.3 | 222.2 | 138.8 | 223.0 | 139.4 | 223.9 | 139.9 | 58 |
| 33 | 215.5 | 140.0 | 216.4 | 140.5 | 217.2 | 141.1 | 218.1 | 141.6 | 218.9 | 142.2 | 219.7 | 142.7 | 220.6 | 143.2 | 221.4 | 143.8 | 57 |
| 34 | 213.1 | 143.7 | 213.9 | 144.3 | 214.7 | 144.8 | 215.5 | 145.4 | 216.4 | 145.9 | 217.2 | 146.5 | 218.0 | 147.1 | 218.9 | 147.6 | 56 |
| 35 | 210.5 | 147.4 | 211.3 | 148.0 | 212.2 | 148.6 | 213.0 | 149.1 | 213.8 | 149.7 | 214.6 | 150.3 | 215.4 | 150.9 | 216.3 | 151.4 | 55 |
| 36 | 207.9 | 151.1 | 208.7 | 151.6 | 209.5 | 152.2 | 210.3 | 152.8 | 211.2 | 153.4 | 212.0 | 154.0 | 212.8 | 154.6 | 213.6 | 155.2 | 54 |
| 37 | 205.2 | 154.7 | 206.0 | 155.3 | 206.8 | 155.9 | 207.6 | 156.5 | 208.4 | 157.1 | 209.2 | 157.7 | 210.0 | 158.3 | 210.8 | 158.9 | 53 |
| 38 | 202.5 | 158.2 | 203.3 | 158.8 | 204.1 | 159.5 | 204.9 | 160.1 | 205.7 | 160.7 | 206.5 | 161.3 | 207.2 | 161.9 | 208.0 | 162.5 | 52 |
| 39 | 199.7 | 161.7 | 200.5 | 162.4 | 201.3 | 163.0 | 202.1 | 163.6 | 202.8 | 164.3 | 203.6 | 164.9 | 204.4 | 165.5 | 205.2 | 166.1 | 51 |
| 40 | 196.9 | 165.2 | 197.6 | 165.8 | 198.4 | 166.5 | 199.2 | 167.1 | 199.9 | 167.8 | 200.7 | 168.4 | 201.5 | 169.1 | 202.2 | 169.7 | 50 |
| 41 | 194.0 | 168.6 | 194.7 | 169.3 | 195.5 | 169.9 | 196.2 | 170.6 | 197.0 | 171.2 | 197.7 | 171.9 | 198.5 | 172.5 | 199.2 | 173.2 | 49 |
| 42 | 191.0 | 172.0 | 191.7 | 172.6 | 192.5 | 173.3 | 193.2 | 174.0 | 194.0 | 174.6 | 194.7 | 175.3 | 195.4 | 176.0 | 196.2 | 176.7 | 48 |
| 43 | 188.0 | 175.3 | 188.7 | 176.0 | 189.4 | 176.6 | 190.2 | 177.3 | 190.9 | 178.0 | 191.6 | 178.7 | 192.3 | 179.4 | 193.1 | 180.0 | 47 |
| 44 | 184.9 | 178.5 | 185.6 | 179.2 | 186.3 | 179.9 | 187.0 | 180.6 | 187.7 | 181.3 | 188.5 | 182.0 | 189.2 | 182.7 | 189.9 | 183.4 | 46 |
| 45 | 181.7 | 181.7 | 182.4 | 182.4 | 183.1 | 183.1 | 183.8 | 183.8 | 184.6 | 184.6 | 185.3 | 185.3 | 186.0 | 186.0 | 186.7 | 186.7 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 265 | | 266 | | 267 | | 268 | | 269 | | 270 | | 271 | | 272 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cmn. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff Lat. | Dep. | Diff.Lat. | Dep. | Diff Lat. | Dep. | Cmn. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 264.7 | 13.0 | 265.7 | 13.1 | 266.7 | 13.1 | 267.7 | 13.2 | 268.7 | 13.2 | 269.7 | 13.3 | 270.7 | 13.3 | 271.7 | 13.3 | ¼ |
| ½ | 263.7 | 26.0 | 264.7 | 26.1 | 265.7 | 26.2 | 266.7 | 26.3 | 267.7 | 26.4 | 268.7 | 26.5 | 269.7 | 26.6 | 270.7 | 26.7 | ½ |
| ¾ | 262.1 | 38.9 | 263.1 | 39.0 | 264.1 | 39.2 | 265.1 | 39.3 | 266.1 | 39.5 | 267.1 | 39.6 | 268.1 | 39.8 | 269.0 | 39.9 | ¾ |
| 1 | 259.9 | 51.7 | 260.9 | 51.9 | 261.9 | 52.1 | 262.8 | 52.3 | 263.8 | 52.5 | 264.8 | 52.7 | 265.8 | 52.9 | 266.8 | 53.1 | 1 |
| ¼ | 257.1 | 64.4 | 258.0 | 64.6 | 259.0 | 64.9 | 260.0 | 65.1 | 260.9 | 65.4 | 261.9 | 65.6 | 262.9 | 65.9 | 263.9 | 66.1 | ¼ |
| ½ | 253.6 | 76.9 | 254.6 | 77.2 | 255.5 | 77.5 | 256.5 | 77.8 | 257.4 | 78.1 | 258.4 | 78.4 | 259.3 | 78.7 | 260.3 | 79.0 | ½ |
| ¾ | 249.5 | 89.3 | 250.4 | 89.6 | 251.4 | 89.9 | 252.3 | 90.3 | 253.3 | 90.6 | 254.2 | 91.0 | 255.2 | 91.3 | 256.1 | 91.6 | ¾ |
| 2 | 244.8 | 101.4 | 245.8 | 101.8 | 246.7 | 102.2 | 247.6 | 102.6 | 248.5 | 102.9 | 249.5 | 103.3 | 250.4 | 103.7 | 251.3 | 104.1 | 6 |
| ¼ | 239.6 | 113.3 | 240.5 | 113.7 | 241.4 | 114.2 | 242.3 | 114.6 | 243.2 | 115.0 | 244.1 | 115.4 | 245.0 | 115.9 | 245.9 | 116.3 | ¼ |
| ½ | 233.7 | 124.9 | 234.6 | 125.4 | 235.5 | 125.9 | 236.4 | 126.3 | 237.2 | 126.8 | 238.1 | 127.3 | 239.0 | 127.7 | 239.9 | 128.2 | ½ |
| ¾ | 227.3 | 136.2 | 228.2 | 136.7 | 229.0 | 137.3 | 229.9 | 137.8 | 230.7 | 138.3 | 231.6 | 138.8 | 232.4 | 139.3 | 233.3 | 139.8 | ¾ |
| 3 | 220.3 | 147.2 | 221.2 | 147.8 | 222.0 | 148.3 | 222.8 | 148.9 | 223.7 | 149.4 | 224.5 | 150.0 | 225.3 | 150.6 | 226.2 | 151.1 | 5 |
| ¼ | 212.8 | 157.9 | 213.6 | 158.5 | 214.5 | 159.1 | 215.3 | 159.6 | 216.1 | 160.2 | 216.9 | 160.8 | 217.7 | 161.4 | 218.5 | 162.0 | ¼ |
| ½ | 204.8 | 168.1 | 205.6 | 168.7 | 206.4 | 169.4 | 207.2 | 170.0 | 207.9 | 170.6 | 208.7 | 171.3 | 209.5 | 171.9 | 210.3 | 172.6 | ½ |
| ¾ | 196.3 | 178.0 | 197.1 | 178.6 | 197.8 | 179.3 | 198.6 | 180.0 | 199.3 | 180.6 | 200.1 | 181.3 | 200.8 | 182.0 | 201.5 | 182.7 | ¾ |
| 4 | 187.4 | 187.4 | 188.1 | 188.1 | 188.8 | 188.8 | 189.5 | 189.5 | 190.2 | 190.2 | 190.9 | 190.9 | 191.6 | 191.6 | 192.3 | 192.3 | 4 |
| 1° | 265.0 | 04.6 | 266.0 | 04.6 | 267.0 | 04.7 | 268.0 | 04.7 | 269.0 | 04.7 | 270.0 | 04.7 | 271.0 | 04.7 | 272.0 | 04.7 | 89° |
| 2 | 264.8 | 09.2 | 265.8 | 09.3 | 266.8 | 09.3 | 267.8 | 09.4 | 268.8 | 09.4 | 269.8 | 09.4 | 270.8 | 09.5 | 271.8 | 09.5 | 88 |
| 3 | 264.6 | 13.9 | 265.6 | 13.9 | 266.6 | 14.0 | 267.6 | 14.0 | 268.6 | 14.1 | 269.6 | 14.1 | 270.6 | 14.2 | 271.6 | 14.2 | 87 |
| 4 | 264.4 | 18.5 | 265.4 | 18.6 | 266.3 | 18.6 | 267.3 | 18.7 | 268.3 | 18.8 | 269.3 | 18.8 | 270.3 | 18.9 | 271.3 | 19.0 | 86 |
| 5 | 264.0 | 23.1 | 265.0 | 23.2 | 266.0 | 23.3 | 267.0 | 23.4 | 268.0 | 23.4 | 269.0 | 23.5 | 270.0 | 23.6 | 271.0 | 23.7 | 85 |
| 6 | 263.5 | 27.7 | 264.5 | 27.8 | 265.5 | 27.9 | 266.5 | 28.0 | 267.5 | 28.1 | 268.5 | 28.2 | 269.5 | 28.3 | 270.5 | 28.4 | 84 |
| 7 | 263.0 | 32.3 | 264.0 | 32.4 | 265.0 | 32.5 | 266.0 | 32.7 | 267.0 | 32.8 | 268.0 | 32.9 | 269.0 | 33.0 | 270.0 | 33.1 | 83 |
| 8 | 262.4 | 36.9 | 263.4 | 37.0 | 264.4 | 37.2 | 265.4 | 37.3 | 266.4 | 37.4 | 267.4 | 37.6 | 268.4 | 37.7 | 269.4 | 37.9 | 82 |
| 9 | 261.7 | 41.5 | 262.7 | 41.6 | 263.7 | 41.8 | 264.7 | 41.9 | 265.7 | 42.1 | 266.7 | 42.2 | 267.7 | 42.4 | 268.7 | 42.6 | 81 |
| 10 | 261.0 | 46.0 | 262.0 | 46.2 | 262.9 | 46.4 | 263.9 | 46.5 | 264.9 | 46.7 | 265.9 | 46.9 | 266.9 | 47.1 | 267.9 | 47.2 | 80 |
| 11 | 260.1 | 50.6 | 261.1 | 50.8 | 262.1 | 50.9 | 263.1 | 51.1 | 264.1 | 51.3 | 265.0 | 51.5 | 266.0 | 51.7 | 267.0 | 51.9 | 79 |
| 12 | 259.2 | 55.1 | 260.2 | 55.3 | 261.2 | 55.5 | 262.1 | 55.7 | 263.1 | 55.9 | 264.1 | 56.1 | 265.1 | 56.3 | 266.1 | 56.6 | 78 |
| 13 | 258.2 | 59.6 | 259.2 | 59.8 | 260.2 | 60.1 | 261.1 | 60.3 | 262.1 | 60.5 | 263.1 | 60.7 | 264.1 | 61.0 | 265.0 | 61.2 | 77 |
| 14 | 257.1 | 64.1 | 258.1 | 64.4 | 259.1 | 64.6 | 260.0 | 64.8 | 261.0 | 65.1 | 262.0 | 65.3 | 263.0 | 65.6 | 263.9 | 65.8 | 76 |
| 15 | 256.0 | 68.6 | 256.9 | 68.8 | 257.9 | 69.1 | 258.9 | 69.4 | 259.8 | 69.6 | 260.8 | 69.9 | 261.8 | 70.1 | 262.7 | 70.4 | 75 |
| 16 | 254.7 | 73.0 | 255.7 | 73.2 | 256.7 | 73.6 | 257.6 | 73.9 | 258.6 | 74.1 | 259.5 | 74.4 | 260.5 | 74.7 | 261.5 | 75.0 | 74 |
| 17 | 253.4 | 77.5 | 254.4 | 77.8 | 255.3 | 78.1 | 256.3 | 78.4 | 257.2 | 78.6 | 258.2 | 78.9 | 259.2 | 79.2 | 260.1 | 79.5 | 73 |
| 18 | 252.0 | 81.9 | 253.0 | 82.2 | 253.9 | 82.5 | 254.9 | 82.8 | 255.8 | 83.1 | 256.8 | 83.4 | 257.7 | 83.7 | 258.7 | 84.1 | 72 |
| 19 | 250.6 | 86.3 | 251.5 | 86.6 | 252.5 | 86.9 | 253.4 | 87.3 | 254.3 | 87.6 | 255.3 | 87.9 | 256.2 | 88.2 | 257.2 | 88.6 | 71 |
| 20 | 249.0 | 90.6 | 250.0 | 91.0 | 250.9 | 91.3 | 251.8 | 91.7 | 252.8 | 92.0 | 253.7 | 92.3 | 254.7 | 92.7 | 255.6 | 93.0 | 70 |
| 21 | 247.4 | 95.0 | 248.3 | 95.3 | 249.3 | 95.7 | 250.2 | 96.0 | 251.1 | 96.4 | 252.1 | 96.8 | 253.0 | 97.1 | 253.9 | 97.5 | 69 |
| 22 | 245.7 | 99.3 | 246.6 | 99.6 | 247.6 | 100.0 | 248.5 | 100.4 | 249.4 | 100.8 | 250.3 | 101.1 | 251.3 | 101.5 | 252.2 | 101.9 | 68 |
| 23 | 243.9 | 103.5 | 244.9 | 103.9 | 245.8 | 104.3 | 246.7 | 104.7 | 247.6 | 105.1 | 248.5 | 105.5 | 249.5 | 106.9 | 250.4 | 106.3 | 67 |
| 24 | 242.1 | 107.8 | 243.0 | 108.2 | 243.9 | 108.6 | 244.8 | 109.0 | 245.7 | 109.4 | 246.7 | 109.8 | 247.6 | 110.2 | 248.5 | 110.6 | 66 |
| 25 | 240.2 | 112.0 | 241.1 | 112.4 | 242.0 | 112.8 | 242.9 | 113.3 | 243.8 | 113.7 | 244.7 | 114.1 | 245.6 | 114.5 | 246.5 | 115.0 | 65 |
| 26 | 238.2 | 116.2 | 239.1 | 116.6 | 240.0 | 117.0 | 240.9 | 117.5 | 241.8 | 117.9 | 242.7 | 118.4 | 243.6 | 118.8 | 244.5 | 119.2 | 64 |
| 27 | 236.1 | 120.3 | 237.0 | 120.8 | 237.9 | 121.2 | 238.8 | 121.7 | 239.7 | 122.1 | 240.6 | 122.6 | 241.5 | 123.0 | 242.4 | 123.5 | 63 |
| 28 | 234.0 | 124.4 | 234.9 | 124.9 | 235.7 | 125.3 | 236.6 | 125.8 | 237.5 | 126.3 | 238.4 | 126.8 | 239.3 | 127.2 | 240.2 | 127.7 | 62 |
| 29 | 231.8 | 128.5 | 232.6 | 129.0 | 233.5 | 129.4 | 234.4 | 129.9 | 235.3 | 130.4 | 236.1 | 130.9 | 237.0 | 131.4 | 237.9 | 131.9 | 61 |
| 30 | 229.5 | 132.5 | 230.4 | 133.0 | 231.2 | 133.5 | 232.1 | 134.0 | 233.0 | 134.5 | 233.8 | 135.0 | 234.7 | 135.5 | 235.6 | 136.0 | 60 |
| 31 | 227.1 | 136.5 | 228.0 | 137.0 | 228.9 | 137.5 | 229.7 | 138.0 | 230.6 | 138.5 | 231.4 | 139.1 | 232.3 | 139.6 | 233.1 | 140.1 | 59 |
| 32 | 224.7 | 140.4 | 225.6 | 141.0 | 226.4 | 141.5 | 227.3 | 142.0 | 228.1 | 142.5 | 229.0 | 143.1 | 229.8 | 143.6 | 230.7 | 144.1 | 58 |
| 33 | 222.2 | 144.3 | 223.1 | 144.9 | 223.9 | 145.4 | 224.8 | 146.0 | 225.6 | 146.5 | 226.4 | 147.1 | 227.3 | 147.6 | 228.1 | 148.1 | 57 |
| 34 | 219.7 | 148.2 | 220.5 | 148.7 | 221.4 | 149.3 | 222.2 | 149.9 | 223.0 | 150.4 | 223.8 | 151.0 | 224.7 | 151.5 | 225.5 | 152.1 | 56 |
| 35 | 217.1 | 152.0 | 217.9 | 152.6 | 218.7 | 153.1 | 219.5 | 153.7 | 220.4 | 154.3 | 221.2 | 154.9 | 222.0 | 155.4 | 222.8 | 156.0 | 55 |
| 36 | 214.4 | 155.8 | 215.2 | 156.4 | 216.0 | 156.9 | 216.8 | 157.5 | 217.6 | 158.1 | 218.4 | 158.7 | 219.2 | 159.3 | 220.1 | 159.9 | 54 |
| 37 | 211.6 | 159.5 | 212.4 | 160.1 | 213.2 | 160.7 | 214.0 | 161.3 | 214.8 | 161.9 | 215.6 | 162.5 | 216.4 | 163.1 | 217.2 | 163.7 | 53 |
| 38 | 208.8 | 163.2 | 209.6 | 163.8 | 210.4 | 164.4 | 211.2 | 165.0 | 212.0 | 165.6 | 212.8 | 166.2 | 213.6 | 166.8 | 214.3 | 167.5 | 52 |
| 39 | 205.9 | 166.8 | 206.7 | 167.4 | 207.5 | 168.0 | 208.3 | 168.7 | 209.1 | 169.3 | 209.8 | 169.9 | 210.6 | 170.5 | 211.4 | 171.2 | 51 |
| 40 | 203.0 | 170.3 | 203.8 | 171.0 | 204.5 | 171.6 | 205.3 | 172.3 | 206.1 | 172.9 | 206.8 | 173.6 | 207.6 | 174.2 | 208.4 | 174.8 | 50 |
| 41 | 200.0 | 173.9 | 200.8 | 174.5 | 201.5 | 175.2 | 202.3 | 175.8 | 203.0 | 176.5 | 203.8 | 177.1 | 204.5 | 177.8 | 205.3 | 178.4 | 49 |
| 42 | 196.9 | 177.3 | 197.7 | 178.0 | 198.4 | 178.7 | 199.2 | 179.3 | 199.9 | 180.0 | 200.6 | 180.7 | 201.4 | 181.3 | 202.1 | 182.0 | 48 |
| 43 | 193.8 | 180.7 | 194.5 | 181.4 | 195.3 | 182.1 | 196.0 | 182.8 | 196.7 | 183.5 | 197.5 | 184.1 | 198.2 | 184.8 | 198.9 | 185.5 | 47 |
| 44 | 190.6 | 184.1 | 191.3 | 184.8 | 192.1 | 185.5 | 192.8 | 186.2 | 193.5 | 186.9 | 194.2 | 187.6 | 194.9 | 188.3 | 195.7 | 188.9 | 46 |
| 45 | 187.4 | 187.4 | 188.1 | 188.1 | 188.8 | 188.8 | 189.5 | 189.5 | 190.2 | 190.2 | 190.9 | 190.9 | 191.6 | 191.6 | 192.3 | 192.3 | 45 |
| Cmn | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat | Dep. | Diff.Lat | Dep. | Diff.Lat | Cmn. |

## Traverse Table. (x)

| Distance. | 273 | | 274 | | 275 | | 276 | | 277 | | 278 | | 279 | | 280 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 272.7 | 13.4 | 273.7 | 13.4 | 274.7 | 13.5 | 275.7 | 13.5 | 276.7 | 13.6 | 277.7 | 13.6 | 278.7 | 13.7 | 279.7 | 13.7 | 7¾ |
| ½ | 271.7 | 26.8 | 272.7 | 26.9 | 273.7 | 27.0 | 274.7 | 27.1 | 275.7 | 27.2 | 276.7 | 27.3 | 277.7 | 27.3 | 278.7 | 27.4 | ½ |
| ¾ | 270.0 | 40.1 | 271.0 | 40.2 | 272.0 | 40.3 | 273.0 | 40.5 | 274.0 | 40.6 | 275.0 | 40.8 | 276.0 | 40.9 | 277.0 | 41.1 | ¼ |
| 1 | 267.8 | 53.3 | 268.7 | 53.5 | 269.7 | 53.6 | 270.7 | 53.8 | 271.7 | 54.0 | 272.7 | 54.2 | 273.6 | 54.4 | 274.6 | 54.6 | 7 |
| ¼ | 264.8 | 66.3 | 265.8 | 66.6 | 266.8 | 66.8 | 267.7 | 67.1 | 268.7 | 67.3 | 269.7 | 67.6 | 270.6 | 67.8 | 271.6 | 68.0 | ¾ |
| ½ | 261.2 | 79.2 | 262.2 | 79.5 | 263.2 | 79.8 | 264.1 | 80.1 | 265.1 | 80.4 | 266.0 | 80.7 | 267.0 | 81.0 | 267.9 | 81.3 | ½ |
| ¾ | 257.0 | 92.0 | 258.0 | 92.3 | 258.9 | 92.6 | 259.9 | 93.0 | 260.8 | 93.3 | 261.7 | 93.7 | 262.7 | 94.0 | 263.6 | 94.3 | ¼ |
| 2 | 252.2 | 104.5 | 253.1 | 104.9 | 254.1 | 105.2 | 255.0 | 105.6 | 255.9 | 106.0 | 256.8 | 106.4 | 257.8 | 106.8 | 258.7 | 107.2 | 6 |
| ¼ | 246.8 | 116.7 | 247.7 | 117.2 | 248.6 | 117.6 | 249.5 | 118.0 | 250.4 | 118.4 | 251.3 | 118.9 | 252.2 | 119.3 | 253.1 | 119.7 | ¾ |
| ½ | 240.8 | 128.7 | 241.7 | 129.2 | 242.5 | 129.6 | 243.4 | 130.1 | 244.3 | 130.6 | 245.2 | 131.0 | 246.1 | 131.5 | 246.3 | 132.0 | ½ |
| ¾ | 234.2 | 140.3 | 235.0 | 140.9 | 235.9 | 141.4 | 236.7 | 141.9 | 237.6 | 142.4 | 238.4 | 142.9 | 239.3 | 143.4 | 240.2 | 143.9 | ¼ |
| 3 | 227.0 | 151.7 | 227.8 | 152.2 | 228.6 | 152.8 | 229.5 | 153.3 | 230.3 | 153.9 | 231.1 | 154.4 | 232.0 | 155.0 | 232.8 | 155.6 | 5 |
| ¼ | 219.3 | 162.6 | 220.1 | 163.2 | 220.9 | 163.8 | 221.7 | 164.4 | 222.5 | 165.0 | 223.3 | 165.6 | 224.1 | 166.2 | 224.9 | 166.8 | ¾ |
| ½ | 211.0 | 173.2 | 211.8 | 173.8 | 212.6 | 174.5 | 213.3 | 175.1 | 214.1 | 175.7 | 214.9 | 176.4 | 215.7 | 177.0 | 216.4 | 177.6 | ½ |
| ¾ | 202.3 | 183.3 | 203.0 | 184.0 | 203.8 | 184.7 | 204.5 | 185.3 | 205.2 | 186.0 | 206.0 | 186.7 | 206.7 | 187.4 | 207.5 | 188.0 | ¼ |
| 4 | 193.0 | 193.0 | 193.7 | 193.7 | 194.5 | 194.5 | 195.2 | 195.2 | 195.9 | 195.9 | 196.6 | 196.6 | 197.3 | 197.3 | 198.0 | 198.0 | 4 |
| 1° | 273.0 | 04.8 | 274.0 | 04.8 | 275.0 | 04.8 | 276.0 | 04.8 | 277.0 | 04.8 | 278.0 | 04.9 | 279.0 | 04.9 | 280.0 | 04.9 | 89° |
| 2 | 272.8 | 09.5 | 273.8 | 09.6 | 274.8 | 09.6 | 275.8 | 09.6 | 276.8 | 09.7 | 277.8 | 09.7 | 278.8 | 09.7 | 279.8 | 09.8 | 88 |
| 3 | 272.6 | 14.3 | 273.6 | 14.3 | 274.6 | 14.4 | 275.6 | 14.4 | 276.6 | 14.5 | 277.6 | 14.5 | 278.6 | 14.6 | 279.6 | 14.7 | 87 |
| 4 | 272.3 | 19.0 | 273.3 | 19.1 | 274.3 | 19.2 | 275.3 | 19.3 | 276.3 | 19.3 | 277.3 | 19.4 | 278.3 | 19.5 | 279.3 | 19.5 | 86 |
| 5 | 272.0 | 23.8 | 273.0 | 23.9 | 274.0 | 24.0 | 274.9 | 24.1 | 275.9 | 24.1 | 276.9 | 24.2 | 277.9 | 24.3 | 278.9 | 24.4 | 85 |
| 6 | 271.5 | 28.5 | 272.5 | 28.6 | 273.5 | 28.7 | 274.5 | 28.8 | 275.5 | 29.0 | 276.5 | 29.1 | 277.5 | 29.2 | 278.5 | 29.3 | 84 |
| 7 | 271.0 | 33.3 | 272.0 | 33.4 | 273.0 | 33.5 | 273.9 | 33.6 | 274.9 | 33.8 | 275.9 | 33.9 | 276.9 | 34.0 | 277.9 | 34.1 | 83 |
| 8 | 270.3 | 38.0 | 271.3 | 38.1 | 272.3 | 38.3 | 273.3 | 38.4 | 274.3 | 38.6 | 275.3 | 38.7 | 276.3 | 38.8 | 277.3 | 39.0 | 82 |
| 9 | 269.6 | 42.7 | 270.6 | 42.9 | 271.6 | 43.0 | 272.6 | 43.2 | 273.6 | 43.3 | 274.6 | 43.5 | 275.6 | 43.6 | 276.6 | 43.8 | 81 |
| 10 | 268.9 | 47.4 | 269.8 | 47.6 | 270.8 | 47.8 | 271.8 | 47.9 | 272.8 | 48.1 | 273.8 | 48.3 | 274.8 | 48.4 | 275.7 | 48.6 | 80 |
| 11 | 268.0 | 52.1 | 269.0 | 52.3 | 269.9 | 52.5 | 270.9 | 52.7 | 271.9 | 52.9 | 272.9 | 53.0 | 273.9 | 53.2 | 274.9 | 53.4 | 79 |
| 12 | 267.0 | 56.8 | 268.0 | 57.0 | 269.0 | 57.2 | 270.0 | 57.4 | 270.9 | 57.6 | 271.9 | 57.8 | 272.9 | 58.0 | 273.9 | 58.2 | 78 |
| 13 | 266.0 | 61.4 | 267.0 | 61.6 | 268.0 | 61.9 | 268.9 | 62.1 | 266.9 | 62.3 | 270.9 | 62.5 | 271.8 | 62.8 | 272.8 | 63.0 | 77 |
| 14 | 264.9 | 66.0 | 265.9 | 66.3 | 266.8 | 66.5 | 267.8 | 66.8 | 268.8 | 67.0 | 269.7 | 67.3 | 270.7 | 67.5 | 271.7 | 67.7 | 76 |
| 15 | 263.7 | 70.7 | 264.7 | 70.9 | 265.6 | 71.2 | 266.6 | 71.4 | 267.6 | 71.7 | 268.5 | 72.0 | 269.5 | 72.2 | 270.5 | 72.5 | 75 |
| 16 | 262.4 | 75.2 | 263.4 | 75.5 | 264.3 | 75.8 | 265.3 | 76.1 | 266.3 | 76.4 | 267.2 | 76.6 | 268.2 | 76.9 | 269.2 | 77.2 | 74 |
| 17 | 261.1 | 79.8 | 262.0 | 80.1 | 263.0 | 80.4 | 263.9 | 80.7 | 264.9 | 81.0 | 265.9 | 81.3 | 266.8 | 81.6 | 267.8 | 81.9 | 73 |
| 18 | 259.6 | 84.4 | 260.6 | 84.7 | 261.5 | 85.0 | 262.5 | 85.3 | 263.4 | 85.6 | 264.4 | 85.9 | 265.3 | 86.2 | 266.3 | 86.5 | 72 |
| 19 | 258.1 | 88.9 | 259.1 | 89.2 | 260.0 | 89.5 | 261.0 | 89.9 | 261.9 | 90.2 | 262.9 | 90.5 | 263.8 | 90.8 | 264.7 | 91.2 | 71 |
| 20 | 256.5 | 93.4 | 257.5 | 93.7 | 258.4 | 94.1 | 259.4 | 94.4 | 260.3 | 94.7 | 261.2 | 95.1 | 262.2 | 95.4 | 263.1 | 95.8 | 70 |
| 21 | 254.9 | 97.8 | 255.8 | 98.2 | 256.7 | 98.6 | 257.7 | 98.9 | 258.6 | 99.3 | 259.5 | 99.6 | 260.5 | 100.0 | 261.4 | 100.3 | 69 |
| 22 | 253.1 | 102.3 | 254.0 | 102.6 | 255.0 | 103.0 | 255.9 | 103.4 | 256.8 | 103.8 | 257.8 | 104.1 | 258.7 | 104.5 | 259.6 | 104.9 | 68 |
| 23 | 251.3 | 106.7 | 252.2 | 107.1 | 253.1 | 107.5 | 254.1 | 107.8 | 255.0 | 108.2 | 255.9 | 108.6 | 256.8 | 109.0 | 257.7 | 109.4 | 67 |
| 24 | 249.4 | 111.0 | 250.3 | 111.4 | 251.2 | 111.9 | 252.1 | 112.3 | 253.1 | 112.7 | 254.0 | 113.1 | 254.9 | 113.5 | 255.8 | 113.9 | 66 |
| 25 | 247.4 | 115.4 | 248.3 | 115.8 | 249.2 | 116.2 | 250.1 | 116.6 | 251.0 | 117.1 | 252.0 | 117.5 | 252.9 | 117.9 | 253.8 | 118.3 | 65 |
| 26 | 245.4 | 119.7 | 246.3 | 120.1 | 247.2 | 120.6 | 248.1 | 121.0 | 249.0 | 121.4 | 249.9 | 121.9 | 250.8 | 122.3 | 251.7 | 122.7 | 64 |
| 27 | 243.2 | 123.9 | 244.1 | 124.4 | 245.0 | 124.8 | 245.9 | 125.3 | 246.8 | 125.8 | 247.7 | 126.2 | 248.6 | 126.7 | 249.5 | 127.1 | 63 |
| 28 | 241.0 | 128.2 | 241.9 | 128.6 | 242.8 | 129.1 | 243.7 | 129.6 | 244.6 | 130.0 | 245.5 | 130.5 | 246.3 | 131.0 | 247.2 | 131.5 | 62 |
| 29 | 238.8 | 132.4 | 239.6 | 132.8 | 240.5 | 133.3 | 241.4 | 133.8 | 242.3 | 134.3 | 243.1 | 134.8 | 244.0 | 135.3 | 244.9 | 135.7 | 61 |
| 30 | 236.4 | 136.5 | 237.3 | 137.0 | 238.2 | 137.5 | 239.0 | 138.0 | 239.9 | 138.5 | 240.8 | 139.0 | 241.6 | 139.5 | 242.5 | 140.0 | 60 |
| 31 | 234.0 | 140.6 | 234.9 | 141.1 | 235.7 | 141.6 | 236.6 | 142.2 | 237.4 | 142.7 | 238.3 | 143.2 | 239.1 | 143.7 | 240.0 | 144.2 | 59 |
| 32 | 231.5 | 144.7 | 232.4 | 145.2 | 233.2 | 145.7 | 234.1 | 146.3 | 234.9 | 146.8 | 235.8 | 147.3 | 236.6 | 147.8 | 237.5 | 148.4 | 58 |
| 33 | 229.0 | 148.7 | 229.8 | 149.2 | 230 6 | 149.8 | 231.5 | 150.3 | 232.3 | 150.9 | 233.2 | 151.4 | 234.0 | 152.0 | 234.8 | 152.5 | 57 |
| 34 | 226.3 | 152.7 | 227.2 | 153.2 | 228.0 | 153.8 | 228.8 | 154.3 | 229.6 | 154.9 | 230.5 | 155.5 | 231.3 | 156.0 | 232.1 | 156.6 | 56 |
| 35 | 223.6 | 156.6 | 224.4 | 157.2 | 225.3 | 157.7 | 226.1 | 158.3 | 226.9 | 158.9 | 227.7 | 159.5 | 228.5 | 160.0 | 229.4 | 160.6 | 55 |
| 36 | 220.9 | 160.5 | 221.7 | 161.1 | 222.5 | 161.6 | 223.3 | 162.2 | 224.1 | 162.8 | 224.9 | 163.4 | 225.7 | 164.0 | 226.5 | 164.6 | 54 |
| 37 | 218.0 | 164.3 | 218.8 | 164.9 | 219.6 | 165.5 | 220.4 | 166.1 | 221.2 | 166.7 | 222.0 | 167.3 | 222.8 | 167.9 | 223.6 | 168.5 | 53 |
| 38 | 215.1 | 168.1 | 215.9 | 168.7 | 216.7 | 169.3 | 217.5 | 169.9 | 218.3 | 170.5 | 219.1 | 171.2 | 219.9 | 171.8 | 220.6 | 172.4 | 52 |
| 39 | 212.2 | 171.8 | 212.9 | 172.4 | 213.7 | 173.1 | 214.5 | 173.7 | 215.3 | 174.3 | 216.0 | 175.0 | 216.8 | 175.6 | 217.6 | 176.2 | 51 |
| 40 | 209.1 | 175.5 | 209.9 | 176.1 | 210.7 | 176.8 | 211.4 | 177.4 | 212.2 | 178.1 | 213.0 | 178.7 | 213.7 | 179.3 | 214.5 | 180.0 | 50 |
| 41 | 206.0 | 179.1 | 206.8 | 179.8 | 207.5 | 180.4 | 208.3 | 181.1 | 209.1 | 181.7 | 209.8 | 182.4 | 210.6 | 183.0 | 211.3 | 183.7 | 49 |
| 42 | 202.9 | 182.7 | 203.6 | 183.3 | 204.4 | 184.0 | 205.1 | 184.7 | 205.9 | 185.3 | 206.6 | 186.0 | 207.3 | 186.7 | 208.1 | 187.4 | 48 |
| 43 | 199.7 | 186.2 | 200.4 | 186.9 | 201.1 | 187.5 | 201.9 | 188.2 | 202.6 | 188.9 | 203.3 | 189.6 | 204.0 | 190.3 | 204.8 | 191.0 | 47 |
| 44 | 196.4 | 189.6 | 197.1 | 190.3 | 197.8 | 191.0 | 198.5 | 191.7 | 199.3 | 192.4 | 200.0 | 193.1 | 200.7 | 193.8 | 201.4 | 194.5 | 46 |
| 45 | 193.0 | 193.0 | 193.7 | 193.7 | 194.5 | 194.5 | 195.2 | 195.2 | 195 9 | 195.9 | 196.6 | 196.6 | 197.3 | 197.3 | 198.0 | 198.0 | 45 |
| Crse | Dep. | Diff. Lat. | Dep | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Crse |

## Traverse Table. (x)

| Distance. | 281 | | 282 | | 283 | | 284 | | 285 | | 286 | | 287 | | 288 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 280.7 | 13.8 | 281.7 | 13.8 | 282.7 | 13.9 | 283.7 | 13.9 | 284.7 | 14.0 | 285.7 | 14.0 | 286.7 | 14.1 | 287.7 | 14.1 | 7¾ |
| ½ | 279.6 | 27.5 | 280.6 | 27.6 | 281.6 | 27.7 | 282.6 | 27.8 | 283.6 | 27.9 | 284.6 | 28.0 | 285.6 | 28.1 | 286.6 | 28.2 | ½ |
| ¾ | 278.0 | 41.2 | 278.9 | 41.4 | 279.9 | 41.5 | 280.9 | 41.7 | 281.9 | 41.8 | 282.9 | 42.0 | 283.9 | 42.1 | 284.9 | 42.3 | ¼ |
| 1 | 275.6 | 54.8 | 276.6 | 55.0 | 277.6 | 55.2 | 278.5 | 55.4 | 279.5 | 55.6 | 280.5 | 55.8 | 281.5 | 56.0 | 282.5 | 56.2 | 7 |
| ¼ | 272.6 | 68.3 | 273.6 | 68.5 | 274.5 | 68.8 | 275.5 | 69.0 | 276.5 | 69.3 | 277.4 | 69.5 | 278.4 | 69.7 | 279.4 | 70.0 | ¾ |
| ½ | 268.9 | 81.6 | 269.9 | 81.9 | 270.8 | 82.1 | 271.8 | 82.4 | 272.7 | 82.7 | 273.7 | 83.0 | 274.6 | 83.3 | 275.6 | 83.6 | ½ |
| ¾ | 264.5 | 94.7 | 265.5 | 95.0 | 266.5 | 95.3 | 267.4 | 95.7 | 268.3 | 96.0 | 269.3 | 96.3 | 270.2 | 96.7 | 271.2 | 97.0 | ¼ |
| 2 | 259.6 | 107.5 | 260.5 | 107.9 | 261.5 | 108.3 | 262.4 | 108.7 | 263.3 | 109.1 | 264.2 | 109.5 | 265.2 | 109.8 | 266.1 | 110.2 | 6 |
| ¼ | 254.0 | 120.2 | 254.9 | 120.6 | 255.8 | 121.0 | 256.7 | 121.4 | 257.6 | 121.9 | 258.5 | 122.3 | 259.4 | 122.7 | 260.3 | 123.1 | ¾ |
| ½ | 247.8 | 132.5 | 248.7 | 132.9 | 249.6 | 133.4 | 250.5 | 133.9 | 251.4 | 134.3 | 252.2 | 134.8 | 253.1 | 135.3 | 254.0 | 135.8 | ½ |
| ¾ | 241.0 | 144.5 | 241.9 | 145.0 | 242.7 | 145.5 | 243.6 | 146.0 | 244.4 | 146.5 | 245.3 | 147.0 | 246.2 | 147.5 | 247.0 | 148.1 | ¼ |
| 3 | 233.6 | 156.1 | 234.5 | 156.7 | 235.3 | 157.2 | 236.1 | 157.8 | 237.0 | 158.3 | 237.8 | 158.9 | 238.6 | 159.4 | 239.5 | 160.0 | 5 |
| ¼ | 225.7 | 167.4 | 226.5 | 168.0 | 227.3 | 168.6 | 228.1 | 169.2 | 228.9 | 169.8 | 229.7 | 170.4 | 230.5 | 171.0 | 231.3 | 171.6 | ¾ |
| ½ | 217.2 | 178.3 | 218.0 | 178.9 | 218.8 | 179.5 | 219.5 | 180.2 | 220.3 | 180.8 | 221.1 | 181.4 | 221.8 | 182.1 | 222.6 | 182.7 | ½ |
| ¾ | 208.2 | 188.7 | 208.9 | 189.4 | 209.7 | 190.0 | 210.4 | 190.7 | 211.2 | 191.4 | 211.9 | 192.1 | 212.6 | 192.7 | 213.4 | 193.4 | ¼ |
| 4 | 198.7 | 198.7 | 199.4 | 199.4 | 200.1 | 200.1 | 200.8 | 200.8 | 201.5 | 201.5 | 202.2 | 202.2 | 202.9 | 202.9 | 203.6 | 203.6 | 4 |
| 1° | 281.0 | 04.9 | 282.0 | 04.9 | 283.0 | 04.9 | 284.0 | 05.0 | 285.0 | 05.0 | 286.0 | 05.0 | 287.0 | 05.0 | 288.0 | 05.0 | 89° |
| 2 | 280.8 | 09.8 | 281.8 | 09.8 | 282.8 | 09.9 | 283.8 | 09.9 | 284.8 | 09.9 | 285.8 | 10.0 | 286.8 | 10.0 | 287.8 | 10.1 | 88 |
| 3 | 280.6 | 14.7 | 281.6 | 14.8 | 282.6 | 14.8 | 283.6 | 14.9 | 284.6 | 14.9 | 285.6 | 15.0 | 286.6 | 15.0 | 287.6 | 15.1 | 87 |
| 4 | 280.2 | 19.6 | 281.3 | 19.7 | 282.3 | 19.7 | 283.3 | 19.8 | 284.3 | 19.9 | 285.3 | 20.0 | 286.3 | 20.0 | 287.3 | 20.1 | 86 |
| 5 | 279.9 | 24.5 | 280.9 | 24.6 | 281.9 | 24.7 | 282.9 | 24.8 | 283.9 | 24.8 | 284.9 | 24.9 | 285.9 | 25.0 | 286.9 | 25.1 | 85 |
| 6 | 279.5 | 29.4 | 280.5 | 29.5 | 281.4 | 29.6 | 282.4 | 29.7 | 283.4 | 29.8 | 284.4 | 29.9 | 285.4 | 30.0 | 286.4 | 30.1 | 84 |
| 7 | 278.9 | 34.2 | 279.9 | 34.4 | 280.9 | 34.5 | 281.9 | 34.6 | 282.9 | 34.7 | 283.9 | 34.9 | 284.9 | 35.0 | 285.9 | 35.1 | 83 |
| 8 | 278.3 | 39.1 | 279.3 | 39.2 | 280.2 | 39.4 | 281.2 | 39.5 | 282.2 | 39.7 | 283.2 | 39.8 | 284.2 | 39.9 | 285.2 | 40.1 | 82 |
| 9 | 277.5 | 44.0 | 278.5 | 44.1 | 279.5 | 44.3 | 280.5 | 44.4 | 281.5 | 44.6 | 282.5 | 44.7 | 283.5 | 44.9 | 284.5 | 45.1 | 81 |
| 10 | 276.7 | 48.8 | 277.7 | 49.0 | 278.7 | 49.1 | 279.7 | 49.3 | 280.7 | 49.5 | 281.7 | 49.7 | 282.6 | 49.8 | 283.6 | 50.0 | 80 |
| 11 | 275.8 | 53.6 | 276.8 | 53.8 | 277.8 | 54.0 | 278.8 | 54.2 | 279.8 | 54.4 | 280.7 | 54.6 | 281.7 | 54.8 | 282.7 | 55.0 | 79 |
| 12 | 274.9 | 58.4 | 275.8 | 58.6 | 276.8 | 58.8 | 277.8 | 59.0 | 278.8 | 59.3 | 279.8 | 59.5 | 280.7 | 59.7 | 281.7 | 59.9 | 78 |
| 13 | 273.8 | 63.2 | 274.8 | 63.4 | 275.7 | 63.7 | 276.7 | 63.9 | 277.7 | 64.1 | 278.7 | 64.3 | 279.6 | 64.6 | 280.6 | 64.8 | 77 |
| 14 | 272.7 | 68.0 | 273.6 | 68.2 | 274.6 | 68.5 | 275.6 | 68.7 | 276.5 | 68.9 | 277.5 | 69.2 | 278.5 | 69.4 | 279.4 | 69.7 | 76 |
| 15 | 271.4 | 72.7 | 272.4 | 73.0 | 273.4 | 73.2 | 274.3 | 73.5 | 275.3 | 73.8 | 276.3 | 74.0 | 277.2 | 74.3 | 278.2 | 74.5 | 75 |
| 16 | 270.1 | 77.5 | 271.1 | 77.7 | 272.0 | 78.0 | 273.0 | 78.3 | 274.0 | 78.6 | 274.9 | 78.8 | 275.9 | 79.1 | 276.8 | 79.4 | 74 |
| 17 | 268.7 | 82.2 | 269.7 | 82.4 | 270.6 | 82.7 | 271.6 | 83.0 | 272.5 | 83.3 | 273.5 | 83.6 | 274.5 | 83.9 | 275.4 | 84.2 | 73 |
| 18 | 267.2 | 86.8 | 268.2 | 87.1 | 269.1 | 87.5 | 270.1 | 87.8 | 271.1 | 88.1 | 272.0 | 88.4 | 273.0 | 88.7 | 273.9 | 89.0 | 72 |
| 19 | 265.7 | 91.5 | 266.6 | 91.8 | 267.6 | 92.1 | 268.5 | 92.5 | 269.5 | 92.8 | 270.4 | 93.1 | 271.4 | 93.4 | 272.3 | 93.8 | 71 |
| 20 | 264.1 | 96.1 | 265.0 | 96.4 | 265.9 | 96.8 | 266.9 | 97.1 | 267.8 | 97.5 | 268.8 | 97.8 | 269.7 | 98.2 | 270.6 | 98.5 | 70 |
| 21 | 262.3 | 100.7 | 263.3 | 101.1 | 264.2 | 101.4 | 265.1 | 101.8 | 266.1 | 102.1 | 267.0 | 102.5 | 267.9 | 102.9 | 268.9 | 103.2 | 69 |
| 22 | 260.5 | 105.3 | 261.5 | 105.6 | 262.4 | 106.0 | 263.3 | 106.4 | 264.2 | 106.8 | 265.2 | 107.1 | 266.1 | 107.5 | 267.0 | 107.9 | 68 |
| 23 | 258.7 | 109.8 | 259.6 | 110.2 | 260.5 | 110.6 | 261.4 | 111.0 | 262.3 | 111.4 | 263.3 | 111.7 | 264.2 | 112.1 | 265.1 | 112.5 | 67 |
| 24 | 256.7 | 114.3 | 257.6 | 114.7 | 258.5 | 115.1 | 259.4 | 115.5 | 260.4 | 115.9 | 261.3 | 116.3 | 262.2 | 116.7 | 263.1 | 117.1 | 66 |
| 25 | 254.7 | 118.8 | 255.6 | 119.2 | 256.5 | 119.6 | 257.4 | 120.0 | 258.3 | 120.4 | 259.2 | 120.9 | 260.1 | 121.3 | 261.0 | 121.7 | 65 |
| 26 | 252.6 | 123.2 | 253.5 | 123.6 | 254.4 | 124.1 | 255.3 | 124.5 | 256.2 | 124.9 | 257.1 | 125.4 | 258.0 | 125.8 | 258.9 | 126.3 | 64 |
| 27 | 250.4 | 127.6 | 251.3 | 128.0 | 252.2 | 128.5 | 253.0 | 128.9 | 253.9 | 129.4 | 254.8 | 129.8 | 255.7 | 130.3 | 256.6 | 130.7 | 63 |
| 28 | 248.1 | 131.9 | 249.0 | 132.4 | 249.9 | 132.9 | 250.8 | 133.3 | 251.6 | 133.8 | 252.5 | 134.3 | 253.4 | 134.7 | 254.3 | 135.2 | 62 |
| 29 | 245.8 | 136.2 | 246.6 | 136.7 | 247.5 | 137.2 | 248.4 | 137.7 | 249.3 | 138.2 | 250.1 | 138.7 | 251.0 | 139.1 | 251.9 | 139.6 | 61 |
| 30 | 243.4 | 140.5 | 244.2 | 141.0 | 245.1 | 141.5 | 246.0 | 142.0 | 246.8 | 142.5 | 247.7 | 143.0 | 248.5 | 143.5 | 249.4 | 144.0 | 60 |
| 31 | 240.9 | 144.7 | 241.7 | 145.2 | 242.6 | 145.8 | 243.4 | 146.3 | 244.3 | 146.8 | 245.1 | 147.3 | 246.0 | 147.8 | 246.9 | 148.3 | 59 |
| 32 | 238.3 | 148.9 | 239.1 | 149.4 | 240.0 | 150.0 | 240.8 | 150.5 | 241.7 | 151.0 | 242.5 | 151.6 | 243.4 | 152.1 | 244.2 | 152.6 | 58 |
| 33 | 235.7 | 153.0 | 236.5 | 153.6 | 237.3 | 154.1 | 238.2 | 154.7 | 239.0 | 155.2 | 239.9 | 155.8 | 240.7 | 156.3 | 241.5 | 156.9 | 57 |
| 34 | 233.0 | 157.1 | 233.8 | 157.7 | 234.6 | 158.3 | 235.4 | 158.8 | 236.3 | 159.4 | 237.1 | 159.9 | 237.9 | 160.5 | 238.8 | 161.0 | 56 |
| 35 | 230.2 | 161.2 | 231.0 | 161.7 | 231.8 | 162.3 | 232.6 | 162.9 | 233.5 | 163.5 | 234.3 | 164.0 | 235.1 | 164.6 | 235.9 | 165.2 | 55 |
| 36 | 227.3 | 165.2 | 228.1 | 165.8 | 229.0 | 166.3 | 229.8 | 166.9 | 230.6 | 167.5 | 231.4 | 168.1 | 232.2 | 168.7 | 233.0 | 169.3 | 54 |
| 37 | 224.4 | 169.1 | 225.2 | 169.7 | 226.0 | 170.3 | 226.8 | 170.9 | 227.6 | 171.5 | 228.4 | 172.1 | 229.2 | 172.7 | 230.0 | 173.3 | 53 |
| 38 | 221.4 | 173.0 | 222.2 | 173.6 | 223.0 | 174.2 | 223.8 | 174.8 | 224.6 | 175.5 | 225.4 | 176.1 | 226.2 | 176.7 | 226.9 | 177.3 | 52 |
| 39 | 218.4 | 176.8 | 219.2 | 177.5 | 219.9 | 178.1 | 220.7 | 178.7 | 221.5 | 179.4 | 222.3 | 180.0 | 223.0 | 180.6 | 223.8 | 181.2 | 51 |
| 40 | 215.3 | 180.6 | 216.0 | 181.3 | 216.8 | 181.9 | 217.6 | 182.6 | 218.3 | 183.2 | 219.1 | 183.8 | 219.9 | 184.5 | 220.6 | 185.1 | 50 |
| 41 | 212.1 | 184.4 | 212.8 | 185.0 | 213.6 | 185.7 | 214.3 | 186.3 | 215.1 | 187.0 | 215.8 | 187.6 | 216.6 | 188.3 | 217.4 | 188.9 | 49 |
| 42 | 208.8 | 188.0 | 209.6 | 188.7 | 210.3 | 189.4 | 211.1 | 190.0 | 211.8 | 190.7 | 212.5 | 191.4 | 213.3 | 192.0 | 214.0 | 192.7 | 48 |
| 43 | 205.5 | 191.6 | 206.2 | 192.3 | 207.0 | 193.0 | 207.7 | 193.7 | 208.4 | 194.4 | 209.2 | 195.1 | 209.9 | 195.7 | 210.6 | 196.4 | 47 |
| 44 | 202.1 | 195.2 | 202.9 | 195.9 | 203.6 | 196.6 | 204.3 | 197.3 | 205.0 | 198.0 | 205.7 | 198.7 | 206.5 | 199.4 | 207.2 | 200.1 | 46 |
| 45 | 198.7 | 198.7 | 199.4 | 199.4 | 200.1 | 200.1 | 200.8 | 200.8 | 201.5 | 201.5 | 202.2 | 202.2 | 202.9 | 202.9 | 203.6 | 203.6 | 45 |
| Crse. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Dep. | Diff.Lat. | Crse. |

## Traverse Table. (x.)

| Distance. | 289 | | 290 | | 291 | | 292 | | 293 | | 294 | | 295 | | 296 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crse. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Crse. |
| Pts. | | | | | | | | | | | | | | | | | Pts. |
| ¼ | 288.7 | 14.2 | 289.7 | 14.2 | 290.7 | 14.3 | 291.7 | 14.3 | 292.7 | 14.4 | 293.6 | 14.4 | 294.6 | 14.5 | 295.6 | 14.5 | 7½ |
| ½ | 287.6 | 28.3 | 288.6 | 28.4 | 289.6 | 28.5 | 290.6 | 28.6 | 291.6 | 28.7 | 292.6 | 28.8 | 293.6 | 28.9 | 294.6 | 29.0 | ½ |
| ¾ | 285.9 | 42.4 | 286.9 | 42.5 | 287.8 | 42.7 | 288.8 | 42.8 | 289.8 | 43.0 | 290.8 | 43.1 | 291.8 | 43.3 | 292.8 | 43.4 | ¼ |
| 1 | 283.4 | 56.4 | 284.4 | 56.6 | 285.4 | 56.8 | 286.4 | 57.0 | 287.4 | 57.2 | 288.3 | 57.4 | 289.3 | 57.6 | 290.3 | 57.7 | 7 |
| ¼ | 280.3 | 70.2 | 281.3 | 70.5 | 282.3 | 70.7 | 283.3 | 71.0 | 284.2 | 71.2 | 285.2 | 71.4 | 286.2 | 71.7 | 287.1 | 71.9 | ¾ |
| ½ | 276.6 | 83.9 | 277.5 | 84.2 | 278.5 | 84.5 | 279.4 | 84.8 | 280.4 | 85.0 | 281.3 | 85.3 | 282.3 | 85.6 | 283.3 | 85.9 | ½ |
| ¾ | 272.1 | 97.4 | 273.0 | 97.7 | 274.0 | 98.0 | 274.9 | 98.4 | 275.9 | 98.7 | 276.8 | 99.0 | 277.7 | 99.4 | 278.7 | 99.7 | ¼ |
| 2 | 267.0 | 110.6 | 267.9 | 111.0 | 268.9 | 111.4 | 269.8 | 111.7 | 270.7 | 112.1 | 271.6 | 112.5 | 272.5 | 112.9 | 273.5 | 113.3 | 6 |
| ¼ | 261.3 | 123.6 | 262.2 | 124.0 | 263.1 | 124.4 | 264.0 | 124.9 | 264.9 | 125.3 | 265.8 | 125.7 | 266.7 | 126.1 | 267.6 | 126.6 | ¾ |
| ½ | 254.9 | 136.2 | 255.8 | 136.7 | 256.6 | 137.2 | 257.5 | 137.6 | 258.4 | 138.1 | 259.3 | 138.6 | 260.2 | 139.1 | 261.1 | 139.5 | ½ |
| ¾ | 247.9 | 148.6 | 248.7 | 149.1 | 249.6 | 149.6 | 250.5 | 150.1 | 251.3 | 150.6 | 252.2 | 151.1 | 253.0 | 151.7 | 253.9 | 152.2 | ¼ |
| 3 | 240.3 | 160.6 | 241.1 | 161.1 | 242.0 | 161.7 | 242.8 | 162.2 | 243.6 | 162.8 | 244.4 | 163.3 | 245.3 | 163.9 | 246.1 | 164.4 | 5 |
| ¼ | 232.1 | 172.2 | 232.9 | 172.8 | 233.7 | 173.3 | 234.5 | 173.9 | 235.3 | 174.5 | 236.1 | 175.1 | 236.9 | 175.7 | 237.7 | 176.3 | ¾ |
| ½ | 223.4 | 183.3 | 224.2 | 184.0 | 224.9 | 184.6 | 225.7 | 185.2 | 226.5 | 185.9 | 227.3 | 186.5 | 228.0 | 187.1 | 228.8 | 187.8 | ½ |
| ¾ | 214.1 | 194.1 | 214.9 | 194.7 | 215.6 | 195.4 | 216.4 | 196.1 | 217.1 | 196.8 | 217.8 | 197.4 | 218.6 | 198.1 | 219.3 | 198.8 | ¼ |
| 4 | 204.3 | 204.3 | 205.1 | 205.1 | 205.8 | 205.8 | 206.5 | 206.5 | 207.2 | 207.2 | 207.9 | 207.9 | 208.6 | 208.6 | 209.3 | 209.3 | 4 |
| 1° | 289.0 | 05.0 | 290.0 | 05.1 | 291.0 | 05.1 | 292.0 | 05.1 | 293.0 | 05.1 | 294.0 | 05.1 | 295.0 | 05.1 | 296.0 | 05.2 | 89° |
| 2 | 288.8 | 10.1 | 289.8 | 10.1 | 290.8 | 10.2 | 291.8 | 10.2 | 292.8 | 10.2 | 293.8 | 10.3 | 294.8 | 10.3 | 295.8 | 10.3 | 88 |
| 3 | 288.6 | 15.1 | 289.6 | 15.2 | 290.6 | 15.2 | 291.6 | 15.3 | 292.6 | 15.3 | 293.6 | 15.4 | 294.6 | 15.4 | 295.6 | 15.5 | 87 |
| 4 | 288.3 | 20.2 | 289.3 | 20.2 | 290.3 | 20.3 | 291.3 | 20.4 | 292.3 | 20.4 | 293.3 | 20.5 | 294.3 | 20.6 | 295.3 | 20.6 | 86 |
| 5 | 287.9 | 25.2 | 288.9 | 25.3 | 289.9 | 25.4 | 290.9 | 25.4 | 291.9 | 25.5 | 292.9 | 25.6 | 293.9 | 25.7 | 294.9 | 25.8 | 85 |
| 6 | 287.4 | 30.2 | 288.4 | 30.3 | 289.4 | 30.4 | 290.4 | 30.5 | 291.4 | 30.6 | 292.4 | 30.7 | 293.4 | 30.8 | 294.4 | 30.9 | 84 |
| 7 | 286.8 | 35.2 | 287.8 | 35.3 | 288.8 | 35.5 | 289.8 | 35.6 | 290.8 | 35.7 | 291.8 | 35.8 | 292.8 | 36.0 | 293.8 | 36.1 | 83 |
| 8 | 286.2 | 40.2 | 287.2 | 40.4 | 288.2 | 40.5 | 289.2 | 40.6 | 290.1 | 40.8 | 291.1 | 40.9 | 292.1 | 41.1 | 293.1 | 41.2 | 82 |
| 9 | 285.4 | 45.2 | 286.4 | 45.4 | 287.4 | 45.5 | 288.4 | 45.7 | 289.4 | 45.8 | 290.4 | 46.0 | 291.4 | 46.1 | 292.4 | 46.3 | 81 |
| 10 | 284.6 | 50.2 | 285.6 | 50.4 | 286.6 | 50.5 | 287.6 | 50.7 | 288.5 | 50.9 | 289.5 | 51.1 | 290.5 | 51.2 | 291.5 | 51.4 | 80 |
| 11 | 283.7 | 55.1 | 284.7 | 55.3 | 285.7 | 55.5 | 286.6 | 55.7 | 287.6 | 55.9 | 288.6 | 56.1 | 289.6 | 56.3 | 290.6 | 56.5 | 79 |
| 12 | 282.7 | 60.1 | 283.7 | 60.3 | 284.6 | 60.5 | 285.6 | 60.7 | 286.6 | 60.9 | 287.6 | 61.1 | 288.6 | 61.3 | 289.5 | 61.5 | 78 |
| 13 | 281.6 | 65.0 | 282.6 | 65.2 | 283.5 | 65.5 | 284.5 | 65.7 | 285.5 | 65.9 | 286.5 | 66.1 | 287.4 | 66.4 | 288.4 | 66.6 | 77 |
| 14 | 280.4 | 69.9 | 281.4 | 70.2 | 282.4 | 70.4 | 283.3 | 70.6 | 284.3 | 70.9 | 285.3 | 71.1 | 286.2 | 71.4 | 287.2 | 71.6 | 76 |
| 15 | 279.2 | 74.8 | 280.1 | 75.1 | 281.1 | 75.3 | 282.1 | 75.6 | 283.0 | 75.8 | 284.0 | 76.1 | 284.9 | 76.4 | 285.9 | 76.6 | 75 |
| 16 | 277.8 | 79.7 | 278.8 | 79.9 | 279.7 | 80.2 | 280.7 | 80.5 | 281.6 | 80.8 | 282.6 | 81.0 | 283.6 | 81.3 | 284.5 | 81.6 | 74 |
| 17 | 276.4 | 84.5 | 277.3 | 84.8 | 278.3 | 85.1 | 279.2 | 85.4 | 280.2 | 85.7 | 281.2 | 86.0 | 282.1 | 86.2 | 283.1 | 86.5 | 73 |
| 18 | 274.9 | 89.3 | 275.8 | 89.6 | 276.8 | 89.9 | 277.7 | 90.2 | 278.7 | 90.5 | 279.6 | 90.9 | 280.6 | 91.2 | 281.5 | 91.5 | 72 |
| 19 | 273.3 | 94.1 | 274.2 | 94.4 | 275.1 | 94.7 | 276.1 | 95.1 | 277.0 | 95.4 | 278.0 | 95.7 | 278.9 | 96.0 | 279.9 | 96.4 | 71 |
| 20 | 271.6 | 98.8 | 272.5 | 99.2 | 273.5 | 99.5 | 274.4 | 99.9 | 275.3 | 100.2 | 276.3 | 100.6 | 277.2 | 100.9 | 278.1 | 101.2 | 70 |
| 21 | 269.8 | 103.6 | 270.7 | 103.9 | 271.7 | 104.3 | 272.6 | 104.6 | 273.5 | 105.0 | 274.5 | 105.4 | 275.4 | 105.7 | 276.3 | 106.1 | 69 |
| 22 | 268.0 | 108.3 | 268.9 | 108.6 | 269.8 | 109.0 | 270.7 | 109.4 | 271.7 | 109.8 | 272.6 | 110.1 | 273.5 | 110.5 | 274.4 | 110.9 | 68 |
| 23 | 266.0 | 112.9 | 266.9 | 113.3 | 267.9 | 113.7 | 268.8 | 114.1 | 269.7 | 114.5 | 270.6 | 114.9 | 271.5 | 115.3 | 272.5 | 115.7 | 67 |
| 24 | 264.0 | 117.5 | 264.9 | 118.0 | 265.8 | 118.4 | 266.8 | 118.8 | 267.7 | 119.2 | 268.6 | 119.6 | 269.5 | 120.0 | 270.4 | 120.4 | 66 |
| 25 | 261.9 | 122.1 | 262.8 | 122.6 | 263.7 | 123.0 | 264.6 | 123.4 | 265.5 | 123.8 | 266.5 | 124.2 | 267.4 | 124.7 | 268.3 | 125.1 | 65 |
| 26 | 259.8 | 126.7 | 260.7 | 127.1 | 261.5 | 127.6 | 262.4 | 128.0 | 263.3 | 128.4 | 264.2 | 128.9 | 265.1 | 129.3 | 266.0 | 129.8 | 64 |
| 27 | 257.5 | 131.2 | 258.4 | 131.7 | 259.3 | 132.1 | 260.2 | 132.6 | 261.1 | 133.0 | 262.0 | 133.5 | 262.8 | 133.9 | 263.7 | 134.4 | 63 |
| 28 | 255.2 | 135.7 | 256.1 | 136.1 | 256.9 | 136.6 | 257.8 | 137.1 | 258.7 | 137.6 | 259.6 | 138.0 | 260.5 | 138.5 | 261.3 | 139.0 | 62 |
| 29 | 252.8 | 140.1 | 253.6 | 140.6 | 254.5 | 141.1 | 255.4 | 141.6 | 256.3 | 142.0 | 257.1 | 142.5 | 258.0 | 143.0 | 258.9 | 143.5 | 61 |
| 30 | 250.3 | 144.5 | 251.1 | 145.0 | 252.0 | 145.5 | 252.9 | 146.0 | 253.7 | 146.5 | 254.6 | 147.0 | 255.5 | 147.5 | 256.3 | 148.0 | 60 |
| 31 | 247.7 | 148.8 | 248.6 | 149.4 | 249.4 | 149.9 | 250.3 | 150.4 | 251.2 | 150.9 | 252.0 | 151.4 | 252.9 | 151.9 | 253.7 | 152.5 | 59 |
| 32 | 245.1 | 153.1 | 245.9 | 153.7 | 246.8 | 154.2 | 247.6 | 154.7 | 248.5 | 155.3 | 249.3 | 155.8 | 250.2 | 156.3 | 251.0 | 156.9 | 58 |
| 33 | 242.4 | 157.4 | 243.2 | 157.9 | 244.1 | 158.5 | 244.9 | 159.0 | 245.7 | 159.6 | 246.6 | 160.1 | 247.4 | 160.7 | 248.2 | 161.2 | 57 |
| 34 | 239.6 | 161.6 | 240.4 | 162.2 | 241.2 | 162.7 | 242.1 | 163.3 | 242.9 | 163.8 | 243.7 | 164.4 | 244.6 | 165.0 | 245.4 | 165.5 | 56 |
| 35 | 236.7 | 165.8 | 237.6 | 166.3 | 238.4 | 166.9 | 239.2 | 167.5 | 240.0 | 168.1 | 240.8 | 168.6 | 241.6 | 169.2 | 242.5 | 169.8 | 55 |
| 36 | 233.8 | 169.9 | 234.6 | 170.5 | 235.4 | 171.0 | 236.2 | 171.6 | 237.0 | 172.2 | 237.9 | 172.8 | 238.7 | 173.4 | 239.5 | 174.0 | 54 |
| 37 | 230.8 | 173.9 | 231.6 | 174.5 | 232.4 | 175.1 | 233.2 | 175.7 | 234.0 | 176.3 | 234.8 | 176.9 | 235.6 | 177.5 | 236.4 | 178.1 | 53 |
| 38 | 227.7 | 177.9 | 228.5 | 178.5 | 229.3 | 179.2 | 230.1 | 179.8 | 230.9 | 180.4 | 231.7 | 181.0 | 232.5 | 181.6 | 233.3 | 182.2 | 52 |
| 39 | 224.6 | 181.9 | 225.4 | 182.5 | 226.1 | 183.1 | 226.9 | 183.8 | 227.7 | 184.4 | 228.5 | 185.0 | 229.3 | 185.6 | 230.0 | 186.3 | 51 |
| 40 | 221.4 | 185.8 | 222.2 | 186.4 | 222.9 | 187.1 | 223.7 | 187.7 | 224.5 | 188.3 | 225.2 | 189.0 | 226.0 | 189.6 | 226.7 | 190.3 | 50 |
| 41 | 218.1 | 189.6 | 218.9 | 190.3 | 219.6 | 190.9 | 220.4 | 191.6 | 221.1 | 192.2 | 221.9 | 192.9 | 222.6 | 193.5 | 223.4 | 194.2 | 49 |
| 42 | 214.8 | 193.4 | 215.5 | 194.0 | 216.3 | 194.7 | 217.0 | 195.4 | 217.7 | 196.1 | 218.5 | 196.7 | 219.2 | 197.4 | 220.0 | 198.1 | 48 |
| 43 | 211.4 | 197.1 | 212.1 | 197.8 | 212.8 | 198.5 | 213.6 | 199.1 | 214.3 | 199.8 | 215.0 | 200.5 | 215.7 | 201.2 | 216.5 | 201.9 | 47 |
| 44 | 207.9 | 200.8 | 208.6 | 201.5 | 209.3 | 202.1 | 210.0 | 202.8 | 210.8 | 203.5 | 211.5 | 204.2 | 212.2 | 204.9 | 212.9 | 205.6 | 46 |
| 45 | 204.3 | 204.3 | 205.1 | 205.1 | 205.8 | 205.8 | 206.5 | 206.5 | 207.2 | 207.2 | 207.9 | 207.9 | 208.6 | 208.6 | 209.3 | 209.3 | 45 |
| Crse. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Dep. | Diff. Lat. | Crse. |

## Meridional Parts. (y)

| Lat. | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 0.00 | 60.00 | 120.02 | 180.08 | 240.19 | 300.38 | 360.66 | 421.05 | 481.57 | 542.23 | 603.07 | 0′ |
| 1 | 1.00 | 61.00 | 121.02 | 181.08 | 241.20 | 301.38 | 361.66 | 422.06 | 482.58 | 543.25 | 604.08 | 1 |
| 2 | 2.00 | 62.00 | 122.03 | 182.08 | 242.20 | 302.39 | 362.67 | 423.06 | 483.59 | 544.26 | 605.10 | 2 |
| 3 | 3.00 | 63.00 | 123.03 | 183.09 | 243.20 | 303.39 | 363.67 | 424.07 | 484.60 | 545.27 | 606.12 | 3 |
| 4 | 4.00 | 64.00 | 124.03 | 184.09 | 244.20 | 304.40 | 364.68 | 425.08 | 485.61 | 546.28 | 607.13 | 4 |
| 5 | 5.00 | 65.00 | 125.03 | 185.09 | 245.21 | 305.40 | 365.69 | 426.09 | 486.62 | 547.30 | 608.15 | 5 |
| 6 | 6.00 | 66.00 | 126.03 | 186.09 | 246.21 | 306.40 | 366.69 | 427.09 | 487.63 | 548.31 | 609.16 | 6 |
| 7 | 7.00 | 67.00 | 127.03 | 187.09 | 247.21 | 307.41 | 367.70 | 428.10 | 488.64 | 549.32 | 610.18 | 7 |
| 8 | 8.00 | 68.00 | 128.03 | 188.09 | 248.21 | 308.41 | 368.70 | 429.11 | 489.65 | 550.34 | 611.19 | 8 |
| 9 | 9.00 | 69.00 | 129.03 | 189.09 | 249.22 | 309.42 | 369.71 | 430.12 | 490.66 | 551.35 | 612.21 | 9 |
| 10 | 10.00 | 70.00 | 130.03 | 190.10 | 250.22 | 310.42 | 370.72 | 431.13 | 491.67 | 552.36 | 613.23 | 10 |
| 11 | 11.00 | 71.00 | 131.03 | 191.10 | 251.22 | 311.42 | 371.72 | 432.13 | 492.68 | 553.37 | 614.24 | 11 |
| 12 | 12.00 | 72.00 | 132.03 | 192.10 | 252.23 | 312.43 | 372.73 | 433.14 | 493.69 | 554.39 | 615.26 | 12 |
| 13 | 13.00 | 73.00 | 133.03 | 193.10 | 253.23 | 313.43 | 373.74 | 434.15 | 494.70 | 555.40 | 616.27 | 13 |
| 14 | 14.00 | 74.01 | 134.03 | 194.10 | 254.23 | 314.44 | 374.74 | 435.16 | 495.71 | 556.41 | 617.29 | 14 |
| 15 | 15.00 | 75.01 | 135.03 | 195.10 | 255.23 | 315.44 | 375.75 | 436.17 | 496.72 | 557.43 | 618.31 | 15 |
| 16 | 16.00 | 76.01 | 136.03 | 196.11 | 256.24 | 316.45 | 376.75 | 437.17 | 497.73 | 558.44 | 619.32 | 16 |
| 17 | 17.00 | 77.01 | 137.04 | 197.11 | 257.24 | 317.45 | 377.76 | 438.18 | 498.74 | 559.45 | 620.34 | 17 |
| 18 | 18.00 | 78.01 | 138.04 | 198.11 | 258.24 | 318.45 | 378.76 | 439.19 | 499.75 | 560.47 | 621.36 | 18 |
| 19 | 19.00 | 79.01 | 139.04 | 199.11 | 259.25 | 319.46 | 379.77 | 440.20 | 500.76 | 561.48 | 622.37 | 19 |
| 20 | 20.00 | 80.01 | 140.04 | 200.11 | 260.25 | 320.46 | 380.78 | 441.21 | 501.77 | 562.49 | 623.39 | 20 |
| 21 | 21.00 | 81.01 | 141.04 | 201.11 | 261.25 | 321.47 | 381.78 | 442.21 | 502.78 | 563.51 | 624.40 | 21 |
| 22 | 22.00 | 82.01 | 142.04 | 202.12 | 262.25 | 322.47 | 382.79 | 443.22 | 503.79 | 564.52 | 625.42 | 22 |
| 23 | 23.00 | 83.01 | 143.04 | 203.12 | 263.26 | 323.48 | 383.79 | 444.23 | 504.80 | 565.53 | 626.44 | 23 |
| 24 | 24.00 | 84.01 | 144.04 | 204.12 | 264.26 | 324.48 | 384.80 | 445.24 | 505.81 | 566.55 | 627.45 | 24 |
| 25 | 25.00 | 85.01 | 145.04 | 205.12 | 265.26 | 325.48 | 385.81 | 446.25 | 506.83 | 567.56 | 628.47 | 25 |
| 26 | 26.00 | 86.01 | 146.04 | 206.12 | 266.27 | 326.49 | 386.81 | 447.26 | 507.84 | 568.57 | 629.49 | 26 |
| 27 | 27.00 | 87.01 | 147.04 | 207.13 | 267.27 | 327.49 | 387.82 | 448.26 | 508.85 | 569.59 | 630.50 | 27 |
| 28 | 28.00 | 88.01 | 148.05 | 208.13 | 268.27 | 328.50 | 388.83 | 449.27 | 509.86 | 570.60 | 631.52 | 28 |
| 29 | 29.00 | 89.01 | 149.05 | 209.13 | 269.27 | 329.50 | 389.83 | 450.28 | 510.87 | 571.62 | 632.54 | 29 |
| 30 | 30.00 | 90.01 | 150.05 | 210.13 | 270.28 | 330.51 | 390.84 | 451.29 | 511.88 | 572.63 | 633.56 | 30 |
| 31 | 31.00 | 91.01 | 151.05 | 211.13 | 271.28 | 331.51 | 391.85 | 452.30 | 512.89 | 573.64 | 634.57 | 31 |
| 32 | 32.00 | 92.01 | 152.05 | 212.13 | 272.28 | 332.52 | 392.85 | 453.31 | 513.90 | 574.66 | 635.59 | 32 |
| 33 | 33.00 | 93.01 | 153.05 | 213.14 | 273.29 | 333.52 | 393.86 | 454.32 | 514.91 | 575.67 | 636.61 | 33 |
| 34 | 34.00 | 94.01 | 154.05 | 214.14 | 274.29 | 334.53 | 394.86 | 455.33 | 515.93 | 576.69 | 637.62 | 34 |
| 35 | 35.00 | 95.01 | 155.05 | 215.14 | 275.29 | 335.53 | 395.87 | 456.33 | 516.94 | 577.70 | 638.64 | 35 |
| 36 | 36.00 | 96.01 | 156.05 | 216.14 | 276.30 | 336.54 | 396.88 | 457.34 | 517.95 | 578.71 | 639.66 | 36 |
| 37 | 37.00 | 97.01 | 157.05 | 217.14 | 277.30 | 337.54 | 397.88 | 458.35 | 518.96 | 579.73 | 640.68 | 37 |
| 38 | 38.00 | 98.01 | 158.06 | 218.15 | 278.30 | 338.55 | 398.89 | 459.36 | 519.97 | 580.74 | 641.69 | 38 |
| 39 | 39.00 | 99.01 | 159.06 | 219.15 | 279.31 | 339.55 | 399.90 | 460.37 | 520.98 | 581.76 | 642.71 | 39 |
| 40 | 40.00 | 100.01 | 160.06 | 220.15 | 280.31 | 340.56 | 400.91 | 461.38 | 521.99 | 582.77 | 643.73 | 40 |
| 41 | 41.00 | 101.01 | 161.06 | 221.15 | 281.31 | 341.56 | 401.91 | 462.39 | 523.01 | 583.79 | 644.75 | 41 |
| 42 | 42.00 | 102.01 | 162.06 | 222.15 | 282.32 | 342.57 | 402.92 | 463.40 | 524.02 | 584.80 | 645.76 | 42 |
| 43 | 43.00 | 103.02 | 163.06 | 223.16 | 283.32 | 343.57 | 403.93 | 464.41 | 525.03 | 585.81 | 646.78 | 43 |
| 44 | 44.00 | 104.02 | 164.06 | 224.16 | 284.32 | 344.58 | 404.93 | 465.41 | 526.04 | 586.83 | 647.80 | 44 |
| 45 | 45.00 | 105.02 | 165.06 | 225.16 | 285.33 | 345.58 | 405.94 | 466.42 | 527.05 | 587.84 | 648.82 | 45 |
| 46 | 46.00 | 106.02 | 166.06 | 226.16 | 286.33 | 346.59 | 406.95 | 467.43 | 528.06 | 588.86 | 649.84 | 46 |
| 47 | 47.00 | 107.02 | 167.07 | 227.16 | 287.33 | 347.59 | 407.95 | 468.44 | 529.08 | 589.87 | 650.85 | 47 |
| 48 | 48.00 | 108.02 | 168.07 | 228.17 | 288.34 | 348.60 | 408.96 | 469.45 | 530.09 | 590.89 | 651.87 | 48 |
| 49 | 49.00 | 109.02 | 169.07 | 229.17 | 289.34 | 349.60 | 409.97 | 470.46 | 531.10 | 591.90 | 652.89 | 49 |
| 50 | 50.00 | 110.02 | 170.07 | 230.17 | 290.34 | 350.61 | 410.97 | 471.47 | 532.11 | 592.92 | 653.91 | 50 |
| 51 | 51.00 | 111.02 | 171.07 | 231.17 | 291.35 | 351.61 | 411.98 | 472.48 | 533.12 | 593.93 | 654.93 | 51 |
| 52 | 52.00 | 112.02 | 172.07 | 232.18 | 292.35 | 352.62 | 412.99 | 473.49 | 534.14 | 594.95 | 655.94 | 52 |
| 53 | 53.00 | 113.02 | 173.07 | 233.18 | 293.35 | 353.62 | 414.00 | 474.50 | 535.15 | 595.96 | 656.96 | 53 |
| 54 | 54.00 | 114.02 | 174.07 | 234.18 | 294.36 | 354.63 | 415.00 | 475.51 | 536.16 | 596.98 | 657.98 | 54 |
| 55 | 55.00 | 115.02 | 175.07 | 235.18 | 295.36 | 355.63 | 416.01 | 476.52 | 537.17 | 597.99 | 659.00 | 55 |
| 56 | 56.00 | 116.02 | 176.08 | 236.18 | 296.37 | 356.64 | 417.02 | 477.53 | 538.18 | 599.01 | 660.02 | 56 |
| 57 | 57.00 | 117.02 | 177.08 | 237.19 | 297.37 | 357.64 | 418.03 | 478.54 | 539.29 | 600.02 | 661.04 | 57 |
| 58 | 58.00 | 118.02 | 178.08 | 238.19 | 298.37 | 358.65 | 419.03 | 479.55 | 540.21 | 601.04 | 662.05 | 58 |
| 59 | 59.00 | 119.02 | 179.08 | 239.19 | 299.38 | 359.65 | 420.04 | 480.56 | 541.22 | 602.05 | 663.07 | 59 |
| 60 | 60.00 | 120.02 | 180.08 | 240.19 | 300.38 | 360.66 | 421.05 | 481.57 | 542.23 | 603.07 | 664.09 | 60 |
| Lat. | 0° | 1° | 2° | 3° | 4° | 5° | 6° | 7° | 8° | 9° | 10° | |

Meridional Parts. (y)

| Lat. | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | 20° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 664.09 | 725.32 | 786.78 | 848.49 | 910.46 | 972.73 | 1035.30 | 1098.22 | 1161.49 | 1225.14 | 0′ |
| 1 | 665.11 | 726.34 | 787.81 | 849.52 | 911.50 | 973.77 | 1036.35 | 1099.27 | 1162.54 | 1226.20 | 1 |
| 2 | 666.13 | 727.37 | 788.83 | 850.55 | 912.53 | 974.81 | 1037.40 | 1100.32 | 1163.60 | 1227.27 | 2 |
| 3 | 667.15 | 728.39 | 789.86 | 851.58 | 913.57 | 975.85 | 1038.44 | 1101.37 | 1164.66 | 1228.33 | 3 |
| 4 | 668.17 | 729.41 | 790.89 | 852.61 | 914.60 | 976.89 | 1039.49 | 1102.42 | 1165.72 | 1229.40 | 4 |
| 5 | 669.19 | 730.43 | 791.91 | 853.64 | 915.64 | 977.93 | 1040.53 | 1103.47 | 1166.78 | 1230.46 | 5 |
| 6 | 670.21 | 731.46 | 792.94 | 854.67 | 916.67 | 978.97 | 1041.58 | 1104.53 | 1167.83 | 1231.53 | 6 |
| 7 | 671.22 | 732.48 | 793.97 | 855.70 | 917.71 | 980.01 | 1042.63 | 1105.58 | 1168.89 | 1232.59 | 7 |
| 8 | 672.24 | 733.50 | 794.99 | 856.73 | 918.75 | 981.05 | 1043.67 | 1106.63 | 1169.95 | 1233.66 | 8 |
| 9 | 673.26 | 734.53 | 796.02 | 857.76 | 919.78 | 982.09 | 1044.72 | 1107.68 | 1171.01 | 1234.72 | 9 |
| 10 | 674.28 | 735.55 | 797.04 | 858.80 | 920.82 | 983.13 | 1045.77 | 1108.74 | 1172.07 | 1235.79 | 10 |
| 11 | 675.30 | 736.57 | 798.07 | 859.83 | 921.85 | 984.17 | 1046.81 | 1109.79 | 1173.13 | 1236.85 | 11 |
| 12 | 676.32 | 737.59 | 799.10 | 860.86 | 922.89 | 985.22 | 1047.86 | 1110.84 | 1174.19 | 1237.92 | 12 |
| 13 | 677.34 | 738.62 | 800.13 | 861.89 | 923.93 | 986.26 | 1048.91 | 1111.89 | 1175.24 | 1238.98 | 13 |
| 14 | 678.36 | 739.64 | 801.15 | 862.92 | 924.96 | 987.30 | 1049.95 | 1112.95 | 1176.30 | 1240.05 | 14 |
| 15 | 679.38 | 740.66 | 802.18 | 863.95 | 926.00 | 988.34 | 1051.00 | 1114.00 | 1177.36 | 1241.11 | 15 |
| 16 | 680.40 | 741.69 | 803.21 | 864.98 | 927.03 | 989.38 | 1052.05 | 1115.05 | 1178.42 | 1242.18 | 16 |
| 17 | 681.42 | 742.71 | 804.24 | 866.02 | 928.07 | 990.42 | 1053.09 | 1116.11 | 1179.48 | 1243.25 | 17 |
| 18 | 682.44 | 743.73 | 805.26 | 867.05 | 929.11 | 991.47 | 1054.14 | 1117.16 | 1180.54 | 1244.31 | 18 |
| 19 | 683.46 | 744.76 | 806.29 | 868.08 | 930.15 | 992.51 | 1055.19 | 1118.21 | 1181.60 | 1245.38 | 19 |
| 20 | 684.48 | 745.78 | 807.32 | 869.11 | 931.18 | 993.55 | 1056.24 | 1119.27 | 1182.66 | 1246.44 | 20 |
| 21 | 685.50 | 746.81 | 808.35 | 870.14 | 932.22 | 994.59 | 1057.28 | 1120.32 | 1183.72 | 1247.51 | 21 |
| 22 | 686.52 | 747.83 | 809.37 | 871.18 | 933.26 | 995.63 | 1058.33 | 1121.37 | 1184.78 | 1248.58 | 22 |
| 23 | 687.54 | 748.85 | 810.40 | 872.21 | 934.29 | 996.68 | 1059.38 | 1122.43 | 1185.84 | 1249.64 | 23 |
| 24 | 688.56 | 749.88 | 811.43 | 873.24 | 935.33 | 997.72 | 1060.43 | 1123.48 | 1186.90 | 1250.71 | 24 |
| 25 | 689.58 | 750.90 | 812.46 | 874.27 | 936.37 | 998.76 | 1061.48 | 1124.53 | 1187.96 | 1251.78 | 25 |
| 26 | 690.60 | 751.92 | 813.49 | 875.31 | 937.40 | 999.80 | 1062.52 | 1125.59 | 1189.02 | 1252.85 | 26 |
| 27 | 691.62 | 752.95 | 814.52 | 876.34 | 938.44 | 1000.85 | 1063.57 | 1126.64 | 1190.08 | 1253.91 | 27 |
| 28 | 692.64 | 753.97 | 815.54 | 877.37 | 939.48 | 1001.89 | 1064.62 | 1127.70 | 1191.14 | 1254.98 | 28 |
| 29 | 693.66 | 755.00 | 816.57 | 878.40 | 940.52 | 1002.93 | 1065.67 | 1128.75 | 1192.20 | 1256.05 | 29 |
| 30 | 694.68 | 756.02 | 817.60 | 879.44 | 941.56 | 1003.97 | 1066.72 | 1129.81 | 1193.26 | 1257.12 | 30 |
| 31 | 695.70 | 757.05 | 818.63 | 880.47 | 942.59 | 1005.02 | 1067.77 | 1130.86 | 1194.32 | 1258.18 | 31 |
| 32 | 696.72 | 758.07 | 819.66 | 881.50 | 943.63 | 1006.06 | 1068.81 | 1131.92 | 1195.39 | 1259.25 | 32 |
| 33 | 697.74 | 759.09 | 820.69 | 882.54 | 944.67 | 1007.10 | 1069.86 | 1132.97 | 1196.45 | 1260.32 | 33 |
| 34 | 698.76 | 760.12 | 821.71 | 883.57 | 945.71 | 1008.15 | 1070.91 | 1134.03 | 1197.51 | 1261.39 | 34 |
| 35 | 699.78 | 761.14 | 822.74 | 884.60 | 946.74 | 1009.19 | 1071.96 | 1135.08 | 1198.57 | 1262.45 | 35 |
| 36 | 700.80 | 762.17 | 823.77 | 885.64 | 947.78 | 1010.23 | 1073.01 | 1136.14 | 1199.63 | 1263.52 | 36 |
| 37 | 701.82 | 763.19 | 824.80 | 886.67 | 948.82 | 1011.28 | 1074.06 | 1137.19 | 1200.69 | 1264.59 | 37 |
| 38 | 702.85 | 764.22 | 825.83 | 887.70 | 949.86 | 1012.32 | 1075.11 | 1138.25 | 1201.75 | 1265.66 | 38 |
| 39 | 703.87 | 765.24 | 826.86 | 888.74 | 950.90 | 1013.36 | 1076.16 | 1139.30 | 1202.82 | 1266.73 | 39 |
| 40 | 704.89 | 766.27 | 827.89 | 889.77 | 951.94 | 1014.41 | 1077.21 | 1140.36 | 1203.88 | 1267.80 | 40 |
| 41 | 705.91 | 767.29 | 828.92 | 890.80 | 952.98 | 1015.45 | 1078.26 | 1141.41 | 1204.94 | 1268.87 | 41 |
| 42 | 706.93 | 768.32 | 829.95 | 891.84 | 954.01 | 1016.50 | 1079.31 | 1142.47 | 1206.00 | 1269.93 | 42 |
| 43 | 707.95 | 769.34 | 830.98 | 892.87 | 955.05 | 1017.54 | 1080.36 | 1143.52 | 1207.06 | 1271.00 | 43 |
| 44 | 708.97 | 770.37 | 832.00 | 893.91 | 956.09 | 1018.58 | 1081.41 | 1144.58 | 1208.13 | 1272.07 | 44 |
| 45 | 709.99 | 771.39 | 833.03 | 894.94 | 957.13 | 1019.63 | 1082.46 | 1145.64 | 1209.19 | 1273.14 | 45 |
| 46 | 711.02 | 772.42 | 834.06 | 895.97 | 958.17 | 1020.67 | 1083.51 | 1146.69 | 1210.25 | 1274.21 | 46 |
| 47 | 712.04 | 773.44 | 835.09 | 897.01 | 959.21 | 1021.72 | 1084.56 | 1147.75 | 1211.31 | 1275.28 | 47 |
| 48 | 713.06 | 774.47 | 836.12 | 898.04 | 960.25 | 1022.76 | 1085.61 | 1148.80 | 1212.38 | 1276.35 | 48 |
| 49 | 714.08 | 775.49 | 837.15 | 899.08 | 961.29 | 1023.81 | 1086.66 | 1149.86 | 1213.44 | 1277.42 | 49 |
| 50 | 715.10 | 776.52 | 838.18 | 900.11 | 962.33 | 1024.85 | 1087.71 | 1150.92 | 1214.50 | 1278.49 | 50 |
| 51 | 716.12 | 777.54 | 839.21 | 901.15 | 963.37 | 1025.90 | 1088.76 | 1151.97 | 1215.57 | 1279.56 | 51 |
| 52 | 717.15 | 778.57 | 840.24 | 902.18 | 964.41 | 1026.94 | 1089.81 | 1153.03 | 1216.63 | 1280.63 | 52 |
| 53 | 718.17 | 779.59 | 841.27 | 903.22 | 965.45 | 1027.99 | 1090.86 | 1154.09 | 1217.69 | 1281.70 | 53 |
| 54 | 719.19 | 780.62 | 842.30 | 904.25 | 966.49 | 1029.03 | 1091.91 | 1155.14 | 1218.76 | 1282.77 | 54 |
| 55 | 720.21 | 781.65 | 843.33 | 905.28 | 967.53 | 1030.08 | 1092.96 | 1156.20 | 1219.82 | 1283.84 | 55 |
| 56 | 721.23 | 782.67 | 844.36 | 906.32 | 968.57 | 1031.12 | 1094.01 | 1157.26 | 1220.88 | 1284.91 | 56 |
| 57 | 722.26 | 783.70 | 845.39 | 907.35 | 969.61 | 1032.17 | 1095.06 | 1158.32 | 1221.95 | 1285.98 | 57 |
| 58 | 723.28 | 784.73 | 846.42 | 908.39 | 970.65 | 1033.21 | 1096.11 | 1159.37 | 1223.01 | 1287.05 | 58 |
| 59 | 724.30 | 785.75 | 847.45 | 909.43 | 971.69 | 1034.26 | 1097.16 | 1160.43 | 1224.07 | 1288.13 | 59 |
| 60 | 725.32 | 786.78 | 848.49 | 910.46 | 972.73 | 1035.30 | 1098.22 | 1161.49 | 1225.14 | 1289.20 | 60 |
| at. | 11° | 12° | 13° | 14° | 15° | 16° | 17° | 18° | 19° | 20° | |

Meridional Parts. (y)

| Lat. | 21° | 22° | 23° | 24° | 25° | 26° | 27° | 28° | 29° | 30° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 1289.20 | 1353.69 | 1418.63 | 1484.06 | 1549.99 | 1616.47 | 1683.52 | 1751.16 | 1819.44 | 1888.38 | 0′ |
| 1 | 1290.27 | 1354.76 | 1419.72 | 1485.15 | 1551.10 | 1617.58 | 1684.64 | 1752.29 | 1820.58 | 1889.53 | 1 |
| 2 | 1291.34 | 1355.84 | 1420.80 | 1486.25 | 1552.20 | 1618.70 | 1685.76 | 1753.43 | 1821.72 | 1890.69 | 2 |
| 3 | 1292.41 | 1356.92 | 1421.89 | 1487.34 | 1553.31 | 1619.81 | 1686.88 | 1754.56 | 1822.87 | 1891.84 | 3 |
| 4 | 1293.48 | 1358.00 | 1422.98 | 1488.44 | 1554.41 | 1620.92 | 1688.01 | 1755.69 | 1824.01 | 1893.00 | 4 |
| 5 | 1294.55 | 1359.08 | 1424.06 | 1489.53 | 1555.51 | 1622.04 | 1689.13 | 1756.83 | 1825.16 | 1894.15 | 5 |
| 6 | 1295.63 | 1360.16 | 1425.15 | 1490.63 | 1556.62 | 1623.15 | 1690.25 | 1757.96 | 1826.30 | 1895.31 | 6 |
| 7 | 1296.70 | 1361.24 | 1426.24 | 1491.72 | 1557.72 | 1624.26 | 1691.38 | 1759.09 | 1827.44 | 1896.46 | 7 |
| 8 | 1297.77 | 1362.32 | 1427.32 | 1492.82 | 1558.83 | 1625.38 | 1692.50 | 1760.23 | 1828.59 | 1897.62 | 8 |
| 9 | 1298.84 | 1363.40 | 1428.41 | 1493.91 | 1559.93 | 1626.49 | 1693.62 | 1761.36 | 1829.73 | 1898.78 | 9 |
| 10 | 1299.91 | 1364.48 | 1429.50 | 1495.01 | 1561.04 | 1627.61 | 1694.75 | 1762.50 | 1830.88 | 1899.93 | 10 |
| 11 | 1300.99 | 1365.56 | 1430.59 | 1496.11 | 1562.14 | 1628.72 | 1695.87 | 1763.63 | 1832.02 | 1901.09 | 11 |
| 12 | 1302.06 | 1366.64 | 1431.68 | 1497.20 | 1563.25 | 1629.84 | 1697.00 | 1764.77 | 1833.17 | 1902.25 | 12 |
| 13 | 1303.13 | 1367.72 | 1432.76 | 1498.30 | 1564.35 | 1630.95 | 1698.12 | 1765.90 | 1834.32 | 1903.40 | 13 |
| 14 | 1304.20 | 1368.80 | 1433.85 | 1499.40 | 1565.46 | 1632.06 | 1699.25 | 1767.04 | 1835.46 | 1904.56 | 14 |
| 15 | 1305.28 | 1369.88 | 1434.94 | 1500.49 | 1566.56 | 1633.18 | 1700.37 | 1768.17 | 1836.61 | 1905.72 | 15 |
| 16 | 1306.35 | 1370.96 | 1436.03 | 1501.59 | 1567.67 | 1634.29 | 1701.50 | 1769.31 | 1837.75 | 1906.88 | 16 |
| 17 | 1307.42 | 1372.04 | 1437.12 | 1502.69 | 1568.77 | 1635.41 | 1702.62 | 1770.44 | 1838.90 | 1908.03 | 17 |
| 18 | 1308.50 | 1373.12 | 1438.21 | 1503.78 | 1569.88 | 1636.52 | 1703.75 | 1771.58 | 1840.05 | 1909.19 | 18 |
| 19 | 1309.57 | 1374.20 | 1439.29 | 1504.88 | 1570.99 | 1637.64 | 1704.87 | 1772.71 | 1841.19 | 1910.35 | 19 |
| 20 | 1310.64 | 1375.28 | 1440.38 | 1505.98 | 1572.09 | 1638.76 | 1706.00 | 1773.85 | 1842.34 | 1911.51 | 20 |
| 21 | 1311.72 | 1376.36 | 1441.47 | 1507.08 | 1573.20 | 1639.87 | 1707.12 | 1774.98 | 1843.49 | 1912.67 | 21 |
| 22 | 1312.79 | 1377.44 | 1442.56 | 1508.17 | 1574.31 | 1640.99 | 1708.25 | 1776.12 | 1844.64 | 1913.83 | 22 |
| 23 | 1313.86 | 1378.52 | 1443.65 | 1509.27 | 1575.41 | 1642.10 | 1709.37 | 1777.26 | 1845.78 | 1914.98 | 23 |
| 24 | 1314.94 | 1379.61 | 1444.74 | 1510.37 | 1576.52 | 1643.22 | 1710.50 | 1778.39 | 1846.93 | 1916.14 | 24 |
| 25 | 1316.01 | 1380.69 | 1445.83 | 1511.47 | 1577.63 | 1644.34 | 1711.63 | 1779.53 | 1848.08 | 1917.30 | 25 |
| 26 | 1317.08 | 1381.77 | 1446.92 | 1512.57 | 1578.73 | 1645.45 | 1712.75 | 1780.67 | 1849.23 | 1918.46 | 26 |
| 27 | 1318.16 | 1382.85 | 1448.01 | 1513.67 | 1579.84 | 1646.57 | 1713.88 | 1781.81 | 1850.37 | 1919.62 | 27 |
| 28 | 1319.23 | 1383.93 | 1449.10 | 1514.76 | 1580.95 | 1647.69 | 1715.01 | 1782.94 | 1851.52 | 1920.78 | 28 |
| 29 | 1320.31 | 1385.02 | 1450.19 | 1515.86 | 1582.06 | 1648.80 | 1716.14 | 1784.08 | 1852.67 | 1921.94 | 29 |
| 30 | 1321.38 | 1386.10 | 1451.28 | 1516.96 | 1583.17 | 1649.92 | 1717.26 | 1785.22 | 1853.82 | 1923.10 | 30 |
| 31 | 1322.45 | 1387.18 | 1452.37 | 1518.06 | 1584.27 | 1651.04 | 1718.39 | 1786.36 | 1854.97 | 1924.26 | 31 |
| 32 | 1323.53 | 1388.26 | 1453.46 | 1519.16 | 1585.38 | 1652.16 | 1719.52 | 1787.50 | 1856.12 | 1925.43 | 32 |
| 33 | 1324.60 | 1389.35 | 1454.55 | 1520.26 | 1586.49 | 1653.27 | 1720.65 | 1788.63 | 1857.27 | 1926.59 | 33 |
| 34 | 1325.68 | 1390.43 | 1455.64 | 1521.36 | 1587.60 | 1654.39 | 1721.77 | 1789.77 | 1858.42 | 1927.75 | 34 |
| 35 | 1326.75 | 1391.51 | 1456.73 | 1522.46 | 1588.71 | 1655.51 | 1722.90 | 1790.91 | 1859.57 | 1928.91 | 35 |
| 36 | 1327.83 | 1392.59 | 1457.83 | 1523.56 | 1589.82 | 1656.63 | 1724.03 | 1792.05 | 1860.72 | 1930.07 | 36 |
| 37 | 1328.90 | 1393.68 | 1458.92 | 1524.66 | 1590.92 | 1657.75 | 1725.16 | 1793.19 | 1861.87 | 1931.23 | 37 |
| 38 | 1329.98 | 1394.76 | 1460.01 | 1525.76 | 1592.03 | 1658.87 | 1726.29 | 1794.33 | 1863.02 | 1932.40 | 38 |
| 39 | 1331.06 | 1395.84 | 1461.10 | 1526.86 | 1593.14 | 1659.98 | 1727.42 | 1795.47 | 1864.17 | 1933.56 | 39 |
| 40 | 1332.13 | 1396.93 | 1462.19 | 1527.96 | 1594.25 | 1661.10 | 1728.54 | 1796.61 | 1865.32 | 1934.72 | 40 |
| 41 | 1333.21 | 1398.01 | 1463.28 | 1529.06 | 1595.36 | 1662.22 | 1729.67 | 1797.75 | 1866.47 | 1935.88 | 41 |
| 42 | 1334.29 | 1399.10 | 1464.38 | 1530.16 | 1596.47 | 1663.34 | 1730.80 | 1798.89 | 1867.62 | 1937.05 | 42 |
| 43 | 1335.37 | 1400.18 | 1465.47 | 1531.26 | 1597.56 | 1664.46 | 1731.93 | 1800.03 | 1868.77 | 1938.21 | 43 |
| 44 | 1336.44 | 1401.26 | 1466.56 | 1532.36 | 1598.69 | 1665.58 | 1733.06 | 1801.17 | 1869.92 | 1939.37 | 44 |
| 45 | 1337.52 | 1402.35 | 1467.65 | 1533.46 | 1599.80 | 1666.70 | 1734.19 | 1802.31 | 1871.08 | 1940.54 | 45 |
| 46 | 1338.60 | 1403.43 | 1468.75 | 1534.56 | 1600.91 | 1667.82 | 1735.32 | 1803.45 | 1872.23 | 1941.70 | 46 |
| 47 | 1339.67 | 1404.52 | 1469.84 | 1535.66 | 1602.02 | 1668.94 | 1736.45 | 1804.59 | 1873.38 | 1942.86 | 47 |
| 48 | 1340.75 | 1405.60 | 1470.93 | 1536.77 | 1603.13 | 1670.06 | 1737.58 | 1805.73 | 1874.53 | 1944.03 | 48 |
| 49 | 1341.83 | 1406.69 | 1472.02 | 1537.87 | 1604.24 | 1671.18 | 1738.71 | 1806.87 | 1875.69 | 1945.19 | 49 |
| 50 | 1342.91 | 1407.77 | 1473.12 | 1538.97 | 1605.35 | 1672.30 | 1739.84 | 1808.01 | 1876.84 | 1946.36 | 50 |
| 51 | 1343.98 | 1408.86 | 1474.21 | 1540.07 | 1606.46 | 1673.42 | 1740.98 | 1809.15 | 1877.99 | 1947.52 | 51 |
| 52 | 1345.06 | 1409.94 | 1475.30 | 1541.17 | 1607.58 | 1674.54 | 1742.11 | 1810.30 | 1879.14 | 1948.69 | 52 |
| 53 | 1346.14 | 1411.03 | 1476.40 | 1542.27 | 1608.69 | 1675.66 | 1743.24 | 1811.44 | 1880.30 | 1949.85 | 53 |
| 54 | 1347.22 | 1412.11 | 1477.49 | 1543.38 | 1609.80 | 1676.79 | 1744.37 | 1812.58 | 1881.45 | 1951.02 | 54 |
| 55 | 1348.29 | 1413.20 | 1478.59 | 1544.48 | 1610.91 | 1677.91 | 1745.50 | 1813.72 | 1882.60 | 1952.18 | 55 |
| 56 | 1349.37 | 1414.28 | 1479.68 | 1545.58 | 1612.02 | 1679.03 | 1746.63 | 1814.86 | 1883.76 | 1953.35 | 56 |
| 57 | 1350.45 | 1415.37 | 1480.77 | 1546.69 | 1613.13 | 1680.15 | 1747.76 | 1816.01 | 1884.91 | 1954.51 | 57 |
| 58 | 1351.53 | 1416.46 | 1481.87 | 1547.79 | 1614.25 | 1681.27 | 1748.90 | 1817.15 | 1886.07 | 1955.68 | 58 |
| 59 | 1352.61 | 1417.54 | 1482.96 | 1548.89 | 1615.36 | 1682.39 | 1750.03 | 1818.29 | 1887.22 | 1956.85 | 59 |
| 60 | 1353.69 | 1418.63 | 1484.06 | 1549.99 | 1616.47 | 1683.52 | 1751.16 | 1819.44 | 1888.38 | 1958.01 | 60 |
| Lat. | 21° | 22° | 23° | 24° | 25° | 26° | 27° | 28° | 29° | 30° | |

## Meridional Parts. (y)

| Lat. | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | 39° | 40° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 1958.01 | 2028.38 | 2099.53 | 2171.48 | 2244.29 | 2317.99 | 2392.63 | 2468.26 | 2544.93 | 2622.69 | 0′ |
| 1 | 1959.18 | 2029.56 | 2100.72 | 2172.69 | 2245.51 | 2319.2 | 2393.88 | 2469.53 | 2546.22 | 2624.00 | 1 |
| 2 | 1960.35 | 2030.74 | 2101.91 | 2173.89 | 2246.73 | 2320.46 | 2395.14 | 2470.80 | 2547.50 | 2625.30 | 2 |
| 3 | 1961.51 | 2031.92 | 2103.10 | 2175.10 | 2247.95 | 2321.70 | 2396.39 | 2472.07 | 2548.79 | 2626.61 | 3 |
| 4 | 1962.68 | 2033.10 | 2104.30 | 2176.31 | 2249.17 | 2322.93 | 2397.64 | 2473 34 | 2550.08 | 2627.91 | 4 |
| 5 | 1963.85 | 2034.28 | 2105.49 | 2177.51 | 2250.39 | 2324.17 | 2398.90 | 2474.61 | 2551.37 | 2629.22 | 5 |
| 6 | 1965.02 | 2035.46 | 2106.68 | 2178.72 | 2251.62 | 2325.41 | 2400.15 | 2475.88 | 2552.66 | 2630.53 | 6 |
| 7 | 1966.18 | 2036.64 | 2107.88 | 2179.93 | 2252.84 | 2326.65 | 2401.40 | 2477.15 | 2553.95 | 2631.84 | 7 |
| 8 | 1967.35 | 2037.82 | 2109.07 | 2181.14 | 2254.06 | 2327.89 | 2402.66 | 2478.42 | 2555.23 | 2633.14 | 8 |
| 9 | 1968.52 | 2039.00 | 2110.27 | 2182.36 | 2255.28 | 2329.12 | 2403.91 | 2479.69 | 2556 52 | 2634.45 | 9 |
| 10 | 1969.69 | 2040.19 | 2111.46 | 2183.55 | 2256.51 | 2330.36 | 2405.17 | 2480.97 | 2557.81 | 2635.76 | 10 |
| 11 | 1970.86 | 2041.37 | 2112.66 | 2184.76 | 2257.73 | 2331.60 | 2406.42 | 2482.24 | 2559.10 | 2637.07 | 11 |
| 12 | 1972.03 | 2042.55 | 2113.85 | 2185.97 | 2258.95 | 2332.84 | 2407.68 | 2483.51 | 2560.39 | 2638.38 | 12 |
| 13 | 1973.20 | 2043.73 | 2115.05 | 2187.18 | 2260.18 | 2334.08 | 2408.93 | 2484.78 | 2561.68 | 2639.69 | 13 |
| 14 | 1974.37 | 2044.91 | 2116.24 | 2188.39 | 2261.40 | 2335.32 | 2410.19 | 2486.06 | 2562.97 | 2641.00 | 14 |
| 15 | 1975.54 | 2046.10 | 2117.44 | 2189.60 | 2262.63 | 2336.56 | 2411.44 | 2487.33 | 2564.27 | 2642.31 | 15 |
| 16 | 1976.71 | 2047.28 | 2118.63 | 2190.81 | 2263.85 | 2337.80 | 2412.70 | 2488.60 | 2565.56 | 2643.62 | 16 |
| 17 | 1977.88 | 2048.46 | 2119.83 | 2192.02 | 2265.08 | 2339.04 | 2413.96 | 2489.88 | 2566.85 | 2644.93 | 17 |
| 18 | 1979.05 | 2049.64 | 2121.03 | 2193.23 | 2266.30 | 2340.28 | 2415.21 | 2491.15 | 2568.14 | 2646.24 | 18 |
| 19 | 1980.22 | 2050.83 | 2122.22 | 2194.44 | 2267.53 | 2341.52 | 2416.47 | 2492.43 | 2569.43 | 2647.55 | 19 |
| 20 | 1981.39 | 2052.01 | 2123.42 | 2195.65 | 2268.75 | 2342.76 | 2417.73 | 2493.70 | 2570.73 | 2648.86 | 20 |
| 21 | 1982.56 | 2053.19 | 2124.62 | 2196.86 | 2269.98 | 2344.00 | 2418.99 | 2494.97 | 2572.02 | 2650.17 | 21 |
| 22 | 1983.73 | 2054.38 | 2125.81 | 2198.07 | 2271.20 | 2345.25 | 2420.24 | 2496.25 | 2573.31 | 2651.49 | 22 |
| 23 | 1984.90 | 2055.56 | 2127.01 | 2199.29 | 2272.43 | 2346.49 | 2421.50 | 2497.52 | 2574.61 | 2652.80 | 23 |
| 24 | 1986.07 | 2056.75 | 2128.21 | 2200.50 | 2273.66 | 2347.73 | 2422.76 | 2498.80 | 2575.90 | 2654.11 | 24 |
| 25 | 1987.24 | 2057.93 | 2129.41 | 2201.71 | 2274.88 | 2348.97 | 2424.02 | 2500.08 | 2577.19 | 2655.43 | 25 |
| 26 | 1988.41 | 2059.11 | 2130.61 | 2202.92 | 2276.11 | 2350.21 | 2425.28 | 2501.35 | 2578.49 | 2656.74 | 26 |
| 27 | 1989.59 | 2060.30 | 2131.80 | 2204.14 | 2277.34 | 2351.46 | 2426.54 | 2502.63 | 2579.78 | 2658.05 | 27 |
| 28 | 1990.76 | 2061.49 | 2133.00 | 2205.35 | 2278.57 | 2352.70 | 2427.80 | 2503.91 | 2581.08 | 2659 37 | 28 |
| 29 | 1991.93 | 2062.67 | 2134.20 | 2206.56 | 2279.79 | 2353.95 | 2429.06 | 2505.18 | 2582.37 | 2660.68 | 29 |
| 30 | 1993.10 | 2063.86 | 2135.40 | 2207.78 | 2281.02 | 2355.19 | 2430.32 | 2506.46 | 2583.67 | 2662.00 | 30 |
| 31 | 1994.28 | 2065.04 | 2136.60 | 2208.99 | 2282.25 | 2356.43 | 2431.58 | 2507.74 | 2584.97 | 2663.31 | 31 |
| 32 | 1995.45 | 2066.23 | 2137.80 | 2210.20 | 2283.48 | 2357.68 | 2432.84 | 2509.02 | 2586.26 | 2664.63 | 32 |
| 33 | 1996.62 | 2067.41 | 2139.00 | 2211.42 | 2284.71 | 2358.92 | 2434.10 | 2510.30 | 2587.56 | 2665.94 | 33 |
| 34 | 1997.80 | 2068.60 | 2140.20 | 2212.63 | 2285.94 | 2360.17 | 2435.36 | 2511.58 | 2588.86 | 2667.26 | 34 |
| 35 | 1998.97 | 2069.79 | 2141.40 | 2213.84 | 2287.17 | 2361.41 | 2436.62 | 2512.86 | 2590.15 | 2668.58 | 35 |
| 36 | 2000.14 | 2070.97 | 2142.60 | 2215.06 | 2288.40 | 2362.66 | 2437.89 | 2514.14 | 2591.45 | 2669.89 | 36 |
| 37 | 2001.32 | 2072.16 | 2143.80 | 2216.27 | 2289.63 | 2363.90 | 2439.15 | 2515.41 | 2592.75 | 2671.21 | 37 |
| 38 | 2002.49 | 2073.35 | 2145.00 | 2217.49 | 2290.86 | 2365.15 | 2440.41 | 2516.69 | 2594.05 | 2672.53 | 38 |
| 39 | 2003.67 | 2074.54 | 2146.20 | 2218.70 | 2292.09 | 2366.40 | 2441.68 | 2517.97 | 2595.35 | 2673.85 | 39 |
| 40 | 2004.84 | 2075.72 | 2147.40 | 2219.92 | 2293.32 | 2367.64 | 2442.94 | 2519.25 | 2596.65 | 2675.16 | 40 |
| 41 | 2006.02 | 2076.91 | 2148.61 | 2221.14 | 2294.55 | 2368.89 | 2444.20 | 2520.54 | 2597.95 | 2676.48 | 41 |
| 42 | 2007.19 | 2078.10 | 2149.81 | 2222.35 | 2295.78 | 2370.14 | 2445.47 | 2521.82 | 2599.24 | 2677.80 | 42 |
| 43 | 2008.37 | 2079.29 | 2151.01 | 2223.57 | 2297.01 | 2371.38 | 2446.73 | 2523.10 | 2600.54 | 2679.12 | 43 |
| 44 | 2009.54 | 2080.48 | 2152.21 | 2224.79 | 2298.24 | 2372.63 | 2447.99 | 2524.38 | 2601.84 | 2680.44 | 44 |
| 45 | 2010.72 | 2081.67 | 2153.41 | 2226.00 | 2299.48 | 2373.88 | 2449.26 | 2525.66 | 2603.14 | 2681.76 | 45 |
| 46 | 2011.90 | 2082.86 | 2154.62 | 2227.22 | 2300.71 | 2375.13 | 2450.52 | 2526.95 | 2604.45 | 2683.08 | 46 |
| 47 | 2013.07 | 2084.04 | 2155.82 | 2228.44 | 2301.94 | 2376.38 | 2451.79 | 2528.23 | 2605.75 | 2684.40 | 47 |
| 48 | 2014.25 | 2085.23 | 2157.02 | 2229.66 | 2303.17 | 2377.63 | 2453.05 | 2529.51 | 2607.05 | 2685.72 | 48 |
| 49 | 2015.43 | 2086.42 | 2158.23 | 2230.87 | 2304.41 | 2378.87 | 2454.32 | 2530.79 | 2608.35 | 2687.04 | 49 |
| 50 | 2016.60 | 2087.61 | 2159.43 | 2232.09 | 2305.64 | 2380.12 | 2455.58 | 2532.08 | 2609.65 | 2688.36 | 50 |
| 51 | 2017.78 | 2088.80 | 2160.63 | 2233.31 | 2306.88 | 2381.37 | 2456.85 | 2533.36 | 2610.95 | 2689.69 | 51 |
| 52 | 2018.96 | 2089.99 | 2161.84 | 2234.53 | 2308.11 | 2382.62 | 2458.12 | 2534.65 | 2612.26 | 2691.01 | 52 |
| 53 | 2020.13 | 2091.19 | 2163.04 | 2235.75 | 2309.34 | 2383.87 | 2459.39 | 2535.93 | 2613.56 | 2692.33 | 53 |
| 54 | 2021.31 | 2092.38 | 2164.25 | 2236.97 | 2310.58 | 2385.12 | 2460.65 | 2537.22 | 2614.86 | 2693.65 | 54 |
| 55 | 2022.49 | 2093.57 | 2165.45 | 2238.19 | 2311.81 | 2386.37 | 2461.92 | 2538.50 | 2616.17 | 2694.98 | 55 |
| 56 | 2023.67 | 2094.76 | 2166.66 | 2239.41 | 2313.05 | 2387.62 | 2463.19 | 2539.79 | 2617.47 | 2696 30 | 56 |
| 57 | 2024.85 | 2095 95 | 2167.86 | 2240.63 | 2314.28 | 2388.88 | 2464.46 | 2541.07 | 2618.78 | 2697.63 | 57 |
| 58 | 2026.03 | 2097.14 | 2169.07 | 2241.85 | 2315.52 | 2390.13 | 2465.72 | 2542.36 | 2620.08 | 2698 95 | 58 |
| 59 | 2027.20 | 2098.33 | 2170.28 | 2243.07 | 2316.75 | 2391.38 | 2466.99 | 2543.64 | 2621.38 | 2700.27 | 59 |
| 60 | 2028.38 | 2099.53 | 2171.48 | 2244.29 | 2317.99 | 2392.63 | 2468.26 | 2544.93 | 2622.69 | 2701.60 | 60 |
| Lat. | 31° | 32° | 33° | 34° | 35° | 36° | 37° | 38° | 39° | 40° | |

## Meridional Parts. (y)

| Lat. | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | 50° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 2701.60 | 2781.71 | 2863.10 | 2945.81 | 3029.94 | 3115.55 | 3202.71 | 3291.53 | 3382.08 | 3474.47 | 0′ |
| 1 | 2702.92 | 2783.06 | 2864.46 | 2947.21 | 3031.35 | 3116.99 | 3204.18 | 3293.02 | 3383.61 | 3476.03 | 1 |
| 2 | 2704.25 | 2784.40 | 2865.83 | 2948.60 | 3032.77 | 3118.43 | 3205.65 | 3294.52 | 3385.13 | 3477.59 | 2 |
| 3 | 2705.57 | 2785.75 | 2867.20 | 2949.99 | 3034.18 | 3119.87 | 3207.12 | 3296.01 | 3386.66 | 3479.14 | 3 |
| 4 | 2706.90 | 2787.09 | 2868.57 | 2951.38 | 3035.60 | 3121.31 | 3208.58 | 3297.51 | 3388.18 | 3480.70 | 4 |
| 5 | 2708.23 | 2788.44 | 2869.94 | 2952.77 | 3037.02 | 3122.75 | 3210.05 | 3299.01 | 3389.71 | 3482.26 | 5 |
| 6 | 2709.55 | 2789.79 | 2871.31 | 2954.16 | 3038.43 | 3124.19 | 3211.52 | 3300.51 | 3391.24 | 3483.82 | 6 |
| 7 | 2710.88 | 2791.14 | 2872.68 | 2955.56 | 3039.85 | 3125.63 | 3212.99 | 3302.00 | 3392.77 | 3485.38 | 7 |
| 8 | 2712.21 | 2792.49 | 2874.05 | 2956.95 | 3041.27 | 3127.08 | 3214.46 | 3303.50 | 3394.29 | 3486.94 | 8 |
| 9 | 2713.54 | 2793.84 | 2875.42 | 2958.34 | 3042.68 | 3128.52 | 3215.93 | 3305.00 | 3395.82 | 3488.50 | 9 |
| 10 | 2714.86 | 2795.19 | 2876.79 | 2959.74 | 3044.10 | 3129.96 | 3217.40 | 3306.50 | 3397.35 | 3490.06 | 10 |
| 11 | 2716.19 | 2796.54 | 2878.16 | 2961.13 | 3045.52 | 3131.41 | 3218.87 | 3308.00 | 3398.88 | 3491.62 | 11 |
| 12 | 2717.52 | 2797.89 | 2879.53 | 2962.53 | 3046.94 | 3132.85 | 3220.34 | 3309.50 | 3400.41 | 3493.18 | 12 |
| 13 | 2718.85 | 2799.24 | 2880.90 | 2963.92 | 3048.36 | 3134.30 | 3221.82 | 3311.00 | 3401.94 | 3494.74 | 13 |
| 14 | 2720.18 | 2800.59 | 2882.28 | 2965.32 | 3049.78 | 3135.75 | 3223.29 | 3312.50 | 3403.47 | 3496.31 | 14 |
| 15 | 2721.51 | 2801.94 | 2883.65 | 2966.71 | 3051.20 | 3137.19 | 3224.76 | 3314.00 | 3405.00 | 3497.87 | 15 |
| 16 | 2722.84 | 2803.29 | 2885.02 | 2968.11 | 3052.62 | 3138.64 | 3226.23 | 3315.50 | 3406.54 | 3499.43 | 16 |
| 17 | 2724.17 | 2804.64 | 2886.39 | 2969.50 | 3054.04 | 3140.08 | 3227.71 | 3317.00 | 3408.07 | 3501.00 | 17 |
| 18 | 2725.50 | 2805.99 | 2887.77 | 2970.90 | 3055.46 | 3141.53 | 3229.18 | 3318.51 | 3409.60 | 3502.56 | 18 |
| 19 | 2726.83 | 2807.34 | 2889.14 | 2972.30 | 3056.88 | 3142.98 | 3230.66 | 3320.01 | 3411.14 | 3504.13 | 19 |
| 20 | 2728.17 | 2808.70 | 2890.52 | 2973.70 | 3058.31 | 3144.42 | 3232.13 | 3321.52 | 3412.67 | 3505.70 | 20 |
| 21 | 2729.50 | 2810.05 | 2891.89 | 2975.09 | 3059.73 | 3145.87 | 3233.61 | 3323.02 | 3414.20 | 3507.26 | 21 |
| 22 | 2730.83 | 2811.40 | 2893.27 | 2976.49 | 3061.15 | 3147.32 | 3235.08 | 3324.53 | 3415.74 | 3508.83 | 22 |
| 23 | 2732.16 | 2812.76 | 2894.64 | 2977.89 | 3062.58 | 3148.77 | 3236.56 | 3326.03 | 3417.28 | 3510.40 | 23 |
| 24 | 2733.50 | 2814.11 | 2896.02 | 2979.29 | 3064.00 | 3150.22 | 3238.04 | 3327.54 | 3418.81 | 3511.97 | 24 |
| 25 | 2734.83 | 2815.46 | 2897.40 | 2980.69 | 3065.42 | 3151.67 | 3239.52 | 3329.04 | 3420.35 | 3513.54 | 25 |
| 26 | 2736.16 | 2816.82 | 2898.77 | 2982.09 | 3066.85 | 3153.12 | 3240.99 | 3330.55 | 3421.89 | 3515.11 | 26 |
| 27 | 2737.50 | 2818.17 | 2900.15 | 2983.49 | 3068.27 | 3154.57 | 3242.47 | 3332.06 | 3423.43 | 3516.68 | 27 |
| 28 | 2738.83 | 2819.53 | 2901.53 | 2984.89 | 3069.70 | 3156.03 | 3243.95 | 3333.56 | 3424.96 | 3518.25 | 28 |
| 29 | 2740.17 | 2820.88 | 2902.91 | 2986.29 | 3071.13 | 3157.48 | 3245.43 | 3335.07 | 3426.50 | 3519.82 | 29 |
| 30 | 2741.50 | 2822.24 | 2904.28 | 2987.70 | 3072.55 | 3158.93 | 3246.91 | 3336.58 | 3428.04 | 3521.39 | 30 |
| 31 | 2742.84 | 2823.60 | 2905.66 | 2989.10 | 3073.98 | 3160.38 | 3248.39 | 3338.09 | 3429.58 | 3522.96 | 31 |
| 32 | 2744.17 | 2824.95 | 2907.04 | 2990.50 | 3075.41 | 3161.84 | 3249.87 | 3339.60 | 3431.12 | 3524.54 | 32 |
| 33 | 2745.51 | 2826.31 | 2908.42 | 2991.90 | 3076.84 | 3163.29 | 3251.35 | 3341.11 | 3432.66 | 3526.11 | 33 |
| 34 | 2746.84 | 2827.67 | 2909.80 | 2993.31 | 3078.26 | 3164.74 | 3252.84 | 3342.62 | 3434.20 | 3527.68 | 34 |
| 35 | 2748.18 | 2829.03 | 2911.18 | 2994.71 | 3079.69 | 3166.20 | 3254.32 | 3344.14 | 3435.75 | 3529.26 | 35 |
| 36 | 2749.52 | 2830.39 | 2912.56 | 2996.12 | 3081.12 | 3167.65 | 3255.80 | 3345.65 | 3437.29 | 3530.83 | 36 |
| 37 | 2750.85 | 2831.74 | 2913.94 | 2997.52 | 3082.55 | 3169.11 | 3257.28 | 3347.16 | 3438.83 | 3532.41 | 37 |
| 38 | 2752.19 | 2833.10 | 2915.32 | 2998.93 | 3083.98 | 3170.57 | 3258.77 | 3348.67 | 3440.38 | 3533.99 | 38 |
| 39 | 2753.53 | 2834.46 | 2916.71 | 3000.33 | 3085.41 | 3172.02 | 3260.25 | 3350.19 | 3441.92 | 3535.56 | 39 |
| 40 | 2754.87 | 2835.82 | 2918.09 | 3001.74 | 3086.84 | 3173.48 | 3261.74 | 3351.70 | 3443.47 | 3537.14 | 40 |
| 41 | 2756.21 | 2837.18 | 2919.47 | 3003.14 | 3088.27 | 3174.94 | 3263.22 | 3353.21 | 3445.01 | 3538.72 | 41 |
| 42 | 2757.55 | 2838.54 | 2920.85 | 3004.55 | 3089.70 | 3176.40 | 3264.71 | 3354.73 | 3446.56 | 3540.30 | 42 |
| 43 | 2758.89 | 2839.90 | 2922.24 | 3005.96 | 3091.14 | 3177.85 | 3266.19 | 3356.24 | 3448.10 | 3541.88 | 43 |
| 44 | 2760.23 | 2841.27 | 2923.62 | 3007.36 | 3092.57 | 3179.31 | 3267.68 | 3357.76 | 3449.65 | 3543.45 | 44 |
| 45 | 2761.57 | 2842.63 | 2925.01 | 3008.77 | 3094.00 | 3180.77 | 3269.17 | 3359.28 | 3451.20 | 3545.04 | 45 |
| 46 | 2762.91 | 2843.99 | 2926.39 | 3010.18 | 3095.43 | 3182.23 | 3270.65 | 3360.79 | 3452.75 | 3546.62 | 46 |
| 47 | 2764.25 | 2845.35 | 2927.78 | 3011.59 | 3096.87 | 3183.69 | 3272.14 | 3362.31 | 3454.29 | 3548.20 | 47 |
| 48 | 2765.59 | 2846.71 | 2929.16 | 3013.00 | 3098.30 | 3185.15 | 3273.63 | 3363.83 | 3455.84 | 3549.78 | 48 |
| 49 | 2766.93 | 2848.06 | 2930.55 | 3014.41 | 3099.74 | 3186.61 | 3275.12 | 3365.35 | 3457.39 | 3551.36 | 49 |
| 50 | 2768.27 | 2849.44 | 2931.93 | 3015.82 | 3101.17 | 3188.07 | 3276.61 | 3366.87 | 3458.94 | 3552.94 | 50 |
| 51 | 2769.62 | 2850.81 | 2933.32 | 3017.23 | 3102.60 | 3189.54 | 3278.10 | 3368.39 | 3460.49 | 3554.53 | 51 |
| 52 | 2770.96 | 2852.17 | 2934.71 | 3018.64 | 3104.04 | 3191.00 | 3279.59 | 3369.91 | 3462.04 | 3556.11 | 52 |
| 53 | 2772.30 | 2853.53 | 2936.09 | 3020.05 | 3105.48 | 3192.46 | 3281.08 | 3371.43 | 3463.60 | 3557.70 | 53 |
| 54 | 2773.64 | 2854.90 | 2937.48 | 3021.46 | 3106.92 | 3193.92 | 3282.57 | 3372.95 | 3465.15 | 3559.28 | 54 |
| 55 | 2774.99 | 2856.26 | 2938.87 | 3022.87 | 3108.35 | 3195.39 | 3284.06 | 3374.47 | 3466.70 | 3560.87 | 55 |
| 56 | 2776.33 | 2857.63 | 2940.26 | 3024.29 | 3109.79 | 3196.85 | 3285 56 | 3375.99 | 3468.26 | 3562.45 | 56 |
| 57 | 2777.68 | 2858.99 | 2941.65 | 3025.70 | 3111.23 | 3198.32 | 3287.05 | 3377.51 | 3469.81 | 3564.04 | 57 |
| 58 | 2779.02 | 2860.36 | 2943.04 | 3027.11 | 3112.67 | 3199.78 | 3288.54 | 3379.04 | 3471.36 | 3565.63 | 58 |
| 59 | 2780.37 | 2861.73 | 2944.42 | 3028.52 | 3114.11 | 3201.25 | 3290.04 | 3380.56 | 3472.92 | 3567.22 | 59 |
| 60 | 2781.71 | 2863.10 | 2945.81 | 3029.94 | 3115.55 | 3202.71 | 3291.53 | 3382.08 | 3474.47 | 3568.81 | 60 |
| Lat. | 41° | 42° | 43° | 44° | 45° | 46° | 47° | 48° | 49° | 50° | |

Meridional Parts. (y)

| Lat. | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | 60° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 3568.81 | 3665.19 | 3763.76 | 3864.64 | 3967.97 | 4073.90 | 4182.62 | 4294.30 | 4409.14 | 4527.37 | 0′ |
| 1 | 3570.40 | 3666.82 | 3765.42 | 3866.34 | 3969.71 | 4075.69 | 4184.46 | 4296.19 | 4411.08 | 4529.37 | 1 |
| 2 | 3571.99 | 3668.44 | 3767.09 | 3868.04 | 3971.46 | 4077.48 | 4186.29 | 4298.07 | 4413.03 | 4531.37 | 2 |
| 3 | 3573.58 | 3670.07 | 3768.75 | 3869.74 | 3973.20 | 4079.27 | 4188.13 | 4299.96 | 4414.97 | 4533.37 | 3 |
| 4 | 3575.17 | 3671.70 | 3770.41 | 3871.45 | 3974.95 | 4081.06 | 4189.97 | 4301.85 | 4416.92 | 4535.38 | 4 |
| 5 | 3576.76 | 3673.32 | 3772.08 | 3873.15 | 3976.69 | 4082.86 | 4191.81 | 4303.74 | 4418.86 | 4537.38 | 5 |
| 6 | 3578.35 | 3674.95 | 3773.74 | 3874.86 | 3978.44 | 4084.65 | 4193.65 | 4305.64 | 4420.81 | 4539.39 | 6 |
| 7 | 3579.94 | 3676.58 | 3775.41 | 3876.56 | 3980.19 | 4086.44 | 4195.49 | 4307.53 | 4422.76 | 4541.39 | 7 |
| 8 | 3581.54 | 3678.21 | 3777.08 | 3878.27 | 3981.94 | 4088.24 | 4197.34 | 4309.42 | 4424.70 | 4543.40 | 8 |
| 9 | 3583.13 | 3679.84 | 3778.74 | 3879.98 | 3983.69 | 4090.03 | 4199.18 | 4311.32 | 4426.65 | 4545.41 | 9 |
| 10 | 3584.73 | 3681.47 | 3780.41 | 3881.68 | 3985.44 | 4091.83 | 4201.02 | 4313.21 | 4428.60 | 4547.42 | 10 |
| 11 | 3586.32 | 3683.10 | 3782.08 | 3883.39 | 3987.19 | 4093.62 | 4202.87 | 4315.11 | 4430.56 | 4549.43 | 11 |
| 12 | 3587.92 | 3684.73 | 3783.75 | 3885.10 | 3988.94 | 4095.42 | 4204.71 | 4317.01 | 4432.51 | 4551.44 | 12 |
| 13 | 3589.51 | 3686.36 | 3785.42 | 3886.81 | 3990.69 | 4097.22 | 4206.56 | 4318.91 | 4434.46 | 4553.45 | 13 |
| 14 | 3591.11 | 3687.99 | 3787.09 | 3888.52 | 3992.45 | 4099.02 | 4208.41 | 4320.80 | 4436.42 | 4555.47 | 14 |
| 15 | 3592.71 | 3689.63 | 3788.76 | 3890.23 | 3994.20 | 4100.82 | 4210.26 | 4322.70 | 4438.37 | 4557.48 | 15 |
| 16 | 3594.30 | 3691.26 | 3790.43 | 3891.95 | 3995.96 | 4102.62 | 4212.10 | 4324.61 | 4440.33 | 4559.50 | 16 |
| 17 | 3595.90 | 3692.90 | 3792.10 | 3893.66 | 3997.71 | 4104.42 | 4213.95 | 4326.51 | 4442.29 | 4561.52 | 17 |
| 18 | 3597.50 | 3694.53 | 3793.78 | 3895.37 | 3999.47 | 4106.22 | 4215.80 | 4328.41 | 4444.24 | 4563.53 | 18 |
| 19 | 3599.10 | 3696.17 | 3795.45 | 3897.09 | 4001.22 | 4108.02 | 4217.66 | 4330.31 | 4446.20 | 4565.55 | 19 |
| 20 | 3600.70 | 3697.80 | 3797.12 | 3898.80 | 4002.98 | 4109.82 | 4219.51 | 4332.22 | 4448.16 | 4567.57 | 20 |
| 21 | 3602.30 | 3699.44 | 3798.80 | 3900.52 | 4004.74 | 4111.63 | 4221.36 | 4334.12 | 4450.12 | 4569.59 | 21 |
| 22 | 3603.90 | 3701.08 | 3800.47 | 3902.23 | 4006.50 | 4113.44 | 4223.22 | 4336.03 | 4452.09 | 4571.61 | 22 |
| 23 | 3605.50 | 3702.71 | 3802.15 | 3903.95 | 4008.26 | 4115.24 | 4225.07 | 4337.94 | 4454.05 | 4573.64 | 23 |
| 24 | 3607.11 | 3704.35 | 3803.83 | 3905.67 | 4010.02 | 4117.05 | 4226.93 | 4339.84 | 4456.01 | 4575.66 | 24 |
| 25 | 3608.71 | 3705.99 | 3805.50 | 3907.38 | 4011.78 | 4118.86 | 4228.78 | 4341.75 | 4457.98 | 4577.69 | 25 |
| 26 | 3610.32 | 3707.63 | 3807.18 | 3909.10 | 4013.54 | 4120.66 | 4230.64 | 4343.66 | 4459.94 | 4579.71 | 26 |
| 27 | 3611.92 | 3709.27 | 3808.86 | 3910.82 | 4015.31 | 4122.47 | 4232.50 | 4345.57 | 4461.91 | 4581.74 | 27 |
| 28 | 3613.52 | 3710.91 | 3810.54 | 3912.54 | 4017.07 | 4124.28 | 4234.36 | 4347.48 | 4463.88 | 4583.77 | 28 |
| 29 | 3615.13 | 3712.56 | 3812.22 | 3914.26 | 4018.84 | 4126.09 | 4236.22 | 4349.40 | 4465.85 | 4585.80 | 29 |
| 30 | 3616.74 | 3714.20 | 3813.90 | 3915.99 | 4020.60 | 4127.90 | 4238.08 | 4351.31 | 4467.82 | 4587.83 | 30 |
| 31 | 3618.34 | 3715.84 | 3815.58 | 3917.71 | 4022.37 | 4129.72 | 4239.94 | 4353.23 | 4469.79 | 4589.86 | 31 |
| 32 | 3619.95 | 3717.48 | 3817.27 | 3919.43 | 4024.13 | 4131.53 | 4241.80 | 4355.14 | 4471.76 | 4591.89 | 32 |
| 33 | 3621.56 | 3719.13 | 3818.95 | 3921.16 | 4025.90 | 4133.34 | 4243.67 | 4357.06 | 4473.73 | 4593.92 | 33 |
| 34 | 3623.17 | 3720.77 | 3820.63 | 3922.88 | 4027.67 | 4135.16 | 4245.53 | 4358.97 | 4475.71 | 4595.96 | 34 |
| 35 | 3624.78 | 3722.42 | 3822.32 | 3924.61 | 4029.44 | 4136.97 | 4247.39 | 4360.89 | 4477.68 | 4598.00 | 35 |
| 36 | 3626.39 | 3724.06 | 3824.00 | 3926.33 | 4031.21 | 4138.79 | 4249.26 | 4362.81 | 4479.66 | 4600.03 | 36 |
| 37 | 3628.00 | 3725.71 | 3825.69 | 3928.06 | 4032.98 | 4140.61 | 4251.13 | 4364.73 | 4481.63 | 4602.07 | 37 |
| 38 | 3629.61 | 3727.36 | 3827.37 | 3929.79 | 4034.75 | 4142.42 | 4252.99 | 4366.65 | 4483.61 | 4604.11 | 38 |
| 39 | 3631.22 | 3729.01 | 3829.06 | 3931.51 | 4036.52 | 4144.24 | 4254.86 | 4368.57 | 4485.59 | 4606.15 | 39 |
| 40 | 3632.83 | 3730.66 | 3830.75 | 3933.24 | 4038.29 | 4146.06 | 4256.73 | 4370.50 | 4487.57 | 4608.19 | 40 |
| 41 | 3634.44 | 3732.30 | 3832.43 | 3934.97 | 4040.07 | 4147.88 | 4258.60 | 4372.42 | 4489.55 | 4610.23 | 41 |
| 42 | 3636.06 | 3733.95 | 3834.12 | 3936.70 | 4041.84 | 4149.70 | 4260.47 | 4374.34 | 4491.53 | 4612.27 | 42 |
| 43 | 3637.67 | 3735.61 | 3835.81 | 3938.43 | 4043.61 | 4151.52 | 4262.34 | 4376.27 | 4493.51 | 4614.32 | 43 |
| 44 | 3639.28 | 3737.26 | 3837.50 | 3940.16 | 4045.39 | 4153.35 | 4264.22 | 4378.20 | 4495.50 | 4616.36 | 44 |
| 45 | 3640.90 | 3738.91 | 3839.19 | 3941.90 | 4047.17 | 4155.17 | 4266.09 | 4380.12 | 4497.48 | 4618.41 | 45 |
| 46 | 3642.51 | 3740.56 | 3840.88 | 3943.63 | 4048.94 | 4157.00 | 4267.97 | 4382.05 | 4499.47 | 4620.45 | 46 |
| 47 | 3644.13 | 3742.21 | 3842.58 | 3945.36 | 4050.72 | 4158.82 | 4269.84 | 4383.98 | 4501.45 | 4622.50 | 47 |
| 48 | 3645.75 | 3743.87 | 3844.27 | 3947.10 | 4052.50 | 4160.65 | 4271.72 | 4385.91 | 4503.44 | 4624.55 | 48 |
| 49 | 3647.36 | 3745.52 | 3845.96 | 3948.83 | 4054.28 | 4162.47 | 4273.59 | 4387.84 | 4505.43 | 4626.60 | 49 |
| 50 | 3648.98 | 3747.18 | 3847.66 | 3950.57 | 4056.06 | 4164.30 | 4275.47 | 4389.77 | 4507.42 | 4628.65 | 50 |
| 51 | 3650.60 | 3748.83 | 3849.35 | 3952.31 | 4057.84 | 4166.13 | 4277.35 | 4391.70 | 4509.41 | 4630.71 | 51 |
| 52 | 3652.22 | 3750.49 | 3851.05 | 3954.04 | 4059.62 | 4167.96 | 4279.23 | 4393.64 | 4511.40 | 4632.76 | 52 |
| 53 | 3653.84 | 3752.15 | 3852.75 | 3955.78 | 4061.41 | 4169.79 | 4281.11 | 4395.57 | 4513.39 | 4634.81 | 53 |
| 54 | 3655.46 | 3753.80 | 3854.44 | 3957.52 | 4063.19 | 4171.62 | 4282.99 | 4397.51 | 4515.39 | 4636.87 | 54 |
| 55 | 3657.08 | 3755.46 | 3856.14 | 3959.26 | 4064.97 | 4173.45 | 4284.87 | 4399.44 | 4517.38 | 4638.93 | 55 |
| 56 | 3658.70 | 3757.12 | 3857.84 | 3961.00 | 4066.76 | 4175.28 | 4286.76 | 4401.38 | 4519.38 | 4640.98 | 56 |
| 57 | 3660.32 | 3758.78 | 3859.54 | 3962.74 | 4068.54 | 4177.12 | 4288.64 | 4403.32 | 4521.37 | 4643.04 | 57 |
| 58 | 3661.95 | 3760.44 | 3861.24 | 3964.48 | 4070.33 | 4178.95 | 4290.53 | 4405.26 | 4523.37 | 4645.10 | 58 |
| 59 | 3663.57 | 3762.10 | 3862.94 | 3966.22 | 4072.12 | 4180.78 | 4292.41 | 4407.20 | 4525.37 | 4647.16 | 59 |
| 60 | 3665.19 | 3763.76 | 3864.64 | 3967.97 | 4073.90 | 4182.62 | 4294.30 | 4409.14 | 4527.37 | 4649.23 | 60 |
| Lat. | 51° | 52° | 53° | 54° | 55° | 56° | 57° | 58° | 59° | 60° | |

## Meridional Parts. (y)

| Lat. | 61° | 62° | 63° | 64° | 65° | 66° | 67° | 68° | 69° | 70° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 4649.23 | 4774.98 | 4904.94 | 5039.42 | 5178.81 | 5323.51 | 5474.01 | 5630.82 | 5794.56 | 5965.92 | 0′ |
| 1 | 4651.29 | 4777.11 | 4907.14 | 5041.70 | 5181.18 | 5325.97 | 5476.57 | 5633.49 | 5797.35 | 5968.84 | 1 |
| 2 | 4653.35 | 4779.25 | 4909.35 | 5043.99 | 5183.54 | 5328.43 | 5479.13 | 5636.16 | 5800.14 | 5971.77 | 2 |
| 3 | 4655.42 | 4781.38 | 4911.55 | 5046.27 | 5185.91 | 5330.90 | 5481.69 | 5638.84 | 5802.94 | 5974.70 | 3 |
| 4 | 4657.49 | 4783.51 | 4913.76 | 5048.56 | 5188.29 | 5333.36 | 5484.26 | 5641.51 | 5805.74 | 5977.63 | 4 |
| 5 | 4659.55 | 4785.65 | 4915.97 | 5050.85 | 5190.66 | 5335.83 | 5486.83 | 5644.19 | 5808.54 | 5980.57 | 5 |
| 6 | 4661.62 | 4787.79 | 4918.18 | 5053.14 | 5193.03 | 5338.30 | 5489.40 | 5646.87 | 5811.34 | 5983.50 | 6 |
| 7 | 4663.69 | 4789.92 | 4920.39 | 5055.43 | 5195.41 | 5340.77 | 5491.97 | 5649.56 | 5814.15 | 5986.44 | 7 |
| 8 | 4665.76 | 4792.06 | 4922.60 | 5057.72 | 5197.79 | 5343.24 | 5494.54 | 5652.24 | 5816.95 | 5989.38 | 8 |
| 9 | 4667.83 | 4794.20 | 4924.81 | 5060.01 | 5200.17 | 5345.71 | 5497.11 | 5654.93 | 5819.76 | 5992.33 | 9 |
| 10 | 4669.91 | 4796.34 | 4927.03 | 5062.30 | 5202.55 | 5348.18 | 5499.69 | 5657.61 | 5822.57 | 5995.27 | 10 |
| 11 | 4671.98 | 4798.49 | 4929.24 | 5064.60 | 5204.93 | 5350.66 | 5502.27 | 5660.30 | 5825.39 | 5998.22 | 11 |
| 12 | 4674.06 | 4800.63 | 4931.46 | 5066.90 | 5207.31 | 5353.14 | 5504.85 | 5663.00 | 5828.20 | 6001.17 | 12 |
| 13 | 4676.13 | 4802.77 | 4933.68 | 5069.19 | 5209.70 | 5355.61 | 5507.43 | 5665.69 | 5831.02 | 6004.13 | 13 |
| 14 | 4678.21 | 4804.92 | 4935 90 | 5071.49 | 5212.08 | 5358.09 | 5510.01 | 5668.38 | 5833.84 | 6007.08 | 14 |
| 15 | 4680.29 | 4807.07 | 4938.12 | 5073.80 | 5214.47 | 5360.58 | 5512.60 | 5671.08 | 5836.66 | 6010.04 | 15 |
| 16 | 4682.37 | 4809.21 | 4940.34 | 5076.10 | 5216.86 | 5363.06 | 5515.18 | 5673.78 | 5839.48 | 6013.00 | 16 |
| 17 | 4684.45 | 4811.36 | 4942.57 | 5078.40 | 5219.25 | 5365.55 | 5517.77 | 5676.48 | 5842.31 | 6015.96 | 17 |
| 18 | 4686.53 | 4813.51 | 4944.79 | 5080.71 | 5221.64 | 5368.03 | 5520.36 | 5679.19 | 5845.13 | 6018.93 | 18 |
| 19 | 4688.61 | 4815.67 | 4947.02 | 5083.01 | 5224.04 | 5370.52 | 5522.95 | 5681.89 | 5847.96 | 6021.90 | 19 |
| 20 | 4690 70 | 4817.82 | 4949.24 | 5085.32 | 5226.43 | 5373.01 | 5525.55 | 5684.60 | 5850.79 | 6024.87 | 20 |
| 21 | 4692.78 | 4819.97 | 4951.47 | 5087.63 | 5228.33 | 5375.50 | 5528.14 | 5687.31 | 5853.63 | 6027.84 | 21 |
| 22 | 4694.87 | 4822.13 | 4953.70 | 5089.94 | 5231.23 | 5378.00 | 5530.74 | 5690.02 | 5856.47 | 6030.81 | 22 |
| 23 | 4696.96 | 4824.29 | 4955.94 | 5092.25 | 5233.63 | 5380.49 | 5533.34 | 5692.73 | 5859.31 | 6033.79 | 23 |
| 24 | 4699.05 | 4826.44 | 4958.17 | 5094.57 | 5236.03 | 5382.99 | 5535.94 | 5695.45 | 5862.15 | 6036.77 | 24 |
| 25 | 4701.14 | 4828.60 | 4960.40 | 5096.88 | 5238.43 | 5385.49 | 5538.55 | 5698.17 | 5864.99 | 6039.75 | 25 |
| 26 | 4703.23 | 4830.76 | 4962.64 | 5099.20 | 5240.84 | 5387.99 | 5541.15 | 5700.89 | 5867.84 | 6042.74 | 26 |
| 27 | 4705.32 | 4832.93 | 4964.88 | 5101.52 | 5243.24 | 5390.49 | 5543.76 | 5703.61 | 5870.69 | 6045.73 | 27 |
| 28 | 4707.41 | 4835.09 | 4967.11 | 5103.84 | 5245.65 | 5392.99 | 5546.37 | 5706.33 | 5873.54 | 6048.72 | 28 |
| 29 | 4709.51 | 4837.25 | 4969.35 | 5106.16 | 5248.06 | 5395.50 | 5548.98 | 5709.06 | 5876.39 | 6051.71 | 29 |
| 30 | 4711.60 | 4839.42 | 4971.59 | 5108.48 | 5250.47 | 5398.01 | 5551.59 | 5711.78 | 5879.24 | 6054.70 | 30 |
| 31 | 4713.70 | 4841.58 | 4973.83 | 5110.80 | 5252.88 | 5400.52 | 5554.20 | 5714.51 | 5882.10 | 6057.70 | 31 |
| 32 | 4715.79 | 4843.75 | 4976.08 | 5113.13 | 5255.30 | 5403.03 | 5556.82 | 5717.25 | 5884.96 | 6060.70 | 32 |
| 33 | 4717.89 | 4845.92 | 4978.32 | 5115.45 | 5257.71 | 5405.54 | 5559.44 | 5719.98 | 5887.82 | 6063.71 | 33 |
| 34 | 4719.99 | 4848.09 | 4980.57 | 5117.78 | 5260.13 | 5408.05 | 5562.06 | 5722.71 | 5890.68 | 6066.71 | 34 |
| 35 | 4722.09 | 4850.26 | 4982.82 | 5120.11 | 5262.55 | 5410.57 | 5564.68 | 5725.45 | 5893.55 | 6069.71 | 35 |
| 36 | 4724.19 | 4852.43 | 4985.06 | 5122.44 | 5264.97 | 5413.08 | 5567.30 | 5728.19 | 5896.41 | 6072.72 | 36 |
| 37 | 4726.30 | 4854.61 | 4987.31 | 5124.77 | 5267.39 | 5415.60 | 5569.93 | 5730.93 | 5899.28 | 6075.73 | 37 |
| 38 | 4728.40 | 4856.78 | 4989.56 | 5127.11 | 5269.81 | 5418.12 | 5572.55 | 5733.68 | 5902.15 | 6078.75 | 38 |
| 39 | 4730.51 | 4858.96 | 4991.82 | 5129.44 | 5272.23 | 5420.64 | 5575.18 | 5736.42 | 5905.03 | 6081.76 | 39 |
| 40 | 4732.61 | 4861.13 | 4994.07 | 5131.78 | 5274.66 | 5423.17 | 5577.81 | 5739.17 | 5907.90 | 6084.78 | 40 |
| 41 | 4734.72 | 4863.31 | 4996.32 | 5134.11 | 5277.09 | 5425.69 | 5580.44 | 5741.92 | 5910.78 | 6087.81 | 41 |
| 42 | 4736.83 | 4865.49 | 4998.58 | 5136.45 | 5279.52 | 5428.22 | 5583.08 | 5744.67 | 5913.67 | 6090.83 | 42 |
| 43 | 4738.94 | 4867.67 | 5000.84 | 5138.79 | 5281.95 | 5430.75 | 5585.71 | 5747.43 | 5916.55 | 6093.86 | 43 |
| 44 | 4741.05 | 4869.86 | 5003.10 | 5141.14 | 5284.38 | 5433.28 | 5588.35 | 5750.18 | 5919.44 | 6096.89 | 44 |
| 45 | 4743.16 | 4872.04 | 5005.36 | 5143.48 | 5286.82 | 5435.81 | 5590.99 | 5752.94 | 5922.33 | 6099.92 | 45 |
| 46 | 4745.28 | 4874.22 | 5007.62 | 5145.83 | 5289 25 | 5438.35 | 5593.64 | 5755.70 | 5925.22 | 6102.95 | 46 |
| 47 | 4747.39 | 4876.41 | 5009.88 | 5148.17 | 5291.69 | 5440.88 | 5596.28 | 5758.46 | 5928.11 | 6105.99 | 47 |
| 48 | 4749 51 | 4878.60 | 5012.15 | 5150.52 | 5294.13 | 5443.42 | 5598.93 | 5761.23 | 5931.00 | 6109.03 | 48 |
| 49 | 4751.63 | 4880.79 | 5014.41 | 5152.87 | 5296.57 | 5445.96 | 5601.57 | 5763.99 | 5933.90 | 6112.07 | 49 |
| 50 | 4753.74 | 4882.98 | 5016.68 | 5155.22 | 5299.01 | 5448.50 | 5604.22 | 5766.76 | 5936.80 | 6115.12 | 50 |
| 51 | 4755.86 | 4885.17 | 5018.94 | 5157.57 | 5301.45 | 5451.05 | 5606.87 | 5769.53 | 5939.70 | 6118.16 | 51 |
| 52 | 4757.98 | 4887.36 | 5021.21 | 5159.93 | 5303.90 | 5453.59 | 5609.53 | 5772.31 | 5942.61 | 6121.21 | 52 |
| 53 | 4760.10 | 4889.55 | 5023.48 | 5162.28 | 5306.34 | 5456.14 | 5612.18 | 5775.08 | 5945.51 | 6124.26 | 53 |
| 54 | 4762.23 | 4891.75 | 5025.76 | 5164.64 | 5308.79 | 5458.68 | 5614.84 | 5777.86 | 5948.42 | 6127.32 | 54 |
| 55 | 4764.35 | 4893.94 | 5028.03 | 5167.00 | 5311.24 | 5461.23 | 5617.50 | 5780.64 | 5951.33 | 6130.38 | 55 |
| 56 | 4766.47 | 4896.14 | 5030.30 | 5169.36 | 5313.69 | 5463.78 | 5620.16 | 5783.42 | 5954.24 | 6133.44 | 56 |
| 57 | 4768.60 | 4898.34 | 5032.58 | 5171.72 | 5316.15 | 5466.34 | 5622.82 | 5786.20 | 5957.16 | 6136.50 | 57 |
| 58 | 4770.73 | 4900.54 | 5034.86 | 5174.08 | 5318.60 | 5468.89 | 5625.49 | 5788.98 | 5960.08 | 6139.56 | 58 |
| 59 | 4772.86 | 4902.74 | 5037.14 | 5176.44 | 5321.06 | 5471.45 | 5628 15 | 5791.77 | 5963.00 | 6142.63 | 59 |
| 60 | 4774 98 | 4904.94 | 5039 42 | 5178.81 | 5323.51 | 5474.01 | 5630.82 | 5794.56 | 5965.92 | 6145.70 | 60 |
| Lat. | 61° | 62° | 63° | 64° | 65° | 66° | 67° | 68° | 69° | 70° | |

## Meridional Parts. (v)

| Lat. | 71° | 72° | 73° | 74° | 75° | 76° | 77° | 78° | 79° | 80° | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 6145.70 | 6334.84 | 6534.42 | 6745.74 | 6970.34 | 7210.07 | 7467.21 | 7744.57 | 8045.71 | 8375.20 | 0′ |
| 1 | 6148.77 | 6338.08 | 6537.85 | 6749.37 | 6974.20 | 7214.20 | 7471.66 | 7749.38 | 8050.95 | 8380.96 | 1 |
| 2 | 6151.85 | 6341.32 | 6541.27 | 6753.02 | 6978.07 | 7218.35 | 7476.11 | 7754.20 | 8056.20 | 8386.73 | 2 |
| 3 | 6154.93 | 6344.56 | 6544.70 | 6756.64 | 6981.95 | 7222.49 | 7480.57 | 7759.02 | 8061.46 | 8392.52 | 3 |
| 4 | 6158.01 | 6347.81 | 6548.13 | 6760.28 | 6985.83 | 7226.64 | 7485.03 | 7763.86 | 8066.73 | 8398.31 | 4 |
| 5 | 6161.09 | 6351.06 | 6551.57 | 6763.93 | 6989.71 | 7230.80 | 7489.50 | 7768.70 | 8072.01 | 8404.11 | 5 |
| 6 | 6164.18 | 6354.31 | 6555.01 | 6767.58 | 6993.60 | 7234.96 | 7493.98 | 7773.55 | 8077.29 | 8409.92 | 6 |
| 7 | 6167.27 | 6357.56 | 6558.45 | 6771.23 | 6997.49 | 7239 12 | 7498.46 | 7778.40 | 8082.58 | 8415.74 | 7 |
| 8 | 6170.36 | 6360.82 | 6561.89 | 6774.89 | 7001.38 | 7243.29 | 7502.95 | 7783.26 | 8087.88 | 8421.57 | 8 |
| 9 | 6173.45 | 6364.08 | 6565.34 | 6778.55 | 7005.28 | 7247.47 | 7507.44 | 7788.12 | 8093.19 | 8427.42 | 9 |
| 10 | 6176.55 | 6367.35 | 6568.79 | 6782.21 | 7009.19 | 7251.65 | 7511.94 | 7793.00 | 8098.51 | 8433.27 | 10 |
| 11 | 6179.65 | 6370.61 | 6572.25 | 6785.88 | 7013.10 | 7255.83 | 7516.45 | 7797.88 | 8103.83 | 8439.13 | 11 |
| 12 | 6182.75 | 6373.88 | 6575.70 | 6789.55 | 7017.01 | 7260.02 | 7520.96 | 7802.76 | 8109.17 | 8445.00 | 12 |
| 13 | 6185.85 | 6377.16 | 6579.16 | 6793.22 | 7020.93 | 7264.22 | 7525.47 | 7807.66 | 8114.51 | 8450.88 | 13 |
| 14 | 6188.96 | 6380.43 | 6582.63 | 6796.90 | 7024.85 | 7268.42 | 7530.00 | 7812.56 | 8119.86 | 8456.77 | 14 |
| 15 | 6192.07 | 6383.71 | 6586.10 | 6800.58 | 7028.77 | 7272.62 | 7534.53 | 7817.46 | 8125.22 | 8462.67 | 15 |
| 16 | 6195.18 | 6386.99 | 6589.57 | 6804.27 | 7032.70 | 7276.83 | 7539.06 | 7822.38 | 8130.58 | 8468.58 | 16 |
| 17 | 6198.30 | 6390.28 | 6593.05 | 6807.96 | 7036.64 | 7281.05 | 7543.60 | 7827.30 | 8135.95 | 8474.50 | 17 |
| 18 | 6201.42 | 6393.57 | 6596.52 | 6811.65 | 7040.58 | 7285.27 | 7548.15 | 7832.23 | 8141.33 | 8480.43 | 18 |
| 19 | 6204.54 | 6396.86 | 6600.01 | 6815.35 | 7044.52 | 7289.49 | 7552.70 | 7837.16 | 8146.72 | 8486.37 | 19 |
| 20 | 6207.66 | 6400.15 | 6603.49 | 6819.05 | 7048 47 | 7293.72 | 7557.26 | 7842.10 | 8152.12 | 8492.32 | 20 |
| 21 | 6210.78 | 6403.44 | 6606.98 | 6822.75 | 7052.42 | 7297.96 | 7561.82 | 7847.05 | 8157.53 | 8498.28 | 21 |
| 22 | 6213.91 | 6406.74 | 6610.47 | 6826.46 | 7056.37 | 7302.20 | 7566.39 | 7852.01 | 8162.95 | 8504.25 | 22 |
| 23 | 6217.04 | 6410.05 | 6613.96 | 6830.18 | 7060.33 | 7306.44 | 7570.96 | 7856.97 | 8168.37 | 8510.23 | 23 |
| 24 | 6220.18 | 6413.35 | 6617.46 | 6833.89 | 7064.30 | 7310.69 | 7575.54 | 7861.94 | 8173.80 | 8516.22 | 24 |
| 25 | 6223.31 | 6416.66 | 6620.97 | 6837.61 | 7068.27 | 7314.95 | 7580.13 | 7866.91 | 8179.24 | 8522.22 | 25 |
| 26 | 6226.45 | 6419.97 | 6624.47 | 6841.34 | 7072.24 | 7319.21 | 7584.72 | 7871.90 | 8184.69 | 8528.23 | 26 |
| 27 | 6229.59 | 6423.29 | 6627.98 | 6845.07 | 7076.22 | 7323.47 | 7589.32 | 7876.89 | 8190.15 | 8534.26 | 27 |
| 28 | 6232.74 | 6426.61 | 6631.49 | 6848.80 | 7080.20 | 7327.74 | 7593.93 | 7881.89 | 8195.61 | 8540.29 | 28 |
| 29 | 6235.89 | 6429.93 | 6635.01 | 6852.53 | 7084.19 | 7332.02 | 7598.54 | 7886.89 | 8201.09 | 8546.33 | 29 |
| 30 | 6239.04 | 6433.25 | 6638.53 | 6856.27 | 7088.18 | 7336.30 | 7603.16 | 7891.91 | 8206.57 | 8552.38 | 30 |
| 31 | 6242.19 | 6436.58 | 6642.05 | 6860.02 | 7092.18 | 7340.55 | 7607.78 | 7896.93 | 8212.06 | 8558.45 | 31 |
| 32 | 6245.35 | 6439.91 | 6645.58 | 6863.77 | 7096.18 | 7344.88 | 7612.41 | 7901.95 | 8217.56 | 8564.52 | 32 |
| 33 | 6248.50 | 6443.24 | 6649.11 | 6867.52 | 7100.18 | 7349.18 | 7617.04 | 7906.98 | 8223.07 | 8570.61 | 33 |
| 34 | 6251.67 | 6446.58 | 6652.64 | 6871.27 | 7104.19 | 7353.48 | 7621.68 | 7912.03 | 8228.59 | 8576.70 | 34 |
| 35 | 6254.83 | 6449 92 | 6656.18 | 6875.03 | 7108.21 | 7357.79 | 7626.33 | 7917.08 | 8234.12 | 8582.81 | 35 |
| 36 | 6258.00 | 6453.26 | 6659.72 | 6878.80 | 7112.23 | 7362.10 | 7630.99 | 7922.13 | 8239.66 | 8588.93 | 36 |
| 37 | 6261.17 | 6456.61 | 6663.26 | 6882.56 | 7116.25 | 7366.42 | 7635.65 | 7927.19 | 8245.20 | 8595.06 | 37 |
| 38 | 6264.34 | 6459.95 | 6666.81 | 6886 34 | 7120.28 | 7370.74 | 7640.31 | 7932.26 | 8250.75 | 8601.20 | 38 |
| 39 | 6267.51 | 6463.31 | 6670.36 | 6890.11 | 7124.31 | 7375.07 | 7644.98 | 7937.34 | 8256.31 | 8607.35 | 39 |
| 40 | 6270.69 | 6466.66 | 6673.91 | 6893.89 | 7128.35 | 7379.40 | 7649.66 | 7942.43 | 8261.88 | 8613.51 | 40 |
| 41 | 6273.87 | 6470.02 | 6677.47 | 6897.68 | 7132.39 | 7383.74 | 7654.35 | 7947.52 | 8267.46 | 8619.68 | 41 |
| 42 | 6277.05 | 6473.38 | 6681.03 | 6901.46 | 7136.43 | 7388.08 | 7659.04 | 7952.62 | 8273.05 | 8625.86 | 42 |
| 43 | 6280.24 | 6476.74 | 6684.59 | 6905.25 | 7140.48 | 7392.43 | 7663.74 | 7957.72 | 8278.65 | 8632.05 | 43 |
| 44 | 6283.43 | 6480.11 | 6688.16 | 6909.05 | 7144.54 | 7396.79 | 7668.44 | 7962.84 | 8284.25 | 8638.26 | 44 |
| 45 | 6286.62 | 6483.48 | 6691.73 | 6912.85 | 7148.60 | 7401.15 | 7673.15 | 7967.96 | 8289.87 | 8644.47 | 45 |
| 46 | 6289.82 | 6486.86 | 6695.31 | 6916.65 | 7152.67 | 7405.51 | 7677.87 | 7973.09 | 8295.49 | 8650.70 | 46 |
| 47 | 6293.01 | 6490.23 | 6698.89 | 6920.46 | 7156.74 | 7409.88 | 7682.59 | 7978.23 | 8301.12 | 8656.94 | 47 |
| 48 | 6296.21 | 6493.61 | 6702.47 | 6924.27 | 7160.81 | 7414.26 | 7687.32 | 7983.37 | 8306.77 | 8663.19 | 48 |
| 49 | 6299.42 | 6497.00 | 6706.06 | 6928.09 | 7164.89 | 7418.64 | 7692.05 | 7988.52 | 8312.42 | 8669.45 | 49 |
| 50 | 6302.62 | 6500.38 | 6709.65 | 6931.91 | 7168.97 | 7423.03 | 7696.79 | 7993.68 | 8318.08 | 8675.72 | 50 |
| 51 | 6305.83 | 6503.77 | 6713.24 | 6935.73 | 7173.06 | 7427.42 | 7701.54 | 7998.85 | 8323.75 | 8682.00 | 51 |
| 52 | 6309.04 | 6507.17 | 6716.84 | 6939.56 | 7177.15 | 7431.82 | 7706.30 | 8004.03 | 8329.43 | 8688.29 | 52 |
| 53 | 6312.26 | 6510.56 | 6720.44 | 6943.40 | 7181.25 | 7436.22 | 7711.06 | 8009.21 | 8335.12 | 8694.60 | 53 |
| 54 | 6315.48 | 6513.96 | 6724.04 | 6947.23 | 7185.35 | 7440.63 | 7715.83 | 8014.40 | 8340.82 | 8700.92 | 54 |
| 55 | 6318.70 | 6517.36 | 6727.65 | 6951.07 | 7189.46 | 7445.05 | 7720.60 | 8019.60 | 8346.52 | 8707.25 | 55 |
| 56 | 6321.92 | 6520.77 | 6731.26 | 6954.92 | 7193.57 | 7449.47 | 7725.38 | 8024 81 | 8352.24 | 8713.59 | 56 |
| 57 | 6325.14 | 6524.18 | 6734.88 | 6958.77 | 7197.69 | 7453.89 | 7730.17 | 8030.02 | 8357.96 | 8719.94 | 57 |
| 58 | 6328.37 | 6527.59 | 6738 50 | 6962.62 | 7201.81 | 7458 33 | 7734.96 | 8035.24 | 8363.70 | 8726.30 | 58 |
| 59 | 6331.61 | 6531.01 | 6742.12 | 6966.48 | 7205.94 | 7462.76 | 7739.76 | 8040.47 | 8369.44 | 8732.68 | 59 |
| 60 | 6334.84 | 6534.42 | 6745.74 | 6970.34 | 7210.07 | 7467.21 | 7744.57 | 8045.71 | 8375.20 | 8739.06 | 60 |
| Lat. | 71° | 72° | 73° | 74° | 75° | 76° | 77° | 78° | 79° | 80° | |

## Meridional Parts. (y)

| Lat. | 81° | 82° | 83° | 84° | 85° | 86° | 87° | 88° | 89° | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0′ | 9139.06 | 9145.46 | 9605.82 | 10136.89 | 10764.62 | 11532.52 | 12522.11 | 13916.43 | 16299.56 | 0′ |
| 1 | 9745.46 | 9152.65 | 9614.03 | 10146.46 | 10776.11 | 11546.88 | 12541.27 | 13945.20 | 16357.34 | 1 |
| 2 | 9751.87 | 9159.86 | 9622.27 | 10156.07 | 10787.65 | 11561.31 | 12560.54 | 13974.22 | 16416.11 | 2 |
| 3 | 9758.29 | 9167.08 | 9630.52 | 10165.70 | 10799.22 | 11575.80 | 12579.91 | 14003.48 | 16475 90 | 3 |
| 4 | 9764.73 | 9174.32 | 9638.80 | 10175.37 | 10810.82 | 11590.34 | 12599.40 | 14033.00 | 16536.76 | 4 |
| 5 | 9771.17 | 9181.57 | 9647.09 | 10185.05 | 10822.47 | 11604.95 | 12619.00 | 14062.77 | 16598.69 | 5 |
| 6 | 9777.63 | 9188.84 | 9655.40 | 10194.77 | 10834.16 | 11619.62 | 12638.70 | 14092.80 | 16661.78 | 6 |
| 7 | 9784.10 | 9196.13 | 9663.74 | 10204.51 | 10845.89 | 11634.36 | 12658.53 | 14123.09 | 16726.04 | 7 |
| 8 | 9790.58 | 9203.42 | 9672.09 | 10214.28 | 10857.65 | 11649.16 | 12678.46 | 14153.66 | 16791.53 | 8 |
| 9 | 9797.08 | 9210.74 | 9680.47 | 10224.08 | 10869.46 | 11664.02 | 12698.52 | 14184.49 | 16858.29 | 9 |
| 10 | 9803.58 | 9218.07 | 9688.86 | 10233.90 | 10881.31 | 11678.94 | 12718.69 | 14215.61 | 16926.36 | 10 |
| 11 | 9810.10 | 9225.41 | 9697.28 | 10243.75 | 10893.20 | 11693.93 | 12738.98 | 14247.01 | 16995.81 | 11 |
| 12 | 9816.63 | 9232.77 | 9705.71 | 10253.64 | 10905.13 | 11708.99 | 12759.39 | 14278.70 | 17066 70 | 12 |
| 13 | 9823.17 | 9240.15 | 9714.17 | 10263.54 | 10917.10 | 11724.11 | 12779.92 | 14310.68 | 17139.09 | 13 |
| 14 | 9829.73 | 9247.54 | 9722.64 | 10273.48 | 10929.11 | 11739.30 | 12800.58 | 14342.97 | 17213.03 | 14 |
| 15 | 9836.30 | 9254.95 | 9731.14 | 10283.45 | 10941.17 | 11754.56 | 12821.36 | 14375.56 | 17288.57 | 15 |
| 16 | 9842.88 | 9262.37 | 9739.66 | 10293.45 | 10953.26 | 11769.88 | 12842.26 | 14408.46 | 17365.83 | 16 |
| 17 | 9849.47 | 9269.81 | 9748.20 | 10303.47 | 10965.40 | 11785.27 | 12863.30 | 14441.68 | 17444.87 | 17 |
| 18 | 9856.07 | 9277.27 | 9756.76 | 10313.53 | 10977.59 | 11800.73 | 12884.46 | 14475.23 | 17525.77 | 18 |
| 19 | 9862.69 | 9284.74 | 9765.34 | 10323.61 | 10989.81 | 11816.26 | 12905.75 | 14509.10 | 17608.63 | 19 |
| 20 | 9869.32 | 9292.23 | 9773.94 | 10333.72 | 11002.08 | 11831.87 | 12927.18 | 14543.31 | 17693.49 | 20 |
| 21 | 9875.96 | 9299.73 | 9782.57 | 10343.86 | 11014.40 | 11847.54 | 12948.74 | 14577.87 | 17780.53 | 21 |
| 22 | 9882.62 | 9307.25 | 9791.21 | 10354.03 | 11026.75 | 11863.28 | 12970.44 | 14612.78 | 17869.83 | 22 |
| 23 | 9889.29 | 9314.79 | 9799.88 | 10364.24 | 11039.15 | 11879.10 | 12992.27 | 14648.04 | 17961.51 | 23 |
| 24 | 9895.97 | 9322.34 | 9808.57 | 10374.47 | 11051.60 | 11894.99 | 13014.25 | 14683.67 | 18055.70 | 24 |
| 25 | 9902.66 | 9329.91 | 9817.28 | 10384.73 | 11064.09 | 11910.95 | 13036.36 | 14719.67 | 18152.55 | 25 |
| 26 | 9909.37 | 9337.49 | 9826.02 | 10395.03 | 11076.63 | 11926.99 | 13058.62 | 14756.05 | 18252.20 | 26 |
| 27 | 9916.09 | 9345.10 | 9834.77 | 10405.35 | 11089.21 | 11943.10 | 13081.02 | 14792.83 | 18354.83 | 27 |
| 28 | 9922.82 | 9352.72 | 9843.55 | 10415.71 | 11101.84 | 11959.29 | 13103.58 | 14830.00 | 18460.62 | 28 |
| 29 | 9929.57 | 9360.35 | 9852.35 | 10426.09 | 11114.52 | 11975.55 | 13126.27 | 14867.57 | 18569.76 | 29 |
| 30 | 9936.33 | 9368.00 | 9861.17 | 10436.51 | 11127.24 | 11991.89 | 13149.12 | 14905.56 | 18682.49 | 30 |
| 31 | 9943.10 | 9375.67 | 9870.02 | 10446.96 | 11140.01 | 12008.31 | 13172.13 | 14943.98 | 18799.03 | 31 |
| 32 | 9949.88 | 9383.36 | 9878.88 | 10457.44 | 11152.82 | 12024.81 | 13195.28 | 14982.83 | 18919.67 | 32 |
| 33 | 9956.68 | 9391.06 | 9887.77 | 10467.95 | 11165.69 | 12041.39 | 13218.60 | 15022.12 | 19044.69 | 33 |
| 34 | 9963.49 | 9398.79 | 9896.69 | 10478.50 | 11178.60 | 12058.05 | 13242.07 | 15061.87 | 19174.44 | 34 |
| 35 | 9970.32 | 9406.53 | 9905.63 | 10489.08 | 11191.56 | 12074.79 | 13265.70 | 15102.08 | 19309.27 | 35 |
| 36 | 9977.16 | 9414.28 | 9914.59 | 10499.69 | 11204.57 | 12091.60 | 13289.50 | 15142.77 | 19449.61 | 36 |
| 37 | 9984.01 | 9422.05 | 9923.57 | 10510.33 | 11217.63 | 12108.51 | 13313.47 | 15183.94 | 19595.92 | 37 |
| 38 | 9990.87 | 9429.84 | 9932.57 | 10521.01 | 11230.74 | 12125.49 | 13337.60 | 15225.62 | 19748.73 | 38 |
| 39 | 9997.75 | 9437.65 | 9941.60 | 10531.71 | 11243.90 | 12142.57 | 13361.90 | 15267.80 | 19908.66 | 39 |
| 40 | 9004.65 | 9445.48 | 9950.66 | 10542.45 | 11257.11 | 12159.72 | 13386.37 | 15310.51 | 20076.39 | 40 |
| 41 | 9011.55 | 9453.32 | 9959.73 | 10553.23 | 11270.37 | 12176.96 | 13411.02 | 15353.76 | 20252.72 | 41 |
| 42 | 9018.47 | 9461.18 | 9968.83 | 10564.04 | 11283.68 | 12194.29 | 13435.85 | 15397.56 | 20438.59 | 42 |
| 43 | 9025.41 | 9469.06 | 9977.96 | 10574.88 | 11297.04 | 12211.71 | 13460.86 | 15441.92 | 20635.09 | 43 |
| 44 | 9032.36 | 9476.96 | 9987.11 | 10585.76 | 11310.46 | 12229.21 | 13486.05 | 15486.86 | 20843.50 | 44 |
| 45 | 9039.32 | 9484.87 | 9996.28 | 10596.67 | 11323.93 | 12246.81 | 13511.43 | 15532.40 | 21065.37 | 45 |
| 46 | 9046.29 | 9492.81 | 10005.48 | 10607.62 | 11337.45 | 12264.49 | 13537.00 | 15578.55 | 21302.55 | 46 |
| 47 | 9053.28 | 9500.76 | 10014.70 | 10618.60 | 11351.02 | 12282.26 | 13562.75 | 15625.32 | 21557.31 | 47 |
| 48 | 9060.29 | 9508.73 | 10023.95 | 10629.61 | 11364.65 | 12300.13 | 13588 71 | 15672.75 | 21832.48 | 48 |
| 49 | 9067.31 | 9516.71 | 10033.22 | 10640.67 | 11378.33 | 12318.09 | 13614.85 | 15720.83 | 22131.60 | 49 |
| 50 | 9074.34 | 9524.72 | 10042.52 | 10651.75 | 11392.06 | 12336.15 | 13641.20 | 15769.59 | 22459.26 | 50 |
| 51 | 9081.39 | 9532.74 | 10051.84 | 10662.87 | 11405.85 | 12354.30 | 13667.75 | 15819.06 | 22821.46 | 51 |
| 52 | 9088.45 | 9540.79 | 10061.19 | 10674.03 | 11419.70 | 12372.54 | 13694.52 | 15869.25 | 23226.39 | 52 |
| 53 | 9095.52 | 9548.85 | 10070.56 | 10685.22 | 11433.60 | 12390.89 | 13721.48 | 15920.19 | 23685.42 | 53 |
| 54 | 9102.61 | 9556.93 | 10079.96 | 10696.46 | 11447.56 | 12409.33 | 13748.67 | 15971.89 | 24215.35 | 54 |
| 55 | 9109.72 | 9565.03 | 10089.38 | 10707.72 | 11461.58 | 12427.87 | 13776.07 | 16024.38 | 24842.12 | 55 |
| 56 | 9116.84 | 9573.15 | 10098.83 | 10719.03 | 11475.65 | 12446.51 | 13803.68 | 16077.68 | 25609.23 | 56 |
| 57 | 9123.97 | 9581.29 | 10108.30 | 10730.37 | 11489.78 | 12465.26 | 13831.53 | 16131.82 | 26598.21 | 57 |
| 58 | 9131.12 | 9589.45 | 10117.81 | 10741.75 | 11503.97 | 12484.10 | 13859.60 | 16186.83 | 27992.10 | 58 |
| 59 | 9138.28 | 9597.62 | 10127.33 | 10753.17 | 11518.21 | 12503.05 | 13887.90 | 16242.74 | 30374.96 | 59 |
| 60 | 9145.46 | 9605 82 | 10136.89 | 10764.62 | 11532.52 | 12522.11 | 13916.43 | 16299.56 | Infin. | 60 |
| Lat. | 81° | 82° | 83° | 84° | 85° | 86° | 87° | 88° | 89° | |

## (z) Bearing Amplitude and Time Amplitude at Rising and Setting of the Sun.

Declination.

| Lat. | 1° | | 2° | | 3° | | 4° | | 5° | | 6° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. |
| ° | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. |
| 1 | 1. 0 | 0. 0 | 2. 0 | 0. 0 | 3. 0 | 0. 0 | 4. 0 | 0. 0 | 5. 0 | 0. 0 | 6. 0 | 0. 0 |
| 2 | 1. 0 | 0. 0 | 2. 0 | 0. 0 | 3. 0 | 0. 0 | 4. 0 | 0. 1 | 5. 0 | 0. 1 | 6. 0 | 0. 1 |
| 3 | 1. 0 | 0. 0 | 2. 0 | 0. 0 | 3. 0 | 0. 1 | 4. 0 | 0. 1 | 5. 0 | 0. 1 | 6. 0 | 0. 1 |
| 4 | 1. 0 | 0. 0 | 2. 0 | 0. 1 | 3. 0 | 0. 1 | 4. 1 | 0. 1 | 5. 1 | 0. 1 | 6. 1 | 0. 2 |
| 5 | 1. 0 | 0. 0 | 2. 0 | 0. 1 | 3. 0 | 0. 1 | 4. 1 | 0. 1 | 5. 1 | 0. 2 | 6. 1 | 0. 2 |
| 6 | 1. 0 | 0. 0 | 2. 0 | 0. 1 | 3. 1 | 0. 1 | 4. 1 | 0. 2 | 5. 1 | 0. 2 | 6. 2 | 0. 3 |
| 7 | 1. 0 | 0. 0 | 2. 1 | 0. 1 | 3. 1 | 0. 1 | 4. 2 | 0. 2 | 5. 2 | 0. 2 | 6. 3 | 0. 3 |
| 8 | 1. 0 | 0. 1 | 2. 1 | 0. 1 | 3. 2 | 0. 2 | 4. 3 | 0. 2 | 5. 3 | 0. 3 | 6. 4 | 0. 3 |
| 9 | 1. 0 | 0. 1 | 2. 1 | 0. 1 | 3. 2 | 0. 2 | 4. 3 | 0. 3 | 5. 3 | 0. 3 | 6. 5 | 0. 4 |
| 10 | 1. 1 | 0. 1 | 2. 2 | 0. 1 | 3. 3 | 0. 2 | 4. 4 | 0. 3 | 5. 5 | 0. 4 | 6. 6 | 0. 4 |
| 11 | 1. 1 | 0. 1 | 2. 2 | 0. 2 | 3. 3 | 0. 2 | 4. 4 | 0. 3 | 5. 6 | 0. 4 | 6. 7 | 0. 5 |
| 12 | 1. 1 | 0. 1 | 2. 3 | 0. 2 | 3. 4 | 0. 3 | 4. 5 | 0. 3 | 5. 7 | 0. 4 | 6. 8 | 0. 5 |
| 13 | 1. 2 | 0. 1 | 2. 3 | 0. 2 | 3. 5 | 0. 3 | 4. 6 | 0. 4 | 5. 8 | 0. 5 | 6.10 | 0. 6 |
| 14 | 1. 2 | 0. 1 | 2. 3 | 0. 2 | 3. 5 | 0. 3 | 4. 7 | 0. 4 | 5. 9 | 0. 5 | 6.11 | 0. 6 |
| 15 | 1. 2 | 0. 1 | 2. 4 | 0. 2 | 3. 6 | 0. 3 | 4. 8 | 0. 4 | 5.11 | 0. 5 | 6.13 | 0. 6 |
| 16 | 1. 3 | 0. 1 | 2. 5 | 0. 2 | 3. 7 | 0. 3 | 4.10 | 0. 5 | 5.12 | 0. 6 | 6.14 | 0. 7 |
| 17 | 1. 3 | 0. 1 | 2. 5 | 0. 2 | 3. 8 | 0. 4 | 4.11 | 0. 5 | 5.13 | 0. 6 | 6.16 | 0. 7 |
| 18 | 1. 3 | 0. 1 | 2. 6 | 0. 3 | 3. 9 | 0. 4 | 4.12 | 0. 5 | 5.15 | 0. 7 | 6.19 | 0. 8 |
| 19 | 1. 3 | 0. 1 | 2. 7 | 0. 3 | 3.10 | 0. 4 | 4.14 | 0. 6 | 5.17 | 0. 7 | 6.21 | 0. 8 |
| 20 | 1. 4 | 0. 1 | 2. 8 | 0. 3 | 3.12 | 0. 4 | 4.16 | 0. 6 | 5.19 | 0. 7 | 6.23 | 0. 9 |
| 21 | 1. 4 | 0. 2 | 2. 9 | 0. 3 | 3.13 | 0. 5 | 4.17 | 0. 6 | 5.21 | 0. 8 | 6.25 | 0. 9 |
| 22 | 1. 5 | 0. 2 | 2.10 | 0. 3 | 3.14 | 0. 5 | 4.19 | 0. 6 | 5.24 | 0. 8 | 6.28 | 0.10 |
| 23 | 1. 5 | 0. 2 | 2.11 | 0. 3 | 3.15 | 0. 5 | 4.21 | 0. 7 | 5.26 | 0. 9 | 6.31 | 0.10 |
| 24 | 1. 6 | 0. 2 | 2.12 | 0. 4 | 3.17 | 0. 5 | 4.23 | 0. 7 | 5.29 | 0. 9 | 6.34 | 0.11 |
| 25 | 1. 6 | 0. 2 | 2.13 | 0. 4 | 3.19 | 0. 6 | 4.25 | 0. 7 | 5.31 | 0. 9 | 6.37 | 0.11 |
| 26 | 1. 7 | 0. 2 | 2.14 | 0. 4 | 3.21 | 0. 6 | 4.27 | 0. 8 | 5.34 | 0.10 | 6.41 | 0.12 |
| 27 | 1. 7 | 0. 2 | 2.15 | 0. 4 | 3.22 | 0. 6 | 4.29 | 0. 8 | 5.37 | 0.10 | 6.44 | 0.12 |
| 28 | 1. 8 | 0. 2 | 2.16 | 0. 4 | 3.24 | 0. 6 | 4.32 | 0. 9 | 5.40 | 0.11 | 6.48 | 0.13 |
| 29 | 1. 9 | 0. 2 | 2.17 | 0. 4 | 3.26 | 0. 7 | 4.34 | 0. 9 | 5.43 | 0.11 | 6.52 | 0.13 |
| 30 | 1.10 | 0. 2 | 2.19 | 0. 5 | 3.28 | 0. 7 | 4.37 | 0. 9 | 5.47 | 0.12 | 6.56 | 0.14 |
| 31 | 1.10 | 0. 2 | 2.20 | 0. 5 | 3.30 | 0. 7 | 4.40 | 0.10 | 5.50 | 0.12 | 7. 0 | 0.14 |
| 32 | 1.11 | 0. 2 | 2.22 | 0. 5 | 3.33 | 0. 7 | 4.43 | 0.10 | 5.54 | 0.13 | 7. 5 | 0.15 |
| 33 | 1.11 | 0. 3 | 2.23 | 0. 5 | 3.35 | 0. 8 | 4.46 | 0.10 | 5.58 | 0.13 | 7.10 | 0.16 |
| 34 | 1.12 | 0. 3 | 2.25 | 0. 5 | 3.37 | 0. 8 | 4.50 | 0.11 | 6. 2 | 0.14 | 7.15 | 0.16 |
| 35 | 1.13 | 0. 3 | 2.27 | 0. 6 | 3.40 | 0. 8 | 4.53 | 0.11 | 6. 6 | 0.14 | 7.20 | 0.17 |
| 36 | 1.14 | 0. 3 | 2.28 | 0. 6 | 3.43 | 0. 9 | 4.57 | 0.12 | 6.11 | 0.15 | 7.25 | 0.18 |
| 37 | 1.15 | 0. 3 | 2.30 | 0 6 | 3.45 | 0. 9 | 5. 1 | 0.12 | 6.16 | 0.15 | 7.31 | 0.18 |
| 38 | 1.16 | 0. 3 | 2.32 | 0. 6 | 3.48 | 0. 9 | 5. 5 | 0.13 | 6.21 | 0.16 | 7.37 | 0.19 |
| 39 | 1.17 | 0. 3 | 2.34 | 0. 6 | 3.52 | 0.10 | 5. 9 | 0.13 | 6.26 | 0.16 | 7.44 | 0.20 |
| 40 | 1.18 | 0. 3 | 2.37 | 0. 7 | 3.55 | 0.10 | 5.14 | 0.13 | 6.32 | 0.17 | 7.51 | 0.20 |
| 41 | 1.19 | 0. 3 | 2.39 | 0. 7 | 3.59 | 0.10 | 5.18 | 0.14 | 6.38 | 0.17 | 7.58 | 0.21 |
| 42 | 1.21 | 0. 4 | 2.41 | 0. 7 | 4. 2 | 0.11 | 5.23 | 0.14 | 6.44 | 0.18 | 8. 5 | 0.22 |
| 43 | 1.22 | 0. 4 | 2.44 | 0. 7 | 4. 6 | 0.11 | 5.28 | 0.15 | 6.51 | 0.19 | 8.13 | 0.22 |
| 44 | 1.23 | 0. 4 | 2.47 | 0. 8 | 4.10 | 0.12 | 5.34 | 0.15 | 6.58 | 0.19 | 8.21 | 0.23 |
| 45 | 1.25 | 0. 4 | 2.50 | 0. 8 | 4.15 | 0.12 | 5.40 | 0.16 | 7. 5 | 0.20 | 8.30 | 0.24 |
| 46 | 1.26 | 0. 4 | 2.53 | 0. 8 | 4.19 | 0.12 | 5.46 | 0.17 | 7.12 | 0.21 | 8.39 | 0.25 |
| 47 | 1.28 | 0. 4 | 2.56 | 0. 9 | 4.24 | 0.13 | 5.52 | 0.17 | 7.21 | 0.22 | 8.49 | 0.26 |
| 48 | 1.30 | 0. 4 | 2.59 | 0. 9 | 4.29 | 0.13 | 5.59 | 0.18 | 7.29 | 0.22 | 8.59 | 0.27 |
| 49 | 1.31 | 0. 5 | 3. 3 | 0. 9 | 4.35 | 0.14 | 6. 6 | 0.18 | 7.38 | 0.23 | 9.10 | 0.28 |
| 50 | 1.33 | 0. 5 | 3. 7 | 0.10 | 4.40 | 0.14 | 6.14 | 0.19 | 7.48 | 0.24 | 9.21 | 0.29 |
| 51 | 1.35 | 0. 5 | 3.11 | 0.10 | 4.46 | 0.15 | 6.22 | 0.20 | 7.58 | 0.25 | 9.34 | 0.30 |
| 52 | 1.37 | 0. 5 | 3.15 | 0.10 | 4.52 | 0.15 | 6.30 | 0.21 | 8. 8 | 0.26 | 9.46 | 0.31 |
| 53 | 1.39 | 0. 5 | 3.20 | 0.11 | 4.59 | 0.16 | 6.40 | 0.21 | 8.20 | 0.27 | 10. 0 | 0.32 |
| 54 | 1.42 | 0. 5 | 3.24 | 0.11 | 5. 7 | 0.16 | 6.49 | 0.22 | 8.32 | 0.28 | 10.15 | 0.33 |
| 55 | 1.45 | 0. 6 | 3.29 | 0.11 | 5.14 | 0.17 | 6.59 | 0.23 | 8.44 | 0.29 | 10.30 | 0.35 |
| 56 | 1.47 | 0. 6 | 3.35 | 0.12 | 5.22 | 0.18 | 7.10 | 0.24 | 8.58 | 0.30 | 10.46 | 0.36 |
| 57 | 1.50 | 0. 6 | 3.41 | 0.12 | 5.31 | 0.19 | 7.22 | 0.25 | 9.13 | 0.31 | 11. 4 | 0.37 |
| 58 | 1.53 | 0. 6 | 3.47 | 0.13 | 5.40 | 0.19 | 7.34 | 0.26 | 9.28 | 0.32 | 11.22 | 0.39 |
| 59 | 1.57 | 0. 7 | 3.53 | 0.13 | 5.50 | 0.20 | 7.47 | 0.27 | 9.45 | 0.33 | 11.43 | 0.40 |
| 60 | 2. 0 | 0. 7 | 4. 0 | 0.14 | 6. 0 | 0.21 | 8. 1 | 0.28 | 10. 2 | 0.35 | 12. 4 | 0.42 |
| 61 | 2. 4 | 0. 7 | 4. 8 | 0.14 | 6.12 | 0.22 | 8.16 | 0.29 | 10.21 | 0.36 | 12.27 | 0.44 |
| 62 | 2. 8 | 0. 8 | 4.16 | 0.15 | 6.24 | 0.23 | 8.33 | 0 30 | 10.42 | 0.38 | 12.52 | 0.46 |
| 63 | 2.12 | 0. 8 | 4.25 | 0.16 | 6.37 | 0.24 | 8.50 | 0.32 | 11. 4 | 0.40 | 13.19 | 0.48 |
| 64 | 2.17 | 0. 8 | 4.34 | 0.16 | 6.51 | 0.25 | 9. 9 | 0.33 | 11.28 | 0.41 | 13.48 | 0.50 |

## Bearing Amplitude and Time Amplitude at Rising and Setting of the Sun. (z)

Declination.

| Lat. | 7° | | 8° | | 9° | | 10° | | 11° | | 12° | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. | Bearg. Ampl. | Time Ampl. |
| ° | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. |
| 1 | 7. 0 | 0. 0 | 8. 0 | 0. 1 | 9. 0 | 0. 1 | 10. 0 | 0. 1 | 11. 0 | 0 1 | 12. 0 | 0. 1 |
| 2 | 7. 0 | 0. 1 | 8. 0 | 0. 1 | 9. 0 | 0. 1 | 10. 0 | 0. 1 | 11. 0 | 0. 2 | 12. 0 | 0. 2 |
| 3 | 7. 1 | 0. 1 | 8. 1 | 0. 2 | 9. 1 | 0. 2 | 10. 1 | 0. 2 | 11. 1 | 0. 2 | 12. 1 | 0. 3 |
| 4 | 7. 1 | 0. 2 | 8. 1 | 0. 2 | 9. 1 | 0. 3 | 10. 2 | 0. 3 | 11. 2 | 0. 3 | 12. 2 | 0. 3 |
| 5 | 7. 2 | 0. 2 | 8. 2 | 0. 3 | 9. 2 | 0. 3 | 10. 3 | 0. 4 | 11. 3 | 0. 4 | 12. 3 | 0. 4 |
| 6 | 7. 3 | 0. 3 | 8. 3 | 0. 3 | 9. 3 | 0. 4 | 10. 4 | 0. 4 | 11. 4 | 0. 5 | 12. 4 | 0. 5 |
| 7 | 7. 4 | 0. 3 | 8. 4 | 0. 4 | 9. 4 | 0. 4 | 10. 5 | 0. 5 | 11. 5 | 0. 5 | 12. 5 | 0. 6 |
| 8 | 7. 5 | 0. 4 | 8. 5 | 0. 5 | 9. 5 | 0. 5 | 10. 6 | 0. 6 | 11. 7 | 0. 6 | 12. 7 | 0. 7 |
| 9 | 7. 5 | 0. 4 | 8. 6 | 0. 5 | 9. 7 | 0. 6 | 10. 8 | 0. 6 | 11. 8 | 0. 6 | 12. 9 | 0. 8 |
| 10 | 7. 7 | 0. 5 | 8. 8 | 0. 6 | 9. 9 | 0. 6 | 10.10 | 0. 7 | 11.11 | 0. 8 | 12.12 | 0. 9 |
| 11 | 7. 9 | 0. 5 | 8. 9 | 0. 6 | 9.10 | 0. 7 | 10.12 | 0. 8 | 11.13 | 0. 9 | 12.14 | 0. 9 |
| 12 | 7.10 | 0. 6 | 8.11 | 0. 7 | 9.12 | 0. 8 | 10.14 | 0. 9 | 11.15 | 0. 9 | 12.16 | 0.10 |
| 13 | 7.11 | 0. 6 | 8.12 | 0. 7 | 9.14 | 0. 8 | 10.15 | 0. 9 | 11.17 | 0.10 | 12.19 | 0.11 |
| 14 | 7.13 | 0. 7 | 8.15 | 0. 8 | 9.17 | 0. 9 | 10.18 | 0.10 | 11.20 | 0.11 | 12.22 | 0.12 |
| 15 | 7.15 | 0. 8 | 8.17 | 0. 9 | 9.19 | 0.10 | 10.21 | 0.11 | 11.23 | 0.12 | 12.25 | 0.13 |
| 16 | 7.17 | 0. 8 | 8.19 | 0. 9 | 9.22 | 0.10 | 10.24 | 0.12 | 11.27 | 0.13 | 12.29 | 0.14 |
| 17 | 7.19 | 0. 9 | 8.22 | 0.10 | 9.25 | 0.11 | 10.27 | 0.12 | 11.30 | 0.14 | 12.33 | 0.15 |
| 18 | 7.22 | 0. 9 | 8.25 | 0.10 | 9.28 | 0.12 | 10.30 | 0.13 | 11.34 | 0.14 | 12.38 | 0.16 |
| 19 | 7.24 | 0.10 | 8.28 | 0.11 | 9.31 | 0.12 | 10.34 | 0.14 | 11.38 | 0.15 | 12.42 | 0.17 |
| 20 | 7.27 | 0.10 | 8.31 | 0.12 | 9.35 | 0.13 | 10.39 | 0.15 | 11.43 | 0.16 | 12.47 | 0.18 |
| 21 | 7.30 | 0.11 | 8.34 | 0.12 | 9.39 | 0.14 | 10.43 | 0.16 | 11.48 | 0.17 | 12.52 | 0.19 |
| 22 | 7.33 | 0.11 | 8.38 | 0.13 | 9.43 | 0.15 | 10.48 | 0.16 | 11.53 | 0.18 | 12.58 | 0.20 |
| 23 | 7.36 | 0.12 | 8.42 | 0.14 | 9.47 | 0.15 | 10.53 | 0.17 | 11.58 | 0.19 | 13. 3 | 0.21 |
| 24 | 7.40 | 0.13 | 8.46 | 0.14 | 9.52 | 0.16 | 10.58 | 0.18 | 12. 4 | 0.20 | 13. 9 | 0.22 |
| 25 | 7.44 | 0.13 | 8.50 | 0.15 | 9.56 | 0.17 | 11. 3 | 0.19 | 12. 9 | 0.21 | 13.15 | 0.23 |
| 26 | 7.48 | 0.14 | 8.55 | 0.16 | 10. 1 | 0.18 | 11. 9 | 0.20 | 12.15 | 0.22 | 13.22 | 0.24 |
| 27 | 7.52 | 0.14 | 8.59 | 0.16 | 10. 6 | 0.19 | 11.15 | 0.21 | 12.22 | 0.23 | 13.29 | 0.25 |
| 28 | 7.56 | 0.15 | 9. 4 | 0.17 | 10.12 | 0.19 | 11.21 | 0.22 | 12.29 | 0.24 | 13.37 | 0.26 |
| 29 | 8. 0 | 0.16 | 9. 9 | 0.18 | 10.18 | 0.20 | 11.27 | 0.22 | 12.36 | 0.25 | 13.45 | 0.27 |
| 30 | 8. 5 | 0.16 | 9.15 | 0.19 | 10.24 | 0.21 | 11.34 | 0.23 | 12.44 | 0.26 | 13.53 | 0.28 |
| 31 | 8.10 | 0.17 | 9.21 | 0.19 | 10.31 | 0.22 | 11.41 | 0.24 | 12.52 | 0.27 | 14. 2 | 0.29 |
| 32 | 8.16 | 0.18 | 9.27 | 0.20 | 10.38 | 0.23 | 11.49 | 0.25 | 13. 0 | 0.28 | 14.11 | 0.31 |
| 33 | 8.21 | 0.18 | 9.33 | 0.21 | 10.45 | 0.24 | 11.57 | 0.26 | 13. 9 | 0.29 | 14.21 | 0.32 |
| 34 | 8.27 | 0.19 | 9.40 | 0.22 | 10.52 | 0.25 | 12. 5 | 0.27 | 13.18 | 0.30 | 14.32 | 0.33 |
| 35 | 8.33 | 0.20 | 9.47 | 0.23 | 11. 0 | 0.25 | 12.14 | 0.28 | 13.28 | 0.31 | 14.43 | 0.34 |
| 36 | 8.40 | 0.20 | 9.54 | 0.23 | 11. 9 | 0.26 | 12.24 | 0.29 | 13.39 | 0.32 | 14.54 | 0.36 |
| 37 | 8.47 | 0.21 | 10. 2 | 0.24 | 11.18 | 0.27 | 12.34 | 0.31 | 13.49 | 0.34 | 15. 6 | 0.37 |
| 38 | 8.54 | 0.22 | 10.11 | 0.25 | 11.27 | 0.28 | 12.44 | 0.32 | 14. 1 | 0.35 | 15.18 | 0.38 |
| 39 | 9. 1 | 0.23 | 10.19 | 0.26 | 11.37 | 0.29 | 12.55 | 0.33 | 14.13 | 0.36 | 15.31 | 0.40 |
| 40 | 9. 9 | 0.24 | 10.28 | 0.27 | 11.47 | 0.31 | 13. 6 | 0.34 | 14.25 | 0.38 | 15.45 | 0.41 |
| 41 | 9.18 | 0.25 | 10.38 | 0.28 | 11.58 | 0.32 | 13.18 | 0.35 | 14.39 | 0.39 | 16. 0 | 0.43 |
| 42 | 9.26 | 0.25 | 10.48 | 0.29 | 12. 9 | 0.33 | 13.31 | 0.37 | 14.53 | 0.40 | 16.15 | 0.44 |
| 43 | 9.35 | 0.26 | 10.58 | 0.30 | 12.21 | 0.34 | 13.44 | 0.38 | 15. 7 | 0.42 | 16.31 | 0.46 |
| 44 | 9.45 | 0.27 | 11. 9 | 0.31 | 12.34 | 0.35 | 13.58 | 0.39 | 15.23 | 0.43 | 16.48 | 0.47 |
| 45 | 9.55 | 0.28 | 11.21 | 0.32 | 12.47 | 0.36 | 14.13 | 0.41 | 15.39 | 0.45 | 17. 6 | 0.49 |
| 46 | 10. 6 | 0.29 | 11.33 | 0.33 | 13. 1 | 0.38 | 14.29 | 0.42 | 15.57 | 0.46 | 17.25 | 0.51 |
| 47 | 10.18 | 0.30 | 11.47 | 0.35 | 13.16 | 0.39 | 14.45 | 0.44 | 16.15 | 0.48 | 17.45 | 0.53 |
| 48 | 10.30 | 0.31 | 12. 1 | 0.36 | 13.31 | 0.41 | 15. 3 | 0.45 | 16.34 | 0.50 | 18. 6 | 0.55 |
| 49 | 10.42 | 0.32 | 12.15 | 0.37 | 13.48 | 0.42 | 15.21 | 0.47 | 16.55 | 0.52 | 18.28 | 0.57 |
| 50 | 10.56 | 0.34 | 12.30 | 0.39 | 14. 5 | 0.44 | 15.40 | 0.49 | 17.16 | 0.54 | 18.52 | 0.59 |
| 51 | 11.10 | 0.35 | 12.47 | 0.40 | 14 24 | 0.45 | 16. 1 | 0.50 | 17.39 | 0.56 | 19.18 | 1. 1 |
| 52 | 11.25 | 0.36 | 13. 4 | 0.41 | 14.43 | 0.47 | 16.23 | 0.52 | 18. 3 | 0.58 | 19.44 | 1. 3 |
| 53 | 11.41 | 0.38 | 13.22 | 0.43 | 15. 4 | 0.49 | 16.46 | 0.54 | 18.29 | 1. 0 | 20.13 | 1. 6 |
| 54 | 11.58 | 0.39 | 13.42 | 0.45 | 15.26 | 0.50 | 17.11 | 0.56 | 18.57 | 1. 2 | 20.43 | 1. 8 |
| 55 | 12.16 | 0.40 | 14. 3 | 0.46 | 15.50 | 0.52 | 17.37 | 0.58 | 19.26 | 1. 4 | 21.15 | 1.11 |
| 56 | 12.35 | 0.42 | 14.25 | 0.48 | 16.15 | 0.54 | 18. 6 | 1. 1 | 19.57 | 1. 7 | 21.50 | 1.13 |
| 57 | 12.56 | 0.44 | 14.48 | 0.50 | 16.42 | 0.56 | 18.36 | 1. 3 | 20.31 | 1.10 | 22.26 | 1.16 |
| 58 | 13.18 | 0.45 | 15.13 | 0.52 | 17.10 | 0.59 | 19. 8 | 1. 6 | 21. 7 | 1.12 | 23. 6 | 1.19 |
| 59 | 13 41 | 0.47 | 15.41 | 0.54 | 17.41 | 1. 1 | 19.42 | 1. 8 | 21.44 | 1.16 | 23.49 | 1.23 |
| 60 | 14. 6 | 0.49 | 16.10 | 0.56 | 18.14 | 1. 4 | 20.19 | 1.11 | 22.26 | 1.19 | 24.34 | 1.26 |
| 61 | 14.34 | 0.51 | 16.41 | 0.59 | 18.49 | 1. 6 | 20.59 | 1.14 | 23.11 | 1.22 | 25.24 | 1.30 |
| 62 | 15. 3 | 0.53 | 17.15 | 1. 1 | 19.28 | 1. 9 | 21.43 | 1.17 | 23.59 | 1.26 | 26.17 | 1.34 |
| 63 | 15.34 | 0.56 | 17 51 | 1. 4 | 20. 9 | 1.12 | 22.29 | 1.21 | 24.51 | 1.30 | 27.15 | 1.39 |
| 64 | 16. 8 | 0.58 | 18.31 | 1. 7 | 20.54 | 1.16 | 23.20 | 1.25 | 25.48 | 1.34 | 28.19 | 1.43 |

(z) Bearing Amplitude and Time Amplitude at Rising and Setting of the Sun.

| Lat. | Declination. 13° Bearing Ampl. | 13° Time Ampl. | 14° Bearing Ampl. | 14° Time Ampl. | 15° Bears. Ampl. | 15° Time Ampl. | 16° Bears. Ampl. | 16° Time Ampl. | 17° Bears. Ampl. | 17° Time Ampl. | 18° Bears. Ampl. | 18° Time Ampl. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. |
| 1 | 13. 0 | 0. 1 | 14. 0 | 0. 1 | 15. 0 | 0. 1 | 16. 0 | 0. 1 | 17. 0 | 0. 1 | 18. 0 | 0. 1 |
| 2 | 13. 0 | 0. 2 | 14. 0 | 0. 2 | 15. 0 | 0. 2 | 16. 1 | 0. 2 | 17. 1 | 0. 2 | 18. 1 | 0. 3 |
| 3 | 13. 1 | 0. 3 | 14. 1 | 0. 3 | 15. 1 | 0. 3 | 16. 1 | 0. 3 | 17. 2 | 0. 4 | 18. 2 | 0. 4 |
| 4 | 13. 2 | 0. 4 | 14. 2 | 0. 4 | 15. 2 | 0. 4 | 16. 2 | 0. 5 | 17. 3 | 0. 5 | 18. 3 | 0. 5 |
| 5 | 13. 3 | 0. 5 | 14. 3 | 0. 5 | 15. 4 | 0. 5 | 16. 4 | 0. 6 | 17. 4 | 0. 6 | 18. 4 | 0. 7 |
| 6 | 13. 4 | 0. 6 | 14. 4 | 0. 6 | 15. 5 | 0. 6 | 16. 5 | 0. 7 | 17. 5 | 0. 7 | 18. 6 | 0. 8 |
| 7 | 13. 6 | 0. 6 | 14. 6 | 0. 7 | 15. 7 | 0. 8 | 16. 7 | 0. 8 | 17. 8 | 0. 9 | 18. 8 | 0. 9 |
| 8 | 13. 8 | 0. 7 | 14. 8 | 0. 8 | 15. 9 | 0. 9 | 16.10 | 0. 9 | 17.10 | 0.10 | 18.11 | 0.10 |
| 9 | 13.10 | 0. 8 | 14.10 | 0. 9 | 15.11 | 0.10 | 16.12 | 0.10 | 17.13 | 0.11 | 18.14 | 0.12 |
| 10 | 13.13 | 0. 9 | 14.14 | 0.10 | 15.15 | 0.11 | 16.16 | 0.12 | 17.17 | 0.12 | 18.18 | 0.13 |
| 11 | 13.15 | 0.10 | 14.16 | 0.11 | 15.17 | 0.12 | 16.18 | 0.13 | 17.20 | 0.14 | 18.21 | 0.14 |
| 12 | 13.18 | 0.11 | 14.19 | 0.12 | 15.21 | 0.13 | 16.22 | 0.14 | 17.23 | 0 15 | 18.25 | 0.16 |
| 13 | 13.21 | 0.12 | 14.22 | 0.13 | 15.24 | 0.14 | 16.26 | 0.15 | 17.28 | 0.16 | 18.30 | 0.17 |
| 14 | 13.24 | 0.13 | 14.26 | 0.14 | 15.28 | 0.15 | 16.30 | 0.16 | 17.32 | 0 17 | 18.34 | 0.19 |
| 15 | 13.28 | 0.14 | 14.30 | 0.15 | 15 33 | 0.16 | 16.35 | 0.18 | 17.37 | 0.19 | 18.40 | 0.20 |
| 16 | 13.32 | 0.15 | 14.34 | 0.16 | 15.37 | 0.18 | 16.40 | 0.19 | 17.43 | 0.20 | 18.45 | 0.21 |
| 17 | 13.36 | 0.16 | 14.39 | 0.17 | 15.42 | 0.19 | 16.45 | 0.20 | 17.48 | 0.21 | 18.51 | 0.23 |
| 18 | 13.41 | 0.17 | 14.44 | 0.19 | 15.47 | 0.20 | 16.51 | 0.21 | 17.54 | 0.23 | 18.57 | 0.24 |
| 19 | 13.46 | 0.18 | 14.50 | 0.20 | 15.53 | 0.21 | 16.57 | 0.23 | 18. 1 | 0.24 | 19. 5 | 0.26 |
| 20 | 13.51 | 0.19 | 14.55 | 0.21 | 15.59 | 0.22 | 17. 4 | 0.24 | 18. 8 | 0.26 | 19.12 | 0.27 |
| 21 | 13.57 | 0.20 | 15. 1 | 0.22 | 16. 6 | 0.24 | 17.11 | 0.25 | 18.15 | 0.27 | 19.20 | 0.29 |
| 22 | 14. 3 | 0.21 | 15. 8 | 0.23 | 16.13 | 0.25 | 17.18 | 0.27 | 18.23 | 0.28 | 19.28 | 0.30 |
| 23 | 14. 9 | 0.22 | 15.15 | 0.24 | 16.20 | 0.26 | 17.26 | 0.28 | 18.31 | 0.30 | 19.37 | 0.32 |
| 24 | 14.16 | 0.24 | 15.22 | 0.26 | 16.28 | 0.27 | 17.34 | 0.29 | 18.40 | 0.31 | 19.46 | 0.33 |
| 25 | 14.23 | 0.25 | 15.29 | 0.27 | 16.36 | 0.29 | 17.43 | 0.31 | 18.49 | 0.33 | 19.56 | 0.35 |
| 26 | 14.30 | 0.26 | 15.37 | 0.28 | 16.45 | 0.30 | 17.52 | 0.32 | 18.59 | 0.34 | 20. 7 | 0.36 |
| 27 | 14.38 | 0.27 | 15.45 | 0.29 | 16.54 | 0.31 | 18. 1 | 0.34 | 19. 9 | 0.36 | 20.18 | 0.38 |
| 28 | 14.46 | 0.28 | 15.54 | 0.30 | 17. 3 | 0.33 | 18.11 | 0.35 | 19.20 | 0.37 | 20.29 | 0.40 |
| 29 | 14.54 | 0.29 | 16. 3 | 0.32 | 17.13 | 0.34 | 18 22 | 0.37 | 19.32 | 0.39 | 20.41 | 0.42 |
| 30 | 15. 3 | 0.31 | 16.13 | 0.33 | 17.23 | 0.36 | 18.34 | 0.38 | 19.44 | 0.41 | 20.54 | 0.43 |
| 31 | 15.13 | 0.32 | 16.23 | 0.34 | 17.34 | 0.37 | 18.46 | 0.40 | 19.57 | 0.42 | 21. 8 | 0.45 |
| 32 | 15.23 | 0.33 | 16.34 | 0.36 | 17.46 | 0.39 | 18.58 | 0.41 | 20.10 | 0.44 | 21.22 | 0.47 |
| 33 | 15.34 | 0.34 | 16.46 | 0.37 | 17.59 | 0.40 | 19.11 | 0.43 | 20.24 | 0.46 | 21.37 | 0.49 |
| 34 | 15.45 | 0.36 | 16.58 | 0.39 | 18.12 | 0.42 | 19.25 | 0.45 | 20.38 | 0.48 | 21.53 | 0.51 |
| 35 | 15.57 | 0.37 | 17.11 | 0.40 | 18.26 | 0.43 | 19.40 | 0.46 | 20.54 | 0.49 | 22.10 | 0.53 |
| 36 | 16. 9 | 0.39 | 17.24 | 0.42 | 18.40 | 0.45 | 19.55 | 0.48 | 21.11 | 0.51 | 22.27 | 0.55 |
| 37 | 16.22 | 0.40 | 17.38 | 0.43 | 18.55 | 0.47 | 20.11 | 0.50 | 21.28 | 0.53 | 22.46 | 0.57 |
| 38 | 16.35 | 0.42 | 17.53 | 0.45 | 19.10 | 0.48 | 20.28 | 0.52 | 21.47 | 0.55 | 23. 5 | 0.59 |
| 39 | 16.50 | 0.43 | 18. 8 | 0.47 | 19.27 | 0.50 | 20.46 | 0.54 | 22. 6 | 0.57 | 23.26 | 1. 1 |
| 40 | 17. 5 | 0.45 | 18.25 | 0.48 | 19.45 | 0.52 | 21. 5 | 0.56 | 22.26 | 0.59 | 23.47 | 1. 3 |
| 41 | 17.21 | 0.46 | 18.42 | 0.50 | 20. 3 | 0.54 | 21.25 | 0.58 | 22.48 | 1. 2 | 24.10 | 1. 6 |
| 42 | 17.37 | 0.48 | 19. 0 | 0.52 | 20.23 | 0.56 | 21.46 | 1. 0 | 23.10 | 1. 4 | 24.34 | 1. 8 |
| 43 | 17.55 | 0.50 | 19.19 | 0.54 | 20.43 | 0.58 | 22. 8 | 1. 2 | 23.34 | 1. 6 | 25. 0 | 1.11 |
| 44 | 18.13 | 0.52 | 19.39 | 0.56 | 21. 5 | 1. 0 | 22.32 | 1. 4 | 23.59 | 1. 9 | 25.26 | 1.13 |
| 45 | 18.33 | 0.53 | 20. 0 | 0.58 | 21.28 | 1. 2 | 22.57 | 1. 7 | 24.25 | 1.11 | 25.55 | 1.16 |
| 46 | 18.54 | 0.55 | 20.23 | 1. 0 | 21.53 | 1. 4 | 23.23 | 1. 9 | 24.53 | 1.14 | 26.25 | 1.19 |
| 47 | 19.16 | 0.57 | 20.47 | 1. 2 | 22.18 | 1. 7 | 23.50 | 1.12 | 25.23 | 1.17 | 26.57 | 1.22 |
| 48 | 19.39 | 0.59 | 21.12 | 1. 4 | 22.45 | 1. 9 | 24.20 | 1.14 | 25.54 | 1.19 | 27.31 | 1.25 |
| 49 | 20. 3 | 1. 2 | 21.38 | 1. 7 | 23.14 | 1.12 | 24.51 | 1.17 | 26.28 | 1.22 | 28. 6 | 1.28 |
| 50 | 20.29 | 1. 4 | 22. 7 | 1. 9 | 23.45 | 1.14 | 25.24 | 1.20 | 27. 3 | 1.25 | 28.44 | 1.31 |
| 51 | 20.57 | 1. 6 | 22.37 | 1.12 | 24.18 | 1.17 | 25.59 | 1.23 | 27.41 | 1.29 | 29.25 | 1.35 |
| 52 | 21.26 | 1. 9 | 23. 9 | 1.14 | 24.52 | 1.20 | 26.36 | 1.26 | 28.21 | 1.32 | 30. 7 | 1.38 |
| 53 | 21.57 | 1.11 | 23.43 | 1.17 | 25.28 | 1.23 | 27.16 | 1.29 | 29. 4 | 1.36 | 30.54 | 1.42 |
| 54 | 22.30 | 1.14 | 24.18 | 1.20 | 26. 7 | 1.27 | 27.58 | 1.33 | 29.50 | 1.40 | 31.43 | 1.46 |
| 55 | 23. 6 | 1.17 | 24.57 | 1.23 | 26.50 | 1.30 | 28.43 | 1.37 | 30.39 | 1.44 | 32.36 | 1.51 |
| 56 | 23.43 | 1.20 | 25.38 | 1.27 | 27.34 | 1.34 | 29.32 | 1.41 | 31.32 | 1.48 | 33.33 | 1.55 |
| 57 | 24.23 | 1 23 | 26.22 | 1.30 | 28.22 | 1.37 | 30.24 | 1.45 | 32.28 | 1.52 | 34.34 | 2 .0 |
| 58 | 25. 7 | 1.27 | 27.10 | 1.34 | 29.14 | 1.42 | 31.20 | 1.49 | 33.29 | 1.57 | 35.40 | 2. 5 |
| 59 | 25.54 | 1.30 | 28. 1 | 1.38 | 30.10 | 1.46 | 32.21 | 1.54 | 34.35 | 2. 2 | 36.52 | 2.11 |
| 60 | 26.44 | 1.34 | 28.56 | 1.42 | 31.10 | 1.51 | 33.27 | 1.59 | 35.47 | 2. 8 | 38.10 | 2.17 |
| 61 | 27.39 | 1.38 | 29.56 | 1.47 | 32.16 | 1.56 | 34.39 | 2. 5 | 37. 5 | 2.14 | 39.36 | 2.24 |
| 62 | 28.38 | 1.43 | 31. 1 | 1.52 | 33.27 | 2. 1 | 35.57 | 2.11 | 38.31 | 2.20 | 41.10 | 2.31 |
| 63 | 29.42 | 1.48 | 32.12 | 1.57 | 34.46 | 2. 7 | 37.23 | 2.17 | 40. 5 | 2.27 | 42.54 | 2.38 |
| 64 | 30.52 | 1.53 | 33.30 | 2. 3 | 36.11 | 2.13 | 38.58 | 2.24 | 41.50 | 2.35 | 44.49 | 2.47 |

## (z) Bearing Amplitude and Time Amplitude at Rising and Setting of the Sun.

Declination.

| Lat. | 19° | | 20° | | 21° | | 22° | | 23° | | 23° 30′ | | 23° 45′ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. | Bearing Ampl. | Time Ampl. |
| ° | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° ′ | h. m. | ° | h. m |
| 1 | 19. 0 | 0. 1 | 20. 0 | 0. 1 | 21. 0 | 0. 2 | 22. 0 | 0. 2 | 23. 1 | 0. 1 | 23.31 | 0. 1 | 23.46 | 0. 2 |
| 2 | 19. 1 | 0. 3 | 20. 1 | 0. 3 | 21. 1 | 0. 3 | 22. 1 | 0. 3 | 23. 2 | 0. 3 | 23.32 | 0. 3 | 23.47 | 0. 4 |
| 3 | 19. 2 | 0. 4 | 20. 2 | 0. 4 | 21. 2 | 0. 5 | 22. 2 | 0. 5 | 23. 3 | 0. 5 | 23.33 | 0. 5 | 23.48 | 0. 6 |
| 4 | 19. 3 | 0. 6 | 20. 3 | 0. 6 | 21. 3 | 0. 6 | 22. 3 | 0. 6 | 23. 4 | 0. 7 | 23.34 | 0. 7 | 23.49 | 0. 8 |
| 5 | 19. 4 | 0. 7 | 20. 5 | 0. 7 | 21. 5 | 0. 8 | 22. 5 | 0. 8 | 23. 5 | 0. 9 | 23.36 | 0. 9 | 23.51 | 0.10 |
| 6 | 19. 6 | 0. 8 | 20. 7 | 0. 9 | 21. 7 | 0. 9 | 22. 7 | 0.10 | 23. 8 | 0.10 | 23.38 | 0.10 | 23.53 | 0.11 |
| 7 | 19. 9 | 0.10 | 20. 9 | 0.10 | 21.10 | 0.11 | 22.10 | 0.11 | 23.11 | 0.12 | 23.41 | 0.12 | 23.56 | 0.13 |
| 8 | 19.12 | 0.11 | 20.12 | 0.12 | 21.13 | 0.12 | 22.14 | 0.13 | 23.14 | 0.14 | 23.44 | 0.14 | 23.59 | 0.15 |
| 9 | 19.15 | 0.12 | 20.16 | 0.13 | 21.17 | 0.14 | 22.18 | 0.15 | 23.18 | 0.15 | 23.48 | 0.15 | 24. 3 | 0.16 |
| 10 | 19.19 | 0.14 | 20.20 | 0.15 | 21.21 | 0.16 | 22.22 | 0.16 | 23.23 | 0.17 | 23.53 | 0.17 | 24. 8 | 0.18 |
| 11 | 19.22 | 0.15 | 20.24 | 0.16 | 21.25 | 0.17 | 22.26 | 0.18 | 23.27 | 0.19 | 23.58 | 0.19 | 24.13 | 0.20 |
| 12 | 19.26 | 0.17 | 20.28 | 0.18 | 21.30 | 0.19 | 22.31 | 0.20 | 23.33 | 0.21 | 24 .3 | 0.21 | 24.18 | 0.22 |
| 13 | 19.31 | 0.18 | 20.33 | 0.19 | 21.35 | 0.20 | 22.37 | 0.21 | 23.39 | 0.22 | 24. 9 | 0.23 | 24.25 | 0.23 |
| 14 | 19.36 | 0.20 | 20.38 | 0.21 | 21.41 | 0.22 | 22.43 | 0.23 | 23.45 | 0.24 | 24.16 | 0.24 | 24.32 | 0.25 |
| 15 | 19.42 | 0.21 | 20.44 | 0.22 | 21.46 | 0.24 | 22.49 | 0.25 | 23.51 | 0.26 | 24.23 | 0.26 | 24.39 | 0.27 |
| 16 | 19.48 | 0.23 | 20.51 | 0.24 | 21.53 | 0.25 | 22.56 | 0.27 | 23.59 | 0.28 | 24.30 | 0.28 | 24.46 | 0.29 |
| 17 | 19.54 | 0.24 | 20.57 | 0.26 | 22. 0 | 0.27 | 23. 4 | 0.28 | 24. 7 | 0.30 | 24.38 | 0.30 | 24.54 | 0.31 |
| 18 | 20. 1 | 0.26 | 21. 5 | 0.27 | 22. 8 | 0.29 | 23.12 | 0.30 | 24.15 | 0.32 | 24.47 | 0.32 | 25. 3 | 0.33 |
| 19 | 20. 8 | 0.27 | 21.12 | 0.29 | 22.16 | 0.30 | 23.21 | 0.32 | 24.24 | 0.34 | 24.56 | 0.34 | 25.12 | 0.35 |
| 20 | 20.16 | 0.29 | 21.21 | 0.30 | 22.25 | 0.32 | 23.30 | 0.34 | 24.34 | 0.36 | 25. 6 | 0.36 | 25.22 | 0.37 |
| 21 | 20.24 | 0.30 | 21.30 | 0.32 | 22.34 | 0.34 | 23.40 | 0.36 | 24.45 | 0.38 | 25.17 | 0.38 | 25.33 | 0.39 |
| 22 | 20.33 | 0.32 | 21.39 | 0.34 | 22.44 | 0.36 | 23.50 | 0.38 | 24.56 | 0.40 | 25.28 | 0.40 | 25.44 | 0.41 |
| 23 | 20.43 | 0.34 | 21.49 | 0.36 | 22.55 | 0.37 | 24. 1 | 0.39 | 25. 7 | 0.42 | 25.40 | 0.43 | 25.57 | 0.43 |
| 24 | 20.53 | 0.35 | 21.59 | 0.37 | 23. 6 | 0.39 | 24.13 | 0.41 | 25.19 | 0.44 | 25.53 | 0.45 | 26.10 | 0.45 |
| 25 | 21. 3 | 0.37 | 22.10 | 0.39 | 23.18 | 0.41 | 24.25 | 0.43 | 25.32 | 0.46 | 26. 6 | 0.47 | 26.23 | 0.47 |
| 26 | 21.14 | 0.39 | 22.22 | 0.41 | 23.30 | 0.43 | 24.38 | 0.45 | 25.46 | 0.48 | 26.20 | 0.49 | 26.37 | 0.49 |
| 27 | 21.26 | 0.40 | 22.34 | 0.43 | 23.43 | 0.45 | 24.52 | 0.48 | 26. 1 | 0.50 | 26.35 | 0.51 | 26.52 | 0.51 |
| 28 | 21.38 | 0.42 | 22.47 | 0.45 | 23.57 | 0.47 | 25. 6 | 0.50 | 26.16 | 0.52 | 26.51 | 0.53 | 27. 8 | 0.54 |
| 29 | 21.51 | 0.44 | 23. 1 | 0.47 | 24.12 | 0.49 | 25.22 | 0.52 | 26.22 | 0.54 | 27. 8 | 0.55 | 27.25 | 0.56 |
| 30 | 22. 5 | 0.46 | 23.16 | 0.49 | 24.27 | 0.51 | 25.38 | 0.54 | 26.49 | 0.57 | 27.25 | 0.58 | 27.43 | 0.59 |
| 31 | 22.20 | 0.48 | 23.31 | 0.51 | 24.43 | 0.53 | 25.56 | 0.56 | 27. 7 | 0.59 | 27.44 | 1. 0 | 28. 2 | 1. 1 |
| 32 | 22.35 | 0.50 | 23.47 | 0.53 | 25. 0 | 0.56 | 26.13 | 0.58 | 27.26 | 1. 1 | 28. 3 | 1. 3 | 28.21 | 1. 4 |
| 33 | 22.51 | 0.52 | 24. 4 | 0.55 | 25.18 | 0.58 | 26.32 | 1. 1 | 27.46 | 1. 4 | 28.24 | 1. 5 | 28.42 | 1. 6 |
| 34 | 23. 7 | 0.54 | 24.22 | 0.57 | 25.37 | 1. 0 | 26.52 | 1. 3 | 28. 7 | 1. 7 | 28.45 | 1. 8 | 29. 4 | 1. 9 |
| 35 | 23.25 | 0.56 | 24.41 | 0.59 | 25.57 | 1. 2 | 27.13 | 1. 6 | 28.30 | 1. 9 | 29. 8 | 1.11 | 29.27 | 1.12 |
| 36 | 23.44 | 0.58 | 25. 1 | 1. 1 | 26.18 | 1. 5 | 27.35 | 1. 8 | 28.53 | 1.12 | 29.32 | 1.14 | 29.51 | 1.15 |
| 37 | 24. 3 | 1. 0 | 25.21 | 1. 4 | 26.40 | 1. 7 | 27.58 | 1.11 | 29.17 | 1.15 | 29.57 | 1.16 | 30.17 | 1.17 |
| 38 | 24.24 | 1. 2 | 25.43 | 1. 6 | 27. 3 | 1.10 | 28.23 | 1.14 | 29.44 | 1.17 | 30.24 | 1.19 | 30.44 | 1.20 |
| 39 | 24.46 | 1. 5 | 26. 7 | 1. 9 | 27.28 | 1.12 | 28.49 | 1.16 | 30.11 | 1.20 | 30.52 | 1.22 | 31.13 | 1.24 |
| 40 | 25. 9 | 1. 7 | 26.31 | 1.11 | 27.54 | 1.15 | 29.17 | 1.19 | 30.40 | 1.23 | 31.22 | 1.25 | 31.43 | 1.27 |
| 41 | 25.33 | 1.10 | 26.57 | 1.14 | 28.21 | 1.18 | 29.46 | 1.22 | 31.11 | 1.27 | 31.54 | 1.29 | 32.15 | 1.30 |
| 42 | 25.59 | 1.12 | 27.24 | 1.17 | 28.50 | 1.21 | 30.16 | 1.25 | 31.43 | 1.30 | 32.27 | 1.32 | 32.49 | 1.34 |
| 43 | 26.26 | 1.15 | 27.53 | 1.19 | 29.20 | 1.24 | 30.49 | 1.29 | 32.18 | 1.33 | 33. 3 | 1.35 | 33.25 | 1.37 |
| 44 | 26.55 | 1.18 | 28.24 | 1.22 | 29.53 | 1.27 | 31.23 | 1.32 | 32.54 | 1.37 | 33.46 | 1.39 | 34. 3 | 1.41 |
| 45 | 27.25 | 1.21 | 28.56 | 1.25 | 30.27 | 1.30 | 31.59 | 1.35 | 33.33 | 1.40 | 34.20 | 1.43 | 34.43 | 1.44 |
| 46 | 27.57 | 1.24 | 29.30 | 1.29 | 31. 3 | 1.34 | 32.38 | 1.39 | 34.14 | 1.44 | 35. 2 | 1.47 | 35.26 | 1.48 |
| 47 | 28.31 | 1.27 | 30. 6 | 1.32 | 31.42 | 1.37 | 33.19 | 1.43 | 34.57 | 1.48 | 35.47 | 1.51 | 36.12 | 1.52 |
| 48 | 29. 7 | 1.30 | 30.44 | 1.35 | 32.23 | 1.41 | 34. 3 | 1.47 | 35.44 | 1.53 | 36.35 | 1.56 | 37. 0 | 1.57 |
| 49 | 29.45 | 1.33 | 31.25 | 1.39 | 33. 6 | 1.45 | 34.49 | 1.51 | 36.33 | 1.57 | 37.26 | 2. 0 | 37.52 | 2. 1 |
| 50 | 30.26 | 1.37 | 32. 9 | 1.43 | 33.53 | 1.49 | 35.38 | 1.55 | 37.26 | 2. 2 | 38.20 | 2. 5 | 38.48 | 2. 6 |
| 51 | 31. 9 | 1.41 | 32.55 | 1.47 | 34.43 | 1.53 | 36.32 | 2. 0 | 38.23 | 2. 6 | 39.19 | 2. 9 | 39.47 | 2.11 |
| 52 | 31.56 | 1.45 | 33.45 | 1.51 | 35.36 | 1.58 | 37.29 | 2. 5 | 39.24 | 2.12 | 40.22 | 2.15 | 40.51 | 2.17 |
| 53 | 32.45 | 1.49 | 34.38 | 1.56 | 36.33 | 2. 2 | 38.30 | 2.10 | 40.29 | 2.17 | 41.29 | 2.21 | 42. 0 | 2.23 |
| 54 | 33.38 | 1.53 | 35.35 | 2. 0 | 37.34 | 2. 8 | 39.36 | 2.15 | 41.40 | 2.23 | 42.43 | 2.27 | 43.15 | 2.29 |
| 55 | 34.35 | 1.58 | 36.36 | 2. 5 | 38.40 | 2.13 | 40.47 | 2.21 | 42.56 | 2.29 | 44. 3 | 2.33 | 44.36 | 2.35 |
| 56 | 35.36 | 2. 3 | 37.42 | 2.11 | 39.51 | 2.19 | 42. 4 | 2.27 | 44.20 | 2.36 | 45.29 | 2.40 | 46. 4 | 2.43 |
| 57 | 36.42 | 2. 8 | 38.54 | 2.16 | 41. 9 | 2.25 | 43.27 | 2.34 | 45.51 | 2.43 | 47. 4 | 2.48 | 47.41 | 2.50 |
| 58 | 37.54 | 2.14 | 40.12 | 2.22 | 42.33 | 2.32 | 44.59 | 2.41 | 47.30 | 2.51 | 48.48 | 2.56 | 49.28 | 2.59 |
| 59 | 39.12 | 2.20 | 41.37 | 2.29 | 44. 6 | 2.39 | 46.40 | 2.49 | 49.21 | 3. 0 | 50.44 | 3. 5 | 51.26 | 3. 8 |
| 60 | 40.37 | 2.26 | 43.10 | 2.36 | 45.47 | 2.47 | 48.32 | 2.58 | 51.24 | 3. 9 | 52.54 | 3.15 | 53.40 | 3.19 |
| 61 | 42.11 | 2.34 | 44.52 | 2.44 | 47.40 | 2.55 | 50.36 | 3. 7 | 53.42 | 3.20 | 55.20 | 3.27 | 56.10 | 3.30 |
| 62 | 43.55 | 2.41 | 46.46 | 2.53 | 49.46 | 3. 5 | 52.56 | 3.18 | 56.20 | 3.32 | 58. 9 | 3.39 | 59. 5 | 3.43 |
| 63 | 45.49 | 2.50 | 48.53 | 3. 2 | 52. 8 | 3.16 | 55.36 | 3.30 | 59.23 | 3.46 | 61.26 | 3.55 | 62.31 | 3.59 |
| 64 | 47.58 | 3. 0 | 51.17 | 3.13 | 54.50 | 3.28 | 58.43 | 3.44 | 63. 2 | 4. 2 | 65.27 | 4.13 | 66.45 | 4.18 |

(z 1) The Time from Noon, at which the True Bearing of the Sun is E. or W.

Declination of the same Name as the Latitude.

| Lat. | 0° | 2° | 4° | 6° | 8° | 10° | 12° | 14° | 16° | 18° | 20° | 22° | 24° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. | h. m. |
| 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 | 6. 0 |
| 1 | 6. 0 | 4. 0 | 5. 2 | 5.22 | 5.31 | 5.37 | 5.41 | 5.44 | 5.46 | 5.48 | 5.49 | 5.50 | 5.51 |
| 2 | 6. 0 | 0. 0 | 4. 0 | 4.42 | 5. 2 | 5.14 | 5.22 | 5.28 | 5.32 | 5.35 | 5.38 | 5.40 | 5.42 |
| 3 | 6. 0 | 3.13 | 2.46 | 4. 0 | 4.32 | 4.51 | 5. 3 | 5.11 | 5.18 | 5.23 | 5.27 | 5.30 | 5.33 |
| 4 | 6. 0 | 4. 0 | 0. 0 | 3.13 | 4. 1 | 4.27 | 4.43 | 4.55 | 5. 4 | 5.10 | 5.16 | 5.20 | 5.24 |
| 5 | 6. 0 | 4.26 | 2.28 | 2.15 | 3.26 | 4. 1 | 4.23 | 4.38 | 4.49 | 4.58 | 5. 4 | 5.10 | 5.15 |
| 6 | 6. 0 | 4.42 | 3.13 | 0. 0 | 2.46 | 3.34 | 4. 1 | 4.20 | 4.34 | 4.45 | 4.53 | 5. 0 | 5. 5 |
| 7 | 6. 0 | 4.54 | 3.41 | 2. 5 | 1.56 | 3. 3 | 3.39 | 4. 2 | 4.19 | 4.31 | 4.41 | 4.49 | 4.56 |
| 8 | 6. 0 | 5. 2 | 4. 1 | 2.46 | 0. 0 | 2.29 | 3.14 | 3.43 | 4. 3 | 4.17 | 4.29 | 4.39 | 4.46 |
| 9 | 6. 0 | 5. 9 | 4.15 | 3.14 | 1.50 | 1.44 | 2.47 | 3.22 | 3.46 | 4. 3 | 4.17 | 4.28 | 4.37 |
| 10 | 6. 0 | 5.14 | 4.27 | 3.34 | 2.29 | 0. 0 | 2.16 | 3. 0 | 3.28 | 3.49 | 4. 4 | 4.16 | 4.27 |
| 11 | 6. 0 | 5.19 | 4.36 | 3.49 | 2.55 | 1.40 | 1.35 | 2.35 | 3. 9 | 3.33 | 3.51 | 4. 5 | 4.16 |
| 12 | 6. 0 | 5.22 | 4.43 | 4. 1 | 3.14 | 2.16 | 0. 0 | 2. 6 | 2.49 | 3.17 | 3.37 | 3.53 | 4. 6 |
| 13 | 6. 0 | 5.25 | 4.49 | 4.12 | 3.30 | 2.41 | 1.32 | 1.29 | 2.26 | 2.59 | 3.23 | 3.41 | 3.55 |
| 14 | 6. 0 | 5.28 | 4.55 | 4.20 | 3.43 | 3. 0 | 2. 6 | 0. 0 | 1.58 | 2.40 | 3. 7 | 3.28 | 3.44 |
| 15 | 6. 0 | 5.30 | 4.59 | 4.28 | 3.53 | 3.15 | 2.30 | 1.26 | 1.23 | 2.18 | 2.50 | 3.14 | 3.32 |
| 16 | 6. 0 | 5.32 | 5. 4 | 4.34 | 4. 3 | 3.28 | 2.49 | 1.58 | 0. 0 | 1.52 | 2.32 | 2.59 | 3.20 |
| 17 | 6. 0 | 5.34 | 5. 7 | 4.40 | 4.11 | 3.39 | 3. 4 | 2.21 | 1.21 | 1.19 | 2.11 | 2.43 | 3. 7 |
| 18 | 6. 0 | 5.35 | 5.10 | 4.45 | 4.17 | 3.49 | 3.17 | 2.40 | 1.52 | 0. 0 | 1.47 | 2.26 | 2.53 |
| 19 | 6. 0 | 5.37 | 5.13 | 4.49 | 4.24 | 3.57 | 3.28 | 2.54 | 2.14 | 1.17 | 1.16 | 2. 6 | 2.37 |
| 20 | 6. 0 | 5.38 | 5.16 | 4.53 | 4.29 | 4. 4 | 3.37 | 3. 7 | 2.32 | 1.47 | 0. 0 | 1.43 | 2.21 |
| 21 | 6. 0 | 5.39 | 5.18 | 4.56 | 4.34 | 4.11 | 3.46 | 3.18 | 2.47 | 2. 9 | 1.14 | 1.13 | 2. 2 |
| 22 | 6. 0 | 5.40 | 5.20 | 5. 0 | 4.39 | 4.16 | 3.53 | 3.28 | 2.59 | 2.26 | 1.43 | 0. 0 | 1.39 |
| 23 | 6. 0 | 5.41 | 5.22 | 5. 3 | 4.43 | 4.22 | 4. 0 | 3.36 | 3.10 | 2.40 | 2. 4 | 1.11 | 1.10 |
| 24 | 6. 0 | 5.42 | 5.24 | 5. 5 | 4.46 | 4.27 | 4. 6 | 3.44 | 3.20 | 2.53 | 2.21 | 1.39 | 0. 0 |
| 25 | 6. 0 | 5.43 | 5.26 | 5. 8 | 4.50 | 4.31 | 4.12 | 3.51 | 3.28 | 3. 3 | 2.35 | 2. 0 | 1. 9 |
| 26 | 6. 0 | 5.44 | 5.27 | 5.10 | 4.53 | 4.35 | 4.17 | 3.57 | 3.36 | 3.13 | 2.47 | 2.16 | 1.36 |
| 27 | 6. 0 | 5.44 | 5.28 | 5.12 | 4.56 | 4.39 | 4.21 | 4. 3 | 3.43 | 3.22 | 3. 0 | 2.30 | 1.56 |
| 28 | 6. 0 | 5.45 | 5.30 | 5.14 | 4.59 | 4.43 | 4.26 | 4. 8 | 3.49 | 3.29 | 3. 7 | 2.42 | 2.13 |
| 29 | 6. 0 | 5.46 | 5.31 | 5.16 | 5. 1 | 4.46 | 4.30 | 4.13 | 3.55 | 3.36 | 3.16 | 2.53 | 2.26 |
| 30 | 6. 0 | 5.46 | 5.32 | 5.18 | 5. 4 | 4.49 | 4.34 | 4.18 | 4. 1 | 3.43 | 3.24 | 3. 2 | 2.38 |
| 31 | 6. 0 | 5.47 | 5.33 | 5.20 | 5. 6 | 4.52 | 4.37 | 4.22 | 4. 6 | 3.49 | 3.31 | 3.11 | 2.49 |
| 32 | 6. 0 | 5.47 | 5.34 | 5.21 | 5. 8 | 4.54 | 4.40 | 4.26 | 4.11 | 3.55 | 3.38 | 3.19 | 2.58 |
| 33 | 6. 0 | 5.48 | 5.35 | 5.23 | 5.10 | 4.57 | 4.44 | 4.30 | 4.15 | 4. 0 | 3.44 | 3.26 | 3. 7 |
| 34 | 6. 0 | 5.48 | 5.36 | 5.24 | 5.12 | 4.59 | 4.47 | 4.33 | 4.19 | 4. 5 | 3.49 | 3.33 | 3.15 |
| 35 | 6. 0 | 5.49 | 5.37 | 5.25 | 5.14 | 5. 2 | 4.49 | 4.37 | 4.23 | 4. 9 | 3.55 | 3.39 | 3.22 |
| 36 | 6. 0 | 5.49 | 5.38 | 5.27 | 5.15 | 5. 4 | 4.52 | 4.40 | 4.27 | 4.14 | 4. 0 | 3.45 | 3.29 |
| 37 | 6. 0 | 5.49 | 5.39 | 5.28 | 5.17 | 5. 6 | 4.54 | 4.43 | 4.31 | 4.18 | 4. 4 | 3.50 | 3.35 |
| 38 | 6. 0 | 5.50 | 5.39 | 5.29 | 5.19 | 5. 8 | 4.57 | 4.46 | 4.34 | 4.22 | 4. 9 | 3.55 | 3.41 |
| 39 | 6. 0 | 5.50 | 5.40 | 5.30 | 5.20 | 5.10 | 4.59 | 4.48 | 4.37 | 4.25 | 4.13 | 4. 0 | 3.47 |
| 40 | 6. 0 | 5.50 | 5.41 | 5.31 | 5.21 | 5.11 | 5. 1 | 4.51 | 4.40 | 4.29 | 4.17 | 4. 5 | 3.52 |
| 41 | 6. 0 | 5.51 | 5.42 | 5.32 | 5.23 | 5.13 | 5. 3 | 4.53 | 4.43 | 4.32 | 4.21 | 4. 9 | 3.57 |
| 42 | 6. 0 | 5.51 | 5.42 | 5.33 | 5.24 | 5.15 | 5. 5 | 4.56 | 4.46 | 4.35 | 4.25 | 4.13 | 4. 1 |
| 43 | 6. 0 | 5.51 | 5.43 | 5.34 | 5.25 | 5.16 | 5. 7 | 4.58 | 4.48 | 4.38 | 4.28 | 4.17 | 4. 6 |
| 44 | 6. 0 | 5.52 | 5.43 | 5.35 | 5.27 | 5.18 | 5. 9 | 5. 0 | 4.51 | 4.41 | 4.31 | 4.21 | 4.10 |
| 45 | 6. 0 | 5.52 | 5.44 | 5.36 | 5.28 | 5.19 | 5.11 | 5. 2 | 4.53 | 4.44 | 4.35 | 4.25 | 4.14 |
| 46 | 6. 0 | 5.52 | 5.45 | 5.37 | 5.29 | 5.21 | 5.13 | 5. 4 | 4.56 | 4.47 | 4.38 | 4.28 | 4.18 |
| 47 | 6. 0 | 5.53 | 5.46 | 5.38 | 5.30 | 5.22 | 5.14 | 5. 6 | 4.58 | 4.49 | 4.41 | 4.31 | 4.22 |
| 48 | 6. 0 | 5.53 | 5.46 | 5.38 | 5.31 | 5.23 | 5.16 | 5. 8 | 5. 0 | 4.52 | 4.43 | 4.35 | 4.25 |
| 49 | 6. 0 | 5.53 | 5.46 | 5.39 | 5.32 | 5.25 | 5.17 | 5.10 | 5. 2 | 4.54 | 4.46 | 4.38 | 4.29 |
| 50 | 6. 0 | 5.53 | 5.47 | 5.40 | 5.33 | 5.26 | 5.19 | 5.12 | 5. 4 | 4.57 | 4.49 | 4.41 | 4.32 |
| 52 | 6. 0 | 5.54 | 5.47 | 5.41 | 5.35 | 5.28 | 5.22 | 5.15 | 5. 8 | 5. 1 | 4.54 | 4.46 | 4.39 |
| 54 | 6. 0 | 5.54 | 5.48 | 5.42 | 5.37 | 5.31 | 5.24 | 5.18 | 5.12 | 5. 5 | 4.59 | 4.52 | 4.45 |
| 56 | 6. 0 | 5.55 | 5.49 | 5.44 | 5.38 | 5.33 | 5.27 | 5.21 | 5.15 | 5. 9 | 5. 3 | 4.57 | 4.50 |
| 58 | 6. 0 | 5.55 | 5.50 | 5.45 | 5.40 | 5.35 | 5.29 | 5.24 | 5.19 | 5.13 | 5. 7 | 5. 2 | 4.55 |
| 60 | 6 0 | 5.55 | 5.51 | 5.46 | 5.41 | 5.37 | 5.32 | 5.27 | 5.22 | 5.17 | 5.11 | 5. 6 | 5. 0 |
| 62 | 6 0 | 5.56 | 5.51 | 5.47 | 5.43 | 5.38 | 5.34 | 5.30 | 5.25 | 5.20 | 5.15 | 5.10 | 5. 5 |
| 64 | 6. 0 | 5.56 | 5.52 | 5.48 | 5.44 | 5.40 | 5.36 | 5.32 | 5.28 | 5.24 | 5.19 | 5.15 | 5.10 |
| 66 | 6 0 | 5.56 | 5.53 | 5.49 | 5.46 | 5.42 | 5.38 | 5.35 | 5.31 | 5.27 | 5.23 | 5.19 | 5.14 |
| 68 | 6. 0 | 5.57 | 5.54 | 5.50 | 5.47 | 5.44 | 5.40 | 5.37 | 5.33 | 5.30 | 5.26 | 5.22 | 5.19 |
| 70 | 6. 0 | 5.57 | 5.54 | 5.51 | 5.48 | 5.45 | 5.42 | 5.39 | 5.36 | 5.33 | 5.30 | 5.26 | 5.23 |

## Equations of Second Differences for 12 Hours. (z 2)

| Time after Noon or Midnight. | | Second Difference. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1′ | 2′ | 3′ | 4′ | 5′ | 6′ | 7′ | 8′ | 9′ | 10′ | 11′ | 12′ |
| h. m. | h. m. | | | | | | | | | | | | |
| 12. 0 | 0. 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11.50 | 0.10 | 0.4 | 0.8 | 1.2 | 1.6 | 2.1 | 2.5 | 2.9 | 3.3 | 3.7 | 4.1 | 4.5 | 4.9 |
| 11.40 | 0.20 | 0.8 | 1.6 | 2.4 | 3.2 | 4.1 | 4.9 | 5.7 | 6.5 | 7.3 | 8.1 | 8.9 | 9.7 |
| 11.30 | 0.30 | 1.2 | 2.4 | 3.6 | 4.8 | 6.0 | 7.2 | 8.4 | 9.6 | 10.8 | 12.0 | 13.2 | 14.4 |
| 11.20 | 0.40 | 1.6 | 3.1 | 4.7 | 6.3 | 7.9 | 9.4 | 11.0 | 12.6 | 14.2 | 15.7 | 17.3 | 18.9 |
| 11.10 | 0.50 | 1.9 | 3.9 | 5.8 | 7.8 | 9.7 | 11.6 | 13.6 | 15.5 | 17.4 | 19.4 | 21.3 | 23.3 |
| 11. 0 | 1. 0 | 2.3 | 4.6 | 6.9 | 9.2 | 11.5 | 13.8 | 16.0 | 18.3 | 20.6 | 22.9 | 25.2 | 27.5 |
| 10.50 | 1.10 | 2.6 | 5.3 | 7.9 | 10.5 | 13.2 | 15.8 | 18.4 | 21.1 | 23.7 | 26.3 | 29.0 | 31.6 |
| 10.40 | 1.20 | 3.0 | 5.9 | 8.9 | 11.9 | 14.8 | 17.8 | 20.7 | 23.7 | 26.7 | 29.6 | 32.6 | 35.6 |
| 10.30 | 1.30 | 3.3 | 6.6 | 9.8 | 13.1 | 16.4 | 19.7 | 23.0 | 26.3 | 29.5 | 32.8 | 36.1 | 39.4 |
| 10.20 | 1.40 | 3.6 | 7.2 | 10.8 | 14.4 | 17.9 | 21.5 | 25.1 | 28.7 | 32.3 | 35.9 | 39.5 | 43.1 |
| 10.10 | 1.50 | 3.9 | 7.8 | 11.6 | 15.5 | 19.4 | 23.3 | 27.2 | 31.1 | 34.9 | 38.8 | 42.7 | 46.6 |
| 10. 0 | 2. 0 | 4.2 | 8.3 | 12.5 | 16.7 | 20.8 | 25.0 | 29.2 | 33.3 | 37.5 | 41.7 | 45.8 | 50.0 |
| 9.50 | 2.10 | 4.4 | 8.9 | 13.3 | 17.8 | 22.2 | 26.6 | 31.1 | 35.5 | 39.9 | 44.4 | 48.8 | 53.3 |
| 9.40 | 2.20 | 4.7 | 9.4 | 14.1 | 18.8 | 23.5 | 28.2 | 32.9 | 37.6 | 42.3 | 47.0 | 51.7 | 56.4 |
| 9.30 | 2.30 | 4.9 | 9.9 | 14.8 | 19.8 | 24.7 | 29.7 | 34.6 | 39.6 | 44.5 | 49.5 | 54.4 | 59.4 |
| 9.20 | 2.40 | 5.2 | 10.4 | 15.6 | 20.7 | 25.9 | 31.1 | 36.3 | 41.5 | 46.7 | 51.9 | 57.0 | 62.2 |
| 9.10 | 2.50 | 5.4 | 10.8 | 16.2 | 21.6 | 27.1 | 32.5 | 37.9 | 43.3 | 48.7 | 54.1 | 59.5 | 64.9 |
| 9. 0 | 3. 0 | 5.6 | 11.3 | 16.9 | 22.5 | 28.1 | 33.8 | 39.4 | 45.0 | 50.6 | 56.3 | 61.9 | 67.5 |
| 8.50 | 3.10 | 5.8 | 11.7 | 17.5 | 23.3 | 29.1 | 35.0 | 40.8 | 46.6 | 52.4 | 58.3 | 64.1 | 69.9 |
| 8.40 | 3.20 | 6.0 | 12.0 | 18.1 | 24.1 | 30.1 | 36.1 | 42.1 | 48.1 | 54.2 | 60.2 | 66.2 | 72.2 |
| 8.30 | 3.30 | 6.2 | 12.4 | 18.6 | 24.8 | 31.0 | 37.2 | 43.4 | 49.6 | 55.8 | 62.0 | 68.2 | 74.4 |
| 8.20 | 3.40 | 6.4 | 12.7 | 19.1 | 25.5 | 31.8 | 38.2 | 44.6 | 50.9 | 57.3 | 63.7 | 70.0 | 76.4 |
| 8.10 | 3.50 | 6.5 | 13.0 | 19.6 | 26.1 | 32.6 | 39.1 | 45.7 | 52.2 | 58.7 | 65.2 | 71.7 | 78.3 |
| 8. 0 | 4. 0 | 6.7 | 13.4 | 20.0 | 26.7 | 33.3 | 40.1 | 46.7 | 53.3 | 60.0 | 66.7 | 73.3 | 80.0 |
| 7.40 | 4.20 | 6.9 | 13.8 | 20.8 | 27.7 | 34.6 | 41.5 | 48.4 | 55.4 | 62.3 | 69.2 | 76.1 | 83.1 |
| 7.20 | 4.40 | 7.1 | 14.3 | 21.4 | 28.5 | 35.6 | 42.8 | 49.9 | 57.0 | 64.2 | 71.3 | 78.4 | 85.6 |
| 7. 0 | 5. 0 | 7.3 | 14.6 | 21.9 | 29.2 | 36.5 | 43.8 | 51.0 | 58.3 | 65.6 | 72.9 | 80.2 | 87.5 |
| 6.40 | 5.20 | 7.4 | 14.8 | 22.2 | 29.6 | 37.0 | 44.4 | 51.9 | 59.3 | 66.7 | 74.1 | 81.5 | 88.9 |
| 6.20 | 5.40 | 7.5 | 15.0 | 22.4 | 29.9 | 37.4 | 44.9 | 52.3 | 59.8 | 67.3 | 74.8 | 82.2 | 89.7 |
| 6. 0 | 6. 0 | 7.5 | 15.0 | 22.5 | 30.0 | 37.5 | 45.0 | 52.5 | 60.0 | 67.5 | 75.0 | 82.5 | 90.0 |

| Time after Noon or Midnight. | | Second Difference. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10″ | 20″ | 30″ | 40″ | 50″ | 1‴ | 2‴ | 3‴ | 4‴ | 5‴ | 6‴ | 7‴ | 8‴ | 9‴ |
| h. m. | h. m. | | | | | | | | | | | | | | |
| 12. 0 | 0. 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 11.50 | 0.10 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 |
| 11.40 | 0.20 | 0.1 | 0.3 | 0.4 | 0.6 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 11.30 | 0.30 | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 |
| 11.20 | 0.40 | 0.3 | 0.5 | 0.8 | 1.0 | 1.3 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 |
| 11.10 | 0.50 | 0.3 | 0.6 | 1.0 | 1.3 | 1.6 | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.3 | 0.3 |
| 11. 0 | 1. 0 | 0.4 | 0.8 | 1.1 | 1.5 | 1.9 | 0.0 | 0.1 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 |
| 10.50 | 1.10 | 0.4 | 0.9 | 1.3 | 1.8 | 2.2 | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.4 |
| 10.40 | 1.20 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5 | 0.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 |
| 10.30 | 1.30 | 0.5 | 1.1 | 1.6 | 2.2 | 2.7 | 0.0 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 |
| 10.20 | 1.40 | 0.6 | 1.2 | 1.8 | 2.4 | 3.0 | 0.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 |
| 10.10 | 1.50 | 0.6 | 1.3 | 1.9 | 2.6 | 3.2 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.4 | 0.4 | 0.5 | 0.6 |
| 10. 0 | 2. 0 | 0.7 | 1.4 | 2.1 | 2.8 | 3.5 | 0.1 | 0.1 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.6 |
| 9.50 | 2.10 | 0.7 | 1.5 | 2.2 | 3.0 | 3.7 | 0.1 | 0.1 | 0.2 | 0.3 | 0.4 | 0.4 | 0.5 | 0.6 | 0.7 |
| 9.40 | 2.20 | 0.8 | 1.6 | 2.3 | 3.1 | 3.9 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 |
| 9.30 | 2.30 | 0.8 | 1.6 | 2.5 | 3.3 | 4.1 | 0.1 | 0.2 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.7 |
| 9.20 | 2.40 | 0.9 | 1.7 | 2.6 | 3.5 | 4.3 | 0.1 | 0.2 | 0.3 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
| 9.10 | 2.50 | 0.9 | 1.8 | 2.7 | 3.6 | 4.5 | 0.1 | 0.2 | 0.3 | 0.4 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 |
| 9. 0 | 3. 0 | 0.9 | 1.9 | 2.8 | 3.8 | 4.7 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.7 | 0.8 |
| 8.50 | 3.10 | 1.0 | 1.9 | 2.9 | 3.9 | 4.9 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 8.40 | 3.20 | 1.0 | 2.0 | 3.0 | 4.0 | 5.0 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 8.30 | 3.30 | 1.0 | 2.1 | 3.1 | 4.1 | 5.2 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 8.20 | 3.40 | 1.1 | 2.1 | 3.2 | 4.2 | 5.3 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 |
| 8.10 | 3.50 | 1.1 | 2.2 | 3.3 | 4.3 | 5.4 | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 | 0.6 | 0.8 | 0.9 | 1.0 |
| 8. 0 | 4. 0 | 1.1 | 2.2 | 3.3 | 4.4 | 5.6 | 0.1 | 0.2 | 0.3 | 0.4 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| 7.40 | 4.20 | 1.2 | 2.3 | 3.5 | 4.6 | 5.8 | 0.1 | 0.2 | 0.3 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| 7.20 | 4.40 | 1.2 | 2.4 | 3.6 | 4.8 | 5.9 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 |
| 7. 0 | 5. 0 | 1.2 | 2.4 | 3.6 | 4.9 | 6.1 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.0 |
| 6.40 | 5.20 | 1.2 | 2.4 | 3.7 | 4.9 | 6.2 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.8 | 1.0 | 1.1 |
| 6.20 | 5.40 | 1.3 | 2.5 | 3.8 | 5.0 | 6.2 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.9 | 1.0 | 1.1 |
| 6. 0 | 6. 0 | 1.3 | 2.5 | 3.8 | 5.0 | 6.3 | 0.1 | 0.2 | 0.4 | 0.5 | 0.6 | 0.7 | 0.9 | 1.0 | 1.1 |

(z 3) Mean Motion of the Sun's Right Ascension for Sidereal Hours.

| Hours. | Motion. | Minutes. | Motion. | Minutes. | Motion. | Seconds. | Motion. |
|---|---|---|---|---|---|---|---|
| | ′ ″ | | ″ | | ″ | | ″ |
| 1 | 0 9.83 | 1 | 0.16 | 31 | 5.08 | 3 | 0.01 |
| 2 | 0 19.66 | 2 | 0.33 | 32 | 5.24 | 6 | 0.02 |
| 3 | 0 29.49 | 3 | 0.49 | 33 | 5.41 | 9 | 0.02 |
| 4 | 0 39.32 | 4 | 0.65 | 34 | 5.57 | 12 | 0.03 |
| 5 | 0 49.15 | 5 | 0.82 | 35 | 5.73 | 15 | 0.04 |
| 6 | 0 58.98 | 6 | 0.98 | 36 | 5.90 | 18 | 0.05 |
| 7 | 1 8.81 | 7 | 1.15 | 37 | 6.06 | 21 | 0.06 |
| 8 | 1 18.64 | 8 | 1.31 | 38 | 6.22 | 24 | 0.06 |
| 9 | 1 28.46 | 9 | 1.47 | 39 | 6.39 | 27 | 0.07 |
| 10 | 1 38.29 | 10 | 1.64 | 40 | 6.55 | 30 | 0.08 |
| 11 | 1 48.12 | 11 | 1.80 | 41 | 6.72 | 33 | 0.09 |
| 12 | 1 57.95 | 12 | 1.97 | 42 | 6.88 | 36 | 0.10 |
| 13 | 2 7.78 | 13 | 2.13 | 43 | 7.04 | 39 | 0.11 |
| 14 | 2 17.61 | 14 | 2.29 | 44 | 7.21 | 42 | 0.11 |
| 15 | 2 27.44 | 15 | 2.46 | 45 | 7.37 | 45 | 0.12 |
| 16 | 2 37.27 | 16 | 2.62 | 46 | 7.54 | 48 | 0.13 |
| 17 | 2 47.10 | 17 | 2.78 | 47 | 7.70 | 51 | 0.14 |
| 18 | 2 56.93 | 18 | 2.95 | 48 | 7.86 | 54 | 0.15 |
| 19 | 3 6.76 | 19 | 3.11 | 49 | 8.03 | 57 | 0.16 |
| 20 | 3 16.59 | 20 | 3.28 | 50 | 8.19 | 60 | 0.16 |
| 21 | 3 26.42 | 21 | 3.44 | 51 | 8.35 | | |
| 22 | 3 36.25 | 22 | 3.60 | 52 | 8.51 | | |
| 23 | 3 46.08 | 23 | 3.77 | 53 | 8.68 | | |
| 24 | 3 55.91 | 24 | 3.93 | 54 | 8.85 | | |
| 25 | 4 5.74 | 25 | 4.10 | 55 | 9.01 | | |
| 26 | 4 15.57 | 26 | 4.26 | 56 | 9.17 | | |
| 27 | 4 25.40 | 27 | 4.42 | 57 | 9.34 | | |
| 28 | 4 35.22 | 28 | 4.59 | 58 | 9.50 | | |
| 29 | 4 45.05 | 29 | 4.75 | 59 | 9.67 | | |
| 30 | 4 54.88 | 30 | 4.91 | 60 | 9.83 | | |

(z 4) Correction of Mean Refraction.

| AA | Bar. +1 in. | Ther. +10° | AA | Bar. +1 in. | Ther. +10° | AA | Bar. +1 in. | Ther. +10° | AA | Bar. +1 in. | Ther. +10° | AA | Bar. +1 in. | Ther. +10° |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | ″ + | ″ — | ° | ″ + | ″ — | ° | ″ + | ″ — | ° | ″ + | ″ — | ° | ″ + | ″ — |
| 5 | 20.10 | 13.80 | 23 | 4.57 | 2.76 | 41 | 2.24 | 1.34 | 59 | 1.17 | 0.70 | 77 | 0.45 | 0.27 |
| 6 | 17.20 | 11.50 | 24 | 4.35 | 2.64 | 42 | 2.16 | 1.30 | 60 | 1.12 | 0.67 | 78 | 0.41 | 0.25 |
| 7 | 15.00 | 9.80 | 25 | 4.16 | 2.52 | 43 | 2.09 | 1.25 | 61 | 1.08 | 0.65 | 79 | 0.38 | 0.23 |
| 8 | 13.30 | 8.50 | 26 | 3.97 | 2.41 | 44 | 2.02 | 1.20 | 62 | 1.04 | 0.62 | 80 | 0.34 | 0.21 |
| 9 | 11.90 | 7.60 | 27 | 3.81 | 2.30 | 45 | 1.94 | 1.17 | 63 | 0.99 | 0.60 | 81 | 0.31 | 0.18 |
| 10 | 10.80 | 6.90 | 28 | 3.65 | 2.19 | 46 | 1.88 | 1.12 | 64 | 0.95 | 0.57 | 82 | 0.27 | 0.16 |
| 11 | 9.80 | 6.00 | 29 | 3.50 | 2.09 | 47 | 1.81 | 1.08 | 65 | 0.91 | 0.55 | 83 | 0.24 | 0.14 |
| 12 | 9.00 | 5.56 | 30 | 3.36 | 2.01 | 48 | 1.75 | 1.04 | 66 | 0.87 | 0.52 | 84 | 0.20 | 0.12 |
| 13 | 8.30 | 5.09 | 31 | 3.23 | 1.93 | 49 | 1.69 | 1.01 | 67 | 0.83 | 0.50 | 85 | 0.17 | 0.10 |
| 14 | 7.70 | 4.69 | 32 | 3.11 | 1.86 | 50 | 1.63 | 0.97 | 68 | 0.79 | 0.47 | 86 | 0.14 | 0.08 |
| 15 | 7.18 | 4.39 | 33 | 2.99 | 1.79 | 51 | 1.58 | 0.94 | 69 | 0.75 | 0.45 | 87 | 0.10 | 0.06 |
| 16 | 6.73 | 4.11 | 34 | 2.88 | 1.73 | 52 | 1.52 | 0.90 | 70 | 0.71 | 0.43 | 88 | 0.07 | 0.04 |
| 17 | 6.31 | 3.86 | 35 | 2.78 | 1.67 | 53 | 1.47 | 0.88 | 71 | 0.67 | 0.40 | 89 | 0.03 | 0.02 |
| 18 | 5.98 | 3.62 | 36 | 2.68 | 1.61 | 54 | 1.41 | 0.85 | 72 | 0.63 | 0.38 | | | |
| 19 | 5.61 | 3.40 | 37 | 2.58 | 1.55 | 55 | 1.36 | 0.82 | 73 | 0.59 | 0.36 | | | |
| 20 | 5.31 | 3.22 | 38 | 2.49 | 1.49 | 56 | 1.31 | 0.79 | 74 | 0.56 | 0.33 | | | |
| 21 | 5.04 | 3.05 | 39 | 2.40 | 1.44 | 57 | 1.26 | 0.76 | 75 | 0.52 | 0.31 | | | |
| 22 | 4.79 | 2.90 | 40 | 2.32 | 1.39 | 58 | 1.22 | 0.73 | 76 | 0.48 | 0.29 | | | |
| | — | + | | — | + | | — | + | | — | + | | — | + |
| AA | Bar. —1 in. | Ther. —10° | AA | Bar. —1 in. | Ther. —10° | AA | Bar. —1 in. | Ther. —10° | AA | Bar. —1 in. | Ther. —10° | AA | Bar. —1 in. | Ther. —10° |

## No. 2.—For Correction of the Mean Refraction.

(Thermometer 50°, and Barometer 30 inches.)

| Apparent Altitude | THERMOMETER. Additive. 10° | 20° | 30° | 40° | 50° | Subtractive. 60° | 70° | 80° | 90° | 100° | BAROMETER. Subtractive. 28·0 | 28·5 | 29·0 | 29·5 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ° ′ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ | ″ |
| 4 0 | 55 | 39 | 26 | 13 | 0 | 11 | 23 | 33 | 45 | 55 | 46 | 35 | 23 | 12 | 0 |
| 20 | 53 | 38 | 25 | 12 | 0 | 11 | 22 | 32 | 43 | 52 | 44 | 33 | 22 | 11 | 0 |
| 40 | 50 | 36 | 24 | 12 | 0 | 10 | 21 | 31 | 41 | 50 | 42 | 32 | 21 | 10 | 0 |
| 5 0 | 48 | 35 | 23 | 11 | 0 | 10 | 20 | 30 | 39 | 48 | 40 | 30 | 20 | 10 | 0 |
| 20 | 46 | 34 | 22 | 11 | 0 | 10 | 19 | 29 | 38 | 46 | 38 | 28 | 19 | 9 | 0 |
| 40 | 44 | 32 | 21 | 10 | 0 | 9 | 19 | 28 | 36 | 45 | 36 | 27 | 18 | 9 | 0 |
| 6 0 | 42 | 31 | 20 | 10 | 0 | 9 | 18 | 27 | 35 | 43 | 34 | 25 | 17 | 8 | 0 |
| 20 | 40 | 30 | 19 | 10 | 0 | 9 | 18 | 26 | 34 | 41 | 32 | 24 | 16 | 8 | 0 |
| 40 | 39 | 29 | 19 | 9 | 0 | 8 | 17 | 25 | 32 | 40 | 31 | 23 | 16 | 8 | 0 |
| 7 0 | 37 | 28 | 18 | 9 | 0 | 8 | 16 | 24 | 31 | 38 | 30 | 22 | 15 | 7 | 0 |
| 30 | 35 | 26 | 17 | 8 | 0 | 8 | 15 | 23 | 30 | 36 | 28 | 21 | 14 | 7 | 0 |
| 8 0 | 34 | 25 | 16 | 8 | 0 | 7 | 15 | 22 | 28 | 34 | 26 | 20 | 13 | 7 | 0 |
| 9 0 | 31 | 22 | 15 | 7 | 0 | 7 | 13 | 20 | 26 | 31 | 24 | 18 | 12 | 6 | 0 |
| 10° | 28 | 20 | 13 | 6 | 0 | 6 | 12 | 18 | 23 | 29 | 21 | 16 | 11 | 6 | 0 |
| 11 | 26 | 19 | 12 | 6 | 0 | 6 | 10 | 17 | 22 | 27 | 20 | 15 | 10 | 6 | 0 |
| 12 | 24 | 17 | 11 | 5 | 0 | 5 | 9 | 15 | 20 | 24 | 18 | 14 | 9 | 5 | 0 |
| 13 | 22 | 16 | 10 | 5 | 0 | 5 | 9 | 14 | 19 | 23 | 17 | 13 | 9 | 5 | 0 |
| 14 | 21 | 15 | 10 | 4 | 0 | 4 | 8 | 13 | 17 | 21 | 15 | 12 | 8 | 4 | 0 |
| 15 | 19 | 14 | 9 | 4 | 0 | 4 | 8 | 12 | 16 | 20 | 14 | 11 | 7 | 4 | 0 |
| 16 | 18 | 14 | 9 | 4 | 0 | 4 | 7 | 11 | 15 | 19 | 13 | 10 | 7 | 4 | 0 |
| 18 | 16 | 12 | 8 | 3 | 0 | 3 | 6 | 11 | 14 | 17 | 13 | 10 | 6 | 3 | 0 |
| 20 | 14 | 11 | 7 | 3 | 0 | 3 | 6 | 9 | 12 | 15 | 11 | 8 | 5 | 3 | 0 |
| 23 | 13 | 10 | 6 | 3 | 0 | 3 | 5 | 8 | 11 | 13 | 10 | 7 | 4 | 3 | 0 |
| 25 | 12 | 9 | 6 | 2 | 0 | 2 | 4 | 8 | 10 | 12 | 8 | 7 | 4 | 3 | 0 |
| 30 | 9 | 7 | 4 | 2 | 0 | 2 | 3 | 6 | 8 | 9 | 7 | 5 | 3 | 2 | 0 |
| 35 | 8 | 6 | 4 | 2 | 0 | 2 | 3 | 5 | 7 | 8 | 5 | 4 | 3 | 2 | 0 |
| 40 | 6 | 5 | 3 | 2 | 0 | 1 | 3 | 4 | 5 | 7 | 5 | 3 | 2 | 1 | 0 |
| 45 | 5 | 4 | 3 | 1 | 0 | 1 | 2 | 4 | 5 | 6 | 4 | 3 | 2 | 1 | 0 |
| 50 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 4 | 5 | 3 | 2 | 2 | 1 | 0 |
| 55 | 4 | 3 | 2 | 1 | 0 | 1 | 2 | 3 | 3 | 4 | 3 | 2 | 1 | 1 | 0 |
| 60 | 3 | 2 | 2 | 1 | 0 | 1 | 2 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 0 |
| 65 | 3 | 2 | 1 | 1 | 0 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 0 | 0 | 0 |
| 70 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 0 | 0 | 0 |
| 75 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | | | | | |
| 80 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | | 31·5 | 31·0 | 30·5 | 30 |
| | | | | | | | | | | | | Additive. | | | |

## Correction of Auxiliary Angle for Thermometer and Barometer.

| Apparent Altitude. | Factor. | Apparent Altitude. | Factor. | Apparent Altitude. | Factor. | Apparent Altitude. | Factor. |
|---|---|---|---|---|---|---|---|
| ° | | ° | | ° | | ° | |
| 4 | ·05 | 24 | ·25 | 44 | ·40 | 64 | ·52 |
| 6 | ·07 | 26 | ·26 | 46 | ·42 | 66 | ·53 |
| 8 | ·09 | 28 | ·28 | 48 | ·43 | 68 | ·53 |
| 10 | ·11 | 30 | ·30 | 50 | ·44 | 70 | ·54 |
| 12 | ·13 | 32 | ·32 | 52 | ·45 | 72 | ·54 |
| 14 | ·15 | 34 | ·33 | 54 | ·47 | 74 | ·55 |
| 16 | ·17 | 36 | ·36 | 56 | ·48 | 78 | ·57 |
| 18 | ·19 | 38 | ·36 | 58 | ·49 | 82 | ·57 |
| 20 | ·21 | 40 | ·37 | 60 | ·50 | 86 | ·58 |
| 22 | ·23 | 42 | ·39 | 62 | ·52 | | |

N.B. To correct Auxiliary Angle, multiply the Factors answering to the Apparent Altitude of each body by the corrections from table for correcting Mean Refraction, and apply the products to the Auxiliary Angle the contrary way to that directed in the Table "For correction of Mean Refraction."

Fahrenheit = Centigr. $\times \frac{9}{5} \pm 32° =$ Reaumur $\times \frac{9}{4} \pm 32°$.

## The Log. Difference.

⊙ or ✱ ☽

(Log. cos. true alt. − log. cos. app. alt.) + (log. cos. true alt. − log. cos. app. alt.) + 6.301030.

Table (A a).—Moon's App. Alt. *less* than 10°. Barom. 30 inches. Therm. Fahrt. 50°.

| ☾ App. Alt. | Moon's Horizontal Parallax. 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Diff. 1′ Hor. Parx. | ☽ App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|
| ° | | | | | | | | | | ° |
| 6 | 6.300349 | 300332 | 300315 | 300297 | 300280 | 300263 | 300246 | 300229 | 17 | 6 |
| | 120 | 123 | 125 | 127 | 129 | 131 | 134 | 136 | | |
| 7 | 300229 | 300209 | 300190 | 300170 | 300151 | 300132 | 300112 | 300093 | 20 | 7 |
| | 120 | 122 | 124 | 126 | 129 | 131 | 133 | 136 | | |
| 8 | 300109 | 300087 | 300065 | 300044 | 300022 | 300001 | 299979 | 299958 | 22 | 8 |
| | 120 | 122 | 124 | 126 | 128 | 131 | 133 | 136 | | |
| 9 | 299989 | 299965 | 299941 | 299917 | 299894 | 299870 | 299846 | 299822 | 24 | 9 |
| | 119 | 122 | 124 | 126 | 127 | 131 | 133 | 135 | | |

Table (A a).—Moon's App. Alt. *more* than 10°. Barom. 30 inches. Therm. Fahrt. 50°.

| ☾ App. Alt. | Moon's Horizontal Parallax. 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | Diff. 1′ Hor. Parx. | ☽ App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ° | | | | | | | | | | | ° |
| 10 | 6.299897 | 9869 | 9843 | 9817 | 9791 | 9765 | 9739 | 9713 | 9687 | 26 | 10 |
| | 118 | 119 | 121 | 124 | 125 | 127 | 130 | 132 | 134 | | |
| 11 | 9779 | 9751 | 9723 | 9694 | 9666 | 9638 | 9610 | 9582 | 9553 | 28 | 11 |
| | 117 | 119 | 121 | 123 | 125 | 127 | 130 | 132 | 133 | | |
| 12 | 9662 | 9632 | 9601 | 9571 | 9541 | 9510 | 9480 | 9450 | 9420 | 30 | 12 |
| | 116 | 118 | 120 | 122 | 124 | 126 | 129 | 131 | 133 | | |
| 13 | 9546 | 9514 | 9481 | 9449 | 9416 | 9384 | 9351 | 9318 | 9287 | 33 | 13 |
| | 115 | 117 | 119 | 122 | 124 | 126 | 128 | 129 | 133 | | |
| 14 | 9431 | 9396 | 9361 | 9327 | 9292 | 9257 | 9223 | 9188 | 9154 | 35 | 14 |
| | 115 | 117 | 119 | 121 | 123 | 126 | 128 | 129 | 133 | | |
| 15 | 6.299316 | 9279 | 9242 | 9205 | 9169 | 9132 | 9095 | 9058 | 9021 | 37 | 15 |
| | 114 | 117 | 118 | 121 | 123 | 125 | 127 | 129 | 132 | | |
| 16 | 9201 | 9162 | 9124 | 9085 | 9046 | 9007 | 8968 | 8929 | 8890 | 39 | 16 |
| | 113 | 116 | 118 | 120 | 122 | 124 | 127 | 128 | 131 | | |
| 17 | 9088 | 9047 | 9006 | 8965 | 8924 | 8882 | 8841 | 8800 | 8759 | 41 | 17 |
| | 113 | 116 | 117 | 120 | 122 | 123 | 126 | 128 | 130 | | |
| 18 | 8974 | 8931 | 8888 | 8845 | 8802 | 8759 | 8715 | 8672 | 8629 | 43 | 18 |
| | 112 | 115 | 116 | 119 | 121 | 123 | 125 | 127 | 129 | | |
| 19 | 8862 | 8817 | 8772 | 8726 | 8681 | 8636 | 8591 | 8545 | 8500 | 45 | 19 |
| | 112 | 114 | 116 | 118 | 120 | 122 | 125 | 126 | 128 | | |
| 20 | 6.298750 | 8703 | 8656 | 8608 | 8561 | 8514 | 8466 | 8419 | 8372 | 48 | 20 |
| | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | 127 | | |
| 21 | 8639 | 8590 | 8540 | 8491 | 8442 | 8392 | 8343 | 8294 | 8245 | 50 | 21 |
| | 110 | 112 | 114 | 116 | 118 | 120 | 122 | 124 | 126 | | |
| 22 | 8529 | 8478 | 8426 | 8375 | 8323 | 8272 | 8221 | 8169 | 8118 | 52 | 22 |
| | 109 | 111 | 113 | 115 | 117 | 119 | 121 | 123 | 125 | | |
| 23 | 8420 | 8366 | 8313 | 8259 | 8206 | 8153 | 8099 | 8046 | 7993 | 54 | 23 |
| | 109 | 110 | 113 | 114 | 116 | 119 | 120 | 123 | 124 | | |
| 24 | 8311 | 8256 | 8200 | 8145 | 8090 | 8034 | 7979 | 7923 | 7868 | 56 | 24 |
| | 107 | 109 | 112 | 113 | 115 | 118 | 120 | 121 | 125 | | |
| 25 | 6.298204 | 8146 | 8089 | 8031 | 7974 | 7916 | 7859 | 7802 | 7745 | 58 | 25 |
| | 107 | 108 | 111 | 112 | 114 | 116 | 119 | 120 | 123 | | |
| 26 | 8097 | 8038 | 7978 | 7919 | 7859 | 7800 | 7740 | 7681 | 7622 | 60 | 26 |
| | 106 | 108 | 110 | 111 | 113 | 115 | 117 | 119 | 122 | | |
| 27 | 7991 | 7930 | 7869 | 7807 | 7746 | 7684 | 7623 | 7562 | 7500 | 61 | 27 |
| | 104 | 107 | 109 | 110 | 112 | 114 | 116 | 118 | 120 | | |
| 28 | 7887 | 7823 | 7760 | 7697 | 7633 | 7570 | 7507 | 7443 | 7380 | 63 | 28 |
| | 104 | 106 | 107 | 109 | 111 | 113 | 115 | 116 | 119 | | |
| 29 | 7783 | 7718 | 7653 | 7588 | 7522 | 7457 | 7392 | 7327 | 7261 | 65 | 29 |
| | 103 | 105 | 107 | 109 | 110 | 113 | 115 | 116 | 118 | | |
| 30 | 6.297680 | 7613 | 7546 | 7479 | 7412 | 7344 | 7277 | 7210 | 7143 | 67 | 30 |

| Alt. | 5° | 6° | 7° | 8° | 9° | 10° | 12° | 14° | 16° | 19° | 21° | 26° | 30° | 34° | 38° | 42° | 46° | 52° | 58° | 64° | 70° | 76° | 82° | 88° | Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⊙ Corr. | 14 | 18 | 20 | 21 | 22 | 23 | 23 | 23 | 23 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | ⊙ Corr. |
| ✱ Corr. | 16 | 20 | 22 | 24 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | ✱ Corr. |

## The Log. Difference.

Table (A a).—Moon's Alt. more than 30°. Barom. 30 inches. Therm. Fahrt. 50°.

| ☾ App. Alt. | Moon's Horizontal Parallax. | | | | | | | | | Diff. 1′ Parx. | ☽ App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | | |
| ° | | | | | | | | | | | ° |
| 30 | 6.297680 | 7613 | 7546 | 7479 | 7412 | 7344 | 7277 | 7210 | 7143 | 67 | 30 |
| | 101 | 104 | 105 | 107 | 109 | 110 | 112 | 114 | 116 | | |
| 31 | 7579 | 7510 | 7441 | 7372 | 7303 | 7234 | 7165 | 7096 | 7027 | 69 | 31 |
| | 100 | 103 | 104 | 105 | 108 | 109 | 111 | 114 | 116 | | |
| 32 | 7478 | 7407 | 7336 | 7265 | 7195 | 7124 | 7053 | 6982 | 6911 | 71 | 32 |
| | 99 | 101 | 103 | 104 | 107 | 108 | 110 | 113 | 115 | | |
| 33 | 7379 | 7306 | 7233 | 7160 | 7088 | 7015 | 6942 | 6869 | 6796 | 73 | 33 |
| | 99 | 100 | 102 | 103 | 106 | 107 | 109 | 110 | 112 | | |
| 34 | 7280 | 7206 | 7131 | 7057 | 6982 | 6908 | 6833 | 6759 | 6684 | 75 | 34 |
| | 97 | 99 | 100 | 102 | 104 | 106 | 108 | 110 | 112 | | |
| 35 | 6.297183 | 7107 | 7031 | 6954 | 6878 | 6802 | 6725 | 6649 | 6572 | 77 | 35 |
| | 95 | 98 | 99 | 101 | 103 | 105 | 106 | 108 | 110 | | |
| 36 | 7088 | 7009 | 6931 | 6853 | 6775 | 6697 | 6619 | 6541 | 6463 | 78 | 36 |
| | 94 | 96 | 98 | 100 | 102 | 103 | 105 | 107 | 109 | | |
| 37 | 6993 | 6913 | 6833 | 6753 | 6673 | 6594 | 6514 | 6434 | 6354 | 80 | 37 |
| | 93 | 95 | 97 | 98 | 100 | 102 | 104 | 106 | 108 | | |
| 38 | 6900 | 6818 | 6736 | 6655 | 6573 | 6492 | 6410 | 6328 | 6246 | 82 | 38 |
| | 92 | 94 | 95 | 97 | 99 | 101 | 102 | 103 | 106 | | |
| 39 | 6808 | 6724 | 6641 | 6558 | 6474 | 6391 | 6308 | 6225 | 6141 | 84 | 39 |
| | 91 | 92 | 94 | 96 | 97 | 99 | 101 | 102 | 104 | | |
| 40 | 6.296717 | 6632 | 6547 | 6462 | 6377 | 6292 | 6207 | 6122 | 6037 | 85 | 40 |
| | 89 | 91 | 93 | 94 | 96 | 97 | 99 | 101 | 103 | | |
| 41 | 6628 | 6541 | 6455 | 6368 | 6281 | 6195 | 6108 | 6021 | 5934 | 87 | 41 |
| | 88 | 89 | 91 | 93 | 94 | 96 | 98 | 99 | 100 | | |
| 42 | 6540 | 6452 | 6363 | 6275 | 6187 | 6099 | 6010 | 5922 | 5833 | 89 | 42 |
| | 86 | 88 | 89 | 91 | 93 | 95 | 96 | 98 | 98 | | |
| 43 | 6454 | 6364 | 6274 | 6184 | 6094 | 6004 | 5914 | 5825 | 5735 | 90 | 43 |
| | 85 | 87 | 88 | 90 | 91 | 93 | 94 | 97 | 97 | | |
| 44 | 6369 | 6277 | 6186 | 6094 | 6003 | 5911 | 5820 | 5728 | 5638 | 91 | 44 |
| | 84 | 85 | 87 | 88 | 90 | 91 | 93 | 95 | 96 | | |
| 45 | 6.296285 | 6192 | 6099 | 6006 | 5913 | 5820 | 5727 | 5634 | 5542 | 93 | 45 |
| | 82 | 83 | 85 | 86 | 88 | 89 | 91 | 92 | 94 | | |
| 46 | 6203 | 6109 | 6014 | 5920 | 5825 | 5731 | 5636 | 5542 | 5448 | 95 | 46 |
| | 80 | 82 | 83 | 85 | 86 | 88 | 89 | 91 | 93 | | |
| 47 | 6123 | 6027 | 5931 | 5835 | 5739 | 5643 | 5547 | 5451 | 5355 | 96 | 47 |
| | 79 | 81 | 82 | 84 | 85 | 87 | 88 | 90 | 90 | | |
| 48 | 6044 | 5946 | 5849 | 5751 | 5654 | 5556 | 5459 | 5361 | 5265 | 97 | 48 |
| | 78 | 79 | 80 | 81 | 83 | 85 | 86 | 87 | 89 | | |
| 49 | 5966 | 5867 | 5769 | 5670 | 5571 | 5472 | 5373 | 5274 | 5176 | 99 | 49 |
| | 76 | 77 | 79 | 80 | 82 | 83 | 84 | 86 | 87 | | |
| 50 | 6.295891 | 5790 | 5690 | 5590 | 5489 | 5389 | 5289 | 5188 | 5089 | 100 | 50 |
| | 75 | 75 | 77 | 78 | 79 | 81 | 83 | 83 | 85 | | |
| 51 | 5816 | 5715 | 5613 | 5511 | 5410 | 5308 | 5206 | 5105 | 5004 | 101 | 51 |
| | 72 | 74 | 76 | 76 | 78 | 79 | 80 | 82 | 84 | | |
| 52 | 5744 | 5641 | 5538 | 5435 | 5332 | 5229 | 5126 | 5023 | 4920 | 103 | 52 |
| | 71 | 73 | 74 | 75 | 77 | 78 | 79 | 80 | 82 | | |
| 53 | 5673 | 5568 | 5464 | 5360 | 5255 | 5151 | 5047 | 4942 | 4838 | 104 | 53 |
| | 69 | 70 | 71 | 73 | 74 | 75 | 77 | 77 | 80 | | |
| 54 | 5604 | 5498 | 5393 | 5287 | 5182 | 5076 | 4971 | 4865 | 4758 | 106 | 54 |
| | 68 | 69 | 70 | 71 | 73 | 74 | 76 | 77 | 77 | | |
| 55 | 6.295536 | 5429 | 5323 | 5216 | 5109 | 5002 | 4895 | 4788 | 4681 | 107 | 55 |
| | 66 | 67 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | | |
| 56 | 5470 | 5362 | 5254 | 5146 | 5038 | 4930 | 4822 | 4714 | 4606 | 108 | 56 |
| | 64 | 65 | 66 | 67 | 69 | 70 | 71 | 72 | 73 | | |
| 57 | 5407 | 5297 | 5188 | 5079 | 4969 | 4860 | 4751 | 4642 | 4533 | 109 | 57 |
| | 63 | 63 | 65 | 66 | 66 | 68 | 69 | 71 | 72 | | |
| 58 | 5344 | 5234 | 5123 | 5013 | 4903 | 4792 | 4682 | 4571 | 4461 | 110 | 58 |
| | 60 | 62 | 62 | 64 | 65 | 66 | 67 | 68 | 69 | | |
| 59 | 5284 | 5172 | 5061 | 4949 | 4838 | 4726 | 4615 | 4503 | 4392 | 111 | 59 |
| | 59 | 59 | 61 | 62 | 63 | 64 | 66 | 66 | 67 | | |
| 60 | 6.295225 | 5113 | 5000 | 4887 | 4775 | 4662 | 4549 | 4437 | 4325 | 112 | 60 |

| Alt. | 5° | 6° | 7° | 8° | 9° | 10° | 12° | 14° | 16° | 19° | 21° | 26° | 30° | 34° | 38° | 42° | 46° | 52° | 58° | 64° | 70° | 76° | 82° | 88° | Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⊙ Corr. | 14 | 18 | 20 | 21 | 22 | 23 | 23 | 23 | 23 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | ⊙ Corr. |
| ☽ Corr. | 16 | 20 | 22 | 24 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | ☽ Corr. |

## The Log. Difference.

Table (A a).—Moon's Alt. more than 60°. Barom. 30 inches. Therm. Fahrt. 50°.

| ☾ App. Alt. | Moon's Horizontal Parallax. | | | | | | | | | Diff. 1′ Parx. | ☽ App. Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 53′ | 54′ | 55′ | 56′ | 57′ | 58′ | 59′ | 60′ | 61′ | | |
| ° | | | | | | | | | | | ° |
| 60 | 6.295225 | 5113 | 5000 | 4887 | 4775 | 4662 | 4549 | 4437 | 4325 | 112 | 60 |
| | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | | |
| 61 | 5168 | 5055 | 4941 | 4827 | 4714 | 4600 | 4486 | 4373 | 4260 | 113 | 61 |
| | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 63 | 64 | | |
| 62 | 5113 | 4999 | 4884 | 4769 | 4655 | 4540 | 4425 | 4310 | 4196 | 115 | 62 |
| | 53 | 55 | 56 | 56 | 58 | 59 | 59 | 60 | 62 | | |
| 63 | 5060 | 4944 | 4828 | 4713 | 4597 | 4481 | 4366 | 4250 | 4134 | 116 | 63 |
| | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | | |
| 64 | 5009 | 4892 | 4776 | 4659 | 4542 | 4426 | 4309 | 4192 | 4075 | 117 | 64 |
| | 50 | 51 | 52 | 53 | 53 | 55 | 55 | 56 | 57 | | |
| 65 | 6.294959 | 4841 | 4724 | 4606 | 4489 | 4371 | 4254 | 4136 | 4018 | 118 | 65 |
| | 48 | 49 | 50 | 51 | 52 | 53 | 53 | 54 | | | |
| 66 | 4912 | 4793 | 4675 | 4556 | 4438 | 4320 | 4201 | 4083 | 3964 | 119 | 66 |
| | 46 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | | |
| 67 | 4866 | 4747 | 4628 | 4508 | 4389 | 4270 | 4150 | 4031 | 3911 | 120 | 67 |
| | 43 | 44 | 45 | 46 | 47 | 48 | 48 | 49 | 50 | | |
| 68 | 4823 | 4703 | 4583 | 4462 | 4342 | 4222 | 4102 | 3982 | 3861 | 120 | 68 |
| | 42 | 43 | 44 | 44 | 44 | 45 | 46 | 47 | 47 | | |
| 69 | 4781 | 4660 | 4539 | 4418 | 4298 | 4177 | 4056 | 3935 | 3814 | 121 | 69 |
| | 40 | 40 | 41 | 41 | 43 | 44 | 44 | 45 | 45 | | |
| 70 | 6.294741 | 4620 | 4498 | 4377 | 4255 | 4133 | 4012 | 3890 | 3769 | 121 | 70 |
| | 37 | 39 | 39 | 40 | 41 | 41 | 42 | 42 | 43 | | |
| 71 | 4704 | 4581 | 4459 | 4337 | 4214 | 4092 | 3970 | 3848 | 3726 | 122 | 71 |
| | 36 | 36 | 37 | 38 | 38 | 39 | 40 | 41 | 42 | | |
| 72 | 4668 | 4545 | 4422 | 4299 | 4176 | 4053 | 3930 | 3807 | 3684 | 123 | 72 |
| | 34 | 34 | 35 | 36 | 36 | 37 | 38 | 38 | 38 | | |
| 73 | 4634 | 4510 | 4387 | 4263 | 4140 | 4016 | 3892 | 3769 | 3646 | 123 | 73 |
| | 32 | 32 | 33 | 33 | 35 | 35 | 35 | 36 | 37 | | |
| 74 | 4602 | 4478 | 4354 | 4230 | 4105 | 3981 | 3857 | 3733 | 3609 | 124 | 74 |
| | 30 | 30 | 31 | 32 | 32 | 32 | 33 | 34 | 35 | | |
| 75 | 6.294572 | 4448 | 4323 | 4198 | 4073 | 3949 | 3824 | 3699 | 3574 | 125 | 75 |
| | 28 | 29 | 29 | 29 | 30 | 31 | 31 | 31 | 31 | | |
| 76 | 4544 | 4419 | 4294 | 4169 | 4043 | 3918 | 3793 | 3668 | 3543 | 125 | 76 |
| | 25 | 26 | 27 | 28 | 27 | 28 | 29 | 29 | 30 | | |
| 77 | 4519 | 4393 | 4267 | 4141 | 4016 | 3890 | 3764 | 3639 | 3513 | 126 | 77 |
| | 24 | 24 | 24 | 25 | 26 | 26 | 26 | 27 | 27 | | |
| 78 | 4495 | 4369 | 4243 | 4116 | 3990 | 3864 | 3738 | 3612 | 3486 | 126 | 78 |
| | 22 | 22 | 23 | 22 | 23 | 24 | 24 | 25 | 25 | | |
| 79 | 4473 | 4347 | 4220 | 4094 | 3967 | 3840 | 3714 | 3587 | 3461 | 127 | 79 |
| | 20 | 20 | 20 | 21 | 21 | 21 | 22 | 22 | 23 | | |
| 80 | 6.294453 | 4327 | 4200 | 4073 | 3946 | 3819 | 3692 | 3565 | 3438 | 127 | 80 |
| | 17 | 18 | 19 | 19 | 19 | 19 | 19 | 20 | 20 | | |
| 81 | 4436 | 4309 | 4181 | 4054 | 3927 | 3800 | 3673 | 3545 | 3418 | 127 | 81 |
| | 16 | 16 | 16 | 16 | 16 | 17 | 17 | 17 | 17 | | |
| 82 | 4420 | 4293 | 4166 | 4038 | 3911 | 3783 | 3656 | 3528 | 3401 | 128 | 82 |
| | 13 | 14 | 15 | 15 | 15 | 15 | 16 | 16 | 16 | | |
| 83 | 4407 | 4279 | 4151 | 4024 | 3896 | 3768 | 3640 | 3513 | 3386 | 128 | 83 |
| | 11 | 11 | 11 | 11 | 12 | 12 | 12 | 13 | 14 | | |
| 84 | 4396 | 4268 | 4140 | 4013 | 3884 | 3756 | 3628 | 3500 | 3372 | 128 | 84 |
| | 10 | 10 | 10 | 11 | 10 | 10 | 11 | 11 | 11 | | |
| 85 | 6.294386 | 4258 | 4130 | 4002 | 3874 | 3746 | 3617 | 3489 | 3361 | 128 | 85 |
| | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | | |
| 86 | 4379 | 4250 | 4122 | 3994 | 3866 | 3738 | 3609 | 3481 | 3353 | 128 | 86 |
| | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | | |
| 87 | 4374 | 4245 | 4117 | 3989 | 3860 | 3732 | 3603 | 3475 | 3347 | 129 | 87 |
| | 3 | 3 | 3 | 4 | 3 | 3 | 3 | 3 | 3 | | |
| 88 | 4371 | 4242 | 4114 | 3985 | 3857 | 3729 | 3600 | 3472 | 3344 | 129 | 88 |
| | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | | |
| 89 | 4370 | 4241 | 4113 | 3984 | 3856 | 3727 | 3599 | 3470 | 3342 | 129 | 89 |

| Alt. | 5° | 6° | 7° | 8° | 9° | 10° | 12° | 14° | 16° | 19° | 21° | 26° | 30° | 34° | 38° | 42° | 46° | 52° | 58° | 64° | 70° | 76° | 82° | 88° | Alt. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⊙ Corr. | 14 | 18 | 20 | 21 | 22 | 23 | 23 | 23 | 23 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | ⊙ Corr. |
| ✱ Corr. | 16 | 20 | 22 | 24 | 25 | 26 | 27 | 28 | 29 | 29 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | 30 | ✱ Corr |

Table (B b). For correcting Log. Differences for Minutes of Altitude and Seconds

| Diff. 1° Alt. or 1′ Parx. | Minutes of Moon's Altitude or Seconds | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 |
| 14 | 14 | 13 | 12 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 4 | 3 | 3 |
| 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 4 | 4 | 3 |
| 18 | 17 | 17 | 16 | 16 | 15 | 14 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 5 | 5 | 4 | 4 |
| 20 | 19 | 19 | 18 | 17 | 17 | 16 | 15 | 15 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 5 | 5 | 4 |
| 22 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 15 | 15 | 14 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 7 | 6 | 5 | 4 |
| 24 | 23 | 22 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 15 | 14 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 6 | 6 | 5 |
| 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 7 | 6 | 5 |
| 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 7 | 6 |
| 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 |
| 32 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 7 | 6 |
| 34 | 33 | 32 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 12 | 11 | 10 | 9 | 8 | 7 |
| 36 | 35 | 34 | 32 | 31 | 30 | 29 | 28 | 26 | 25 | 24 | 23 | 22 | 20 | 19 | 18 | 17 | 16 | 14 | 13 | 12 | 11 | 10 | 8 | 7 |
| 38 | 37 | 35 | 34 | 33 | 32 | 30 | 29 | 28 | 27 | 25 | 24 | 23 | 22 | 20 | 19 | 18 | 16 | 15 | 14 | 13 | 11 | 10 | 9 | 8 |
| 40 | 39 | 37 | 36 | 35 | 33 | 32 | 31 | 29 | 28 | 27 | 25 | 24 | 23 | 21 | 20 | 19 | 17 | 16 | 15 | 13 | 12 | 11 | 9 | 8 |
| 42 | 41 | 39 | 38 | 36 | 35 | 34 | 32 | 31 | 29 | 28 | 27 | 25 | 24 | 22 | 21 | 20 | 18 | 17 | 15 | 14 | 13 | 11 | 10 | 8 |
| 44 | 43 | 41 | 39 | 38 | 37 | 35 | 34 | 32 | 31 | 29 | 28 | 26 | 25 | 23 | 22 | 21 | 19 | 18 | 16 | 15 | 13 | 12 | 10 | 9 |
| 46 | 44 | 43 | 41 | 40 | 38 | 37 | 35 | 34 | 32 | 31 | 29 | 28 | 26 | 25 | 23 | 21 | 20 | 18 | 17 | 15 | 14 | 12 | 11 | 9 |
| 48 | 46 | 45 | 43 | 42 | 40 | 38 | 37 | 35 | 34 | 32 | 30 | 29 | 27 | 26 | 24 | 22 | 21 | 19 | 18 | 16 | 14 | 13 | 11 | 10 |
| 50 | 48 | 47 | 45 | 43 | 42 | 40 | 38 | 37 | 35 | 33 | 32 | 30 | 28 | 27 | 25 | 23 | 22 | 20 | 18 | 17 | 15 | 13 | 12 | 10 |
| 52 | 50 | 49 | 47 | 45 | 43 | 42 | 40 | 38 | 36 | 34 | 33 | 31 | 29 | 28 | 26 | 24 | 23 | 21 | 19 | 17 | 16 | 14 | 12 | 10 |
| 54 | 52 | 50 | 48 | 47 | 45 | 43 | 41 | 39 | 38 | 36 | 34 | 32 | 31 | 29 | 27 | 25 | 23 | 22 | 20 | 18 | 16 | 14 | 13 | 11 |
| 56 | 54 | 52 | 50 | 48 | 47 | 45 | 43 | 40 | 39 | 37 | 35 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 21 | 19 | 17 | 15 | 13 | 11 |
| 58 | 56 | 54 | 52 | 50 | 48 | 46 | 44 | 43 | 41 | 38 | 37 | 35 | 33 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 17 | 15 | 14 | 12 |
| 60 | 58 | 56 | 54 | 52 | 50 | 48 | 46 | 44 | 42 | 40 | 38 | 36 | 34 | 32 | 30 | 28 | 26 | 24 | 22 | 20 | 18 | 16 | 14 | 12 |
| 62 | 60 | 58 | 56 | 54 | 52 | 50 | 48 | 45 | 43 | 41 | 39 | 37 | 35 | 33 | 31 | 29 | 27 | 25 | 23 | 21 | 19 | 17 | 14 | 12 |
| 64 | 62 | 60 | 57 | 55 | 53 | 51 | 49 | 47 | 45 | 43 | 41 | 38 | 36 | 34 | 32 | 30 | 28 | 26 | 23 | 21 | 19 | 17 | 15 | 13 |
| 66 | 64 | 62 | 59 | 57 | 55 | 53 | 51 | 48 | 46 | 44 | 42 | 40 | 37 | 35 | 33 | 31 | 29 | 26 | 24 | 22 | 20 | 18 | 15 | 13 |
| 68 | 66 | 63 | 61 | 59 | 57 | 54 | 52 | 50 | 48 | 45 | 43 | 41 | 39 | 36 | 34 | 32 | 29 | 27 | 25 | 23 | 20 | 18 | 16 | 14 |
| 70 | 68 | 65 | 63 | 61 | 58 | 56 | 54 | 51 | 49 | 47 | 44 | 42 | 40 | 37 | 35 | 33 | 30 | 28 | 26 | 23 | 21 | 19 | 16 | 14 |
| 72 | 70 | 67 | 65 | 62 | 60 | 58 | 55 | 53 | 50 | 48 | 46 | 43 | 41 | 38 | 36 | 34 | 31 | 29 | 26 | 24 | 22 | 19 | 17 | 14 |
| 74 | 72 | 69 | 66 | 64 | 62 | 59 | 57 | 54 | 52 | 49 | 47 | 44 | 42 | 39 | 37 | 35 | 32 | 30 | 27 | 25 | 22 | 20 | 17 | 15 |
| 76 | 73 | 71 | 68 | 66 | 63 | 61 | 58 | 56 | 53 | 51 | 48 | 46 | 43 | 41 | 38 | 35 | 33 | 30 | 28 | 25 | 23 | 20 | 18 | 15 |
| 78 | 75 | 73 | 70 | 68 | 65 | 62 | 60 | 57 | 55 | 52 | 49 | 47 | 44 | 42 | 39 | 36 | 34 | 31 | 29 | 26 | 23 | 21 | 18 | 16 |
| 80 | 77 | 75 | 72 | 69 | 67 | 64 | 61 | 59 | 56 | 53 | 51 | 48 | 45 | 43 | 40 | 37 | 35 | 32 | 29 | 27 | 24 | 21 | 19 | 16 |
| 82 | 79 | 77 | 74 | 71 | 68 | 66 | 63 | 60 | 57 | 55 | 52 | 49 | 46 | 44 | 41 | 38 | 36 | 33 | 30 | 27 | 25 | 22 | 19 | 16 |
| 84 | 81 | 78 | 75 | 73 | 70 | 67 | 64 | 62 | 59 | 56 | 53 | 50 | 48 | 45 | 42 | 39 | 36 | 34 | 31 | 28 | 25 | 22 | 20 | 17 |
| 86 | 83 | 80 | 77 | 75 | 72 | 69 | 66 | 63 | 60 | 57 | 54 | 52 | 49 | 46 | 43 | 40 | 37 | 34 | 32 | 29 | 26 | 23 | 20 | 17 |
| 88 | 85 | 82 | 79 | 76 | 73 | 70 | 67 | 65 | 62 | 59 | 56 | 53 | 50 | 47 | 44 | 41 | 38 | 35 | 32 | 29 | 26 | 23 | 21 | 18 |
| 90 | 87 | 84 | 81 | 78 | 75 | 72 | 69 | 66 | 63 | 60 | 57 | 54 | 51 | 48 | 45 | 42 | 39 | 36 | 33 | 30 | 27 | 24 | 21 | 18 |
| 92 | 89 | 86 | 83 | 80 | 77 | 74 | 71 | 67 | 64 | 61 | 58 | 55 | 52 | 49 | 46 | 43 | 40 | 37 | 34 | 31 | 28 | 25 | 21 | 18 |
| 94 | 91 | 88 | 84 | 81 | 78 | 75 | 72 | 69 | 66 | 63 | 60 | 56 | 53 | 50 | 47 | 44 | 41 | 38 | 34 | 31 | 28 | 25 | 22 | 19 |
| 96 | 93 | 90 | 86 | 83 | 80 | 77 | 74 | 70 | 67 | 64 | 61 | 58 | 54 | 51 | 48 | 45 | 42 | 38 | 35 | 32 | 29 | 26 | 22 | 19 |
| 98 | 95 | 91 | 88 | 85 | 82 | 78 | 75 | 72 | 69 | 65 | 62 | 59 | 56 | 52 | 49 | 46 | 42 | 39 | 36 | 33 | 29 | 26 | 23 | 20 |
| 100 | 97 | 93 | 90 | 87 | 83 | 80 | 77 | 73 | 70 | 67 | 63 | 60 | 57 | 53 | 50 | 47 | 43 | 40 | 37 | 33 | 30 | 27 | 23 | 20 |
| 102 | 99 | 95 | 92 | 88 | 85 | 82 | 78 | 75 | 71 | 68 | 65 | 61 | 58 | 54 | 51 | 48 | 44 | 41 | 37 | 34 | 31 | 27 | 24 | 20 |
| 104 | 101 | 97 | 93 | 90 | 87 | 83 | 80 | 76 | 73 | 69 | 66 | 62 | 59 | 56 | 52 | 49 | 45 | 42 | 38 | 35 | 31 | 28 | 24 | 21 |
| 106 | 102 | 99 | 95 | 92 | 88 | 85 | 81 | 78 | 74 | 71 | 67 | 64 | 60 | 57 | 53 | 49 | 46 | 42 | 39 | 35 | 32 | 28 | 25 | 21 |
| 108 | 104 | 101 | 97 | 94 | 90 | 86 | 83 | 79 | 76 | 72 | 68 | 65 | 61 | 58 | 54 | 50 | 47 | 43 | 40 | 36 | 32 | 29 | 25 | 22 |
| 110 | 106 | 103 | 99 | 95 | 92 | 88 | 84 | 81 | 77 | 73 | 70 | 66 | 62 | 59 | 55 | 51 | 48 | 44 | 40 | 37 | 33 | 29 | 26 | 22 |
| 112 | 108 | 105 | 101 | 97 | 93 | 90 | 86 | 82 | 78 | 75 | 71 | 67 | 63 | 60 | 56 | 52 | 49 | 45 | 41 | 37 | 34 | 30 | 26 | 22 |
| 114 | 110 | 106 | 102 | 99 | 95 | 91 | 87 | 84 | 80 | 76 | 72 | 68 | 65 | 61 | 57 | 53 | 49 | 46 | 42 | 38 | 34 | 30 | 27 | 23 |
| 116 | 112 | 108 | 104 | 100 | 97 | 93 | 89 | 85 | 81 | 77 | 73 | 70 | 66 | 62 | 58 | 54 | 50 | 46 | 43 | 39 | 35 | 31 | 27 | 23 |
| 118 | 114 | 110 | 106 | 102 | 98 | 94 | 90 | 87 | 83 | 79 | 75 | 71 | 67 | 63 | 59 | 55 | 51 | 47 | 43 | 39 | 35 | 31 | 28 | 24 |
| 120 | 116 | 112 | 108 | 104 | 100 | 96 | 92 | 88 | 84 | 80 | 76 | 72 | 68 | 64 | 60 | 56 | 52 | 48 | 44 | 40 | 36 | 32 | 28 | 24 |
| 122 | 118 | 114 | 110 | 106 | 102 | 98 | 94 | 89 | 85 | 81 | 77 | 73 | 69 | 65 | 61 | 57 | 53 | 49 | 45 | 41 | 37 | 33 | 28 | 24 |
| 124 | 120 | 116 | 111 | 107 | 103 | 99 | 95 | 91 | 87 | 83 | 79 | 74 | 70 | 66 | 62 | 58 | 54 | 50 | 45 | 41 | 37 | 33 | 29 | 25 |
| 126 | 122 | 118 | 113 | 109 | 105 | 101 | 97 | 92 | 88 | 84 | 80 | 76 | 71 | 67 | 63 | 59 | 55 | 50 | 46 | 42 | 38 | 34 | 29 | 25 |
| 128 | 124 | 119 | 115 | 111 | 107 | 102 | 98 | 94 | 90 | 85 | 81 | 77 | 73 | 68 | 64 | 60 | 55 | 51 | 47 | 43 | 38 | 34 | 30 | 26 |
| 130 | 126 | 121 | 117 | 113 | 108 | 104 | 100 | 95 | 91 | 87 | 82 | 78 | 74 | 69 | 65 | 61 | 56 | 52 | 48 | 43 | 39 | 35 | 30 | 26 |
| 132 | 128 | 123 | 119 | 114 | 110 | 105 | 101 | 97 | 92 | 88 | 84 | 79 | 75 | 70 | 66 | 62 | 57 | 53 | 48 | 44 | 40 | 35 | 31 | 26 |
| 134 | 130 | 125 | 120 | 116 | 112 | 107 | 103 | 98 | 94 | 89 | 85 | 80 | 76 | 71 | 67 | 63 | 58 | 54 | 49 | 45 | 40 | 36 | 31 | 27 |
| 136 | 132 | 127 | 122 | 118 | 113 | 109 | 104 | 100 | 95 | 91 | 86 | 82 | 77 | 72 | 68 | 64 | 59 | 54 | 50 | 45 | 41 | 36 | 32 | 27 |

of Parallax (*both additive*).

| of Parallax. | | | | | | Diff. 1° Alt. or 1′ Parx. |
|---|---|---|---|---|---|---|
| 50 | 52 | 54 | 56 | 58 | 60 | |
| 2 | 2 | 1 | 1 | 0 | 0 | 14 |
| 3 | 2 | 2 | 1 | 1 | 0 | 16 |
| 3 | 2 | 2 | 1 | 1 | 0 | 18 |
| 3 | 3 | 2 | 1 | 1 | 0 | 20 |
| 4 | 3 | 2 | 1 | 1 | 0 | 22 |
| 4 | 3 | 2 | 2 | 1 | 0 | 24 |
| 4 | 3 | 3 | 2 | 1 | 0 | 26 |
| 5 | 4 | 3 | 2 | 1 | 0 | 28 |
| 5 | 4 | 3 | 2 | 1 | 0 | 30 |
| 5 | 4 | 3 | 2 | 1 | 0 | 32 |
| 6 | 5 | 3 | 2 | 1 | 1 | 34 |
| 6 | 5 | 4 | 2 | 1 | 1 | 36 |
| 6 | 5 | 4 | 3 | 1 | 1 | 38 |
| 7 | 5 | 4 | 3 | 1 | 1 | 40 |
| 7 | 6 | 4 | 3 | 1 | 1 | 42 |
| 7 | 6 | 4 | 3 | 1 | 1 | 44 |
| 8 | 6 | 5 | 3 | 2 | 1 | 46 |
| 8 | 6 | 5 | 3 | 2 | 1 | 48 |
| 8 | 7 | 5 | 3 | 2 | 1 | 50 |
| 9 | 7 | 5 | 3 | 2 | 1 | 52 |
| 9 | 7 | 5 | 4 | 2 | 1 | 54 |
| 9 | 7 | 6 | 4 | 2 | 1 | 56 |
| 10 | 8 | 6 | 4 | 2 | 1 | 58 |
| 10 | 8 | 6 | 4 | 2 | 1 | 60 |
| 10 | 8 | 6 | 4 | 2 | 1 | 62 |
| 11 | 9 | 6 | 4 | 2 | 1 | 64 |
| 11 | 9 | 7 | 4 | 2 | 1 | 66 |
| 11 | 9 | 7 | 5 | 2 | 1 | 68 |
| 12 | 9 | 7 | 5 | 2 | 1 | 70 |
| 12 | 10 | 7 | 5 | 2 | 1 | 72 |
| 12 | 10 | 7 | 5 | 2 | 1 | 74 |
| 13 | 10 | 8 | 5 | 3 | 1 | 76 |
| 13 | 10 | 8 | 5 | 3 | 1 | 78 |
| 13 | 11 | 8 | 5 | 3 | 1 | 80 |
| 14 | 11 | 8 | 5 | 3 | 1 | 82 |
| 14 | 11 | 8 | 6 | 3 | 1 | 84 |
| 14 | 11 | 9 | 6 | 3 | 1 | 86 |
| 15 | 12 | 9 | 6 | 3 | 1 | 88 |
| 15 | 12 | 9 | 6 | 3 | 1 | 90 |
| 15 | 12 | 9 | 6 | 3 | 1 | 92 |
| 16 | 13 | 9 | 6 | 3 | 2 | 94 |
| 16 | 13 | 10 | 6 | 3 | 2 | 96 |
| 16 | 13 | 10 | 7 | 3 | 2 | 98 |
| 17 | 13 | 10 | 7 | 3 | 2 | 100 |
| 17 | 14 | 10 | 7 | 3 | 2 | 102 |
| 17 | 14 | 10 | 7 | 3 | 2 | 104 |
| 18 | 14 | 11 | 7 | 4 | 2 | 106 |
| 18 | 14 | 11 | 7 | 4 | 2 | 108 |
| 18 | 15 | 11 | 7 | 4 | 2 | 110 |
| 19 | 15 | 11 | 7 | 4 | 2 | 112 |
| 19 | 15 | 11 | 8 | 4 | 2 | 114 |
| 19 | 15 | 12 | 8 | 4 | 2 | 116 |
| 20 | 16 | 12 | 8 | 4 | 2 | 118 |
| 20 | 16 | 12 | 8 | 4 | 2 | 120 |
| 20 | 16 | 12 | 8 | 4 | 2 | 122 |
| 21 | 17 | 12 | 8 | 4 | 2 | 124 |
| 21 | 17 | 13 | 8 | 4 | 2 | 126 |
| 21 | 17 | 13 | 9 | 4 | 2 | 128 |
| 22 | 17 | 13 | 9 | 4 | 2 | 130 |
| 22 | 18 | 13 | 9 | 4 | 2 | 132 |
| 22 | 18 | 13 | 9 | 4 | 2 | 134 |
| 23 | 18 | 14 | 9 | 5 | 2 | 136 |

## Table (C c). For correcting Log. Difference for Planet's Altitude.

| App. Alt. | Planet's Horizontal Parallax. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2″ | 4″ | 6″ | 8″ | 10″ | 12″ | 14″ | 16″ | 18″ | 20″ | 22″ | 24″ | 26″ | 28″ | 30″ | 32″ |
| ° | | | | | | | | | | | | | | | | |
| 7 | 21 | 20 | 20 | 20 | 19 | 18 | 18 | 17 | 17 | 16 | 16 | 15 | 15 | 14 | 14 | 13 |
| 8 | 23 | 22 | 22 | 21 | 20 | 20 | 19 | 19 | 18 | 17 | 17 | 16 | 15 | 15 | 15 | 14 |
| 9 | 24 | 23 | 23 | 22 | 21 | 21 | 20 | 19 | 19 | 18 | 18 | 17 | 15 | 15 | 15 | 14 |
| 10 | 25 | 24 | 23 | 23 | 22 | 21 | 21 | 20 | 19 | 18 | 18 | 17 | 16 | 15 | 15 | 14 |
| 12 | 26 | 25 | 24 | 23 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 | 16 | 14 | 14 | 13 |
| 14 | 27 | 26 | 25 | 24 | 23 | 22 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 |
| 16 | 27 | 26 | 25 | 24 | 23 | 21 | 20 | 19 | 18 | 17 | 16 | 14 | 13 | 12 | 11 | 10 |
| 18 | 27 | 26 | 25 | 23 | 22 | 21 | 20 | 18 | 17 | 16 | 14 | 13 | 12 | 10 | 9 | 8 |
| 22 | 28 | 26 | 24 | 23 | 21 | 20 | 18 | 17 | 15 | 13 | 12 | 10 | 9 | 7 | 6 | 4 |
| 26 | 28 | 26 | 24 | 22 | 20 | 18 | 17 | 15 | 13 | 11 | 9 | 7 | 5 | 4 | 2 | 0 |
| 30 | 27 | 25 | 23 | 21 | 19 | 17 | 15 | 13 | 11 | 9 | 6 | 4 | 2 | 0 | 2 | 4 |
| 35 | 27 | 25 | 23 | 20 | 17 | 15 | 13 | 11 | 8 | 5 | 3 | 1 | 1 | 4 | 6 | 8 |
| 40 | 27 | 24 | 22 | 19 | 16 | 14 | 11 | 8 | 5 | 3 | 0 | 3 | 5 | 8 | 11 | 13 |
| 45 | 27 | 24 | 21 | 18 | 15 | 12 | 9 | 6 | 3 | 1 | 2 | 6 | 9 | 12 | 15 | 18 |
| 50 | 27 | 24 | 20 | 17 | 14 | 11 | 7 | 4 | 1 | 2 | 5 | 9 | 12 | 15 | 18 | 22 |
| 60 | 26 | 23 | 19 | 15 | 12 | 8 | 4 | 1 | 3 | 7 | 10 | 14 | 17 | 21 | 25 | 28 |
| 70 | 26 | 22 | 18 | 14 | 10 | 6 | 2 | 2 | 6 | 10 | 13 | 17 | 21 | 25 | 29 | 33 |
| 80 | 26 | 22 | 18 | 13 | 9 | 5 | 1 | 3 | 7 | 11 | 16 | 20 | 24 | 28 | 32 | 36 |

The corrections *above* the black line are *additive*, and those *below* subtractive.

## Table (D d). For correcting Log. Difference for the Height of Thermometer and Barometer.

| Alt. ° | Factor. | Alt. ° | Factor. |
|---|---|---|---|
| 4 | 0.2 | 33 | 1.2 |
| 6 | 0.3 | 36 | 1.3 |
| 8 | 0.3 | 39 | 1.4 |
| 9 | 0.4 | 42 | 1.5 |
| 12 | 0.5 | 46 | 1.6 |
| 14 | 0.6 | 50 | 1.7 |
| 17 | 0.7 | 54 | 1.8 |
| 20 | 0.8 | 59 | 1.9 |
| 23 | 0.9 | 65 | 2.0 |
| 26 | 1.0 | 72 | 2.1 |
| 29 | 1.1 | 90 | 2.1 |

N.B. To correct Log. Diff., multiply the factors answering to the app. alt. of each body by the corrections from "Table for correcting Mean Refraction," No. 2, page 380, and apply the products to the Log. Diff. as directed in the above No. 2 Table.

## Correction for Pole Star.

| Mer. R. A. | Lat. 30°. | | Lat. 50°. | | Lat. 70°. | |
|---|---|---|---|---|---|---|
| | 1871. | 1881. | 1871. | 1881. | 1871. | 1881. |
| h. m. | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ |
| 0 0 | −1 18 39 | −1 15 15 | −1 18 36 | −1 15 12 | −1 18 26 | −1 15 2 |
| 0 10 | −1 19 42 | −1 16 19 | −1 19 39 | −1 16 16 | −1 19 33 | −1 16 9 |
| 0 20 | −1 20 36 | −1 17 13 | −1 20 34 | −1 17 12 | −1 20 30 | −1 17 7 |
| 0 30 | −1 21 20 | −1 17 59 | −1 21 19 | −1 17 58 | −1 21 17 | −1 17 55 |
| 0 40 | −1 21 53 | −1 18 36 | −1 21 55 | −1 18 35 | −1 21 53 | −1 18 33 |
| 0 50 | −1 22 21 | −1 19 4 | −1 22 21 | −1 19 3 | −1 22 21 | −1 19 2 |
| 1 0 | −1 22 37 | −1 19 22 | −1 22 37 | −1 19 22 | −1 22 37 | −1 19 21 |
| 1 10 | −1 22 43 | −1 19 31 | −1 22 43 | −1 19 31 | −1 22 43 | −1 19 31 |
| 1 20 | −1 22 39 | −1 19 31 | −1 22 40 | −1 19 31 | −1 22 40 | −1 19 31 |
| 1 30 | −1 22 27 | −1 19 22 | −1 22 27 | −1 19 22 | −1 22 26 | −1 19 22 |
| 1 40 | −1 22 5 | −1 19 4 | −1 22 4 | −1 19 3 | −1 22 3 | −1 19 2 |
| 1 50 | −1 21 33 | −1 18 36 | −1 21 32 | −1 18 35 | −1 21 29 | −1 18 33 |
| 2 0 | −1 20 51 | −1 17 59 | −1 20 50 | −1 17 58 | −1 20 46 | −1 17 55 |
| 2 10 | −1 20 1 | −1 17 13 | −1 19 58 | −1 17 12 | −1 19 52 | −1 17 7 |
| 2 20 | −1 19 1 | −1 16 19 | −1 18 57 | −1 16 16 | −1 18 49 | −1 16 9 |
| 2 30 | −1 17 52 | −1 15 15 | −1 17 47 | −1 15 12 | −1 17 37 | −1 15 2 |
| 2 40 | −1 16 33 | −1 14 3 | −1 16 28 | −1 13 59 | −1 16 14 | −1 13 47 |
| 2 50 | −1 15 7 | −1 12 48 | −1 15 0 | −1 12 37 | −1 14 43 | −1 12 22 |
| 3 0 | −1 13 31 | −1 11 13 | −1 13 24 | −1 11 7 | −1 13 1 | −1 10 48 |
| 3 10 | −1 11 47 | −1 9 36 | −1 11 38 | −1 9 28 | −1 11 13 | −1 9 6 |
| 3 20 | −1 9 55 | −1 7 51 | −1 9 44 | −1 7 42 | −1 9 17 | −1 7 16 |
| 3 30 | −1 7 55 | −1 5 58 | −1 7 42 | −1 5 47 | −1 7 9 | −1 5 19 |
| 3 40 | −1 5 46 | −1 3 57 | −1 5 32 | −1 3 45 | −1 4 56 | −1 3 12 |
| 3 50 | −1 3 30 | −1 1 49 | −1 3 15 | −1 1 35 | −1 2 35 | −1 1 0 |
| 4 0 | −1 1 7 | −0 59 34 | −1 0 50 | −0 59 19 | −1 0 5 | −0 58 39 |
| 4 10 | −0 58 38 | −0 57 12 | −0 58 18 | −0 56 55 | −0 57 30 | −0 56 12 |
| 4 20 | −0 56 0 | −0 54 43 | −0 55 40 | −0 54 25 | −0 54 48 | −0 53 38 |
| 4 30 | −0 53 17 | −0 52 8 | −0 52 55 | −0 51 49 | −0 51 59 | −0 50 58 |
| 4 40 | −0 50 28 | −0 49 27 | −0 50 5 | −0 49 6 | −0 49 4 | −0 48 11 |
| 4 50 | −0 47 33 | −0 46 41 | −0 47 7 | −0 46 18 | −0 46 4 | −0 45 20 |
| 5 0 | −0 44 32 | −0 43 49 | −0 44 5 | −0 43 25 | −0 42 58 | −0 42 23 |
| 5 10 | −0 41 26 | −0 40 52 | −0 40 58 | −0 40 27 | −0 39 47 | −0 39 21 |
| 5 20 | −0 38 16 | −0 37 51 | −0 37 47 | −0 37 24 | −0 36 32 | −0 36 15 |
| 5 30 | −0 35 2 | −0 34 46 | −0 34 31 | −0 34 17 | −0 33 12 | −0 33 5 |
| 5 40 | −0 31 43 | −0 31 35 | −0 31 11 | −0 31 6 | −0 29 49 | −0 29 52 |
| 5 50 | −0 28 20 | −0 28 22 | −0 27 48 | −0 27 52 | −0 26 23 | −0 26 35 |
| 6 0 | −0 24 55 | −0 25 5 | −0 24 21 | −0 24 35 | −0 22 56 | −0 23 16 |
| 6 10 | −0 21 27 | −0 21 46 | −0 20 52 | −0 21 15 | −0 19 23 | −0 19 54 |
| 6 20 | −0 17 56 | −0 18 24 | −0 17 20 | −0 17 52 | −0 15 52 | −0 16 30 |
| 6 30 | −0 14 24 | −0 15 1 | −0 13 47 | −0 14 28 | −0 12 15 | −0 13 4 |
| 6 40 | −0 10 50 | −0 11 35 | −0 10 13 | −0 11 2 | −0 8 42 | −0 9 37 |
| 6 50 | −0 7 14 | −0 8 8 | −0 6 36 | −0 7 35 | −0 5 4 | −0 6 9 |
| 7 0 | −0 3 38 | −0 4 41 | −0 3 0 | −0 4 7 | −0 1 28 | −0 2 42 |
| 7 10 | −0 0 1 | −0 1 12 | +0 0 35 | −0 0 38 | +0 2 8 | +0 0 46 |
| 7 20 | +0 3 35 | +0 2 15 | +0 4 11 | +0 2 49 | +0 5 43 | +0 4 14 |
| 7 30 | +0 7 11 | +0 5 43 | +0 7 45 | +0 6 17 | +0 9 18 | +0 7 41 |
| 7 40 | +0 10 46 | +0 9 10 | +0 11 31 | +0 9 44 | +0 12 52 | +0 11 7 |
| 7 50 | +0 14 19 | +0 12 36 | +0 14 54 | +0 13 9 | +0 16 23 | +0 14 32 |

## Correction for Pole Star.

| Mer. R. A. | Lat. 30°. | | Lat. 50°. | | Lat. 70°. | |
|---|---|---|---|---|---|---|
| | 1871. | 1881. | 1871. | 1881. | 1871. | 1881. |
| h. m. | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ |
| 8 0 | +0 17 50 | +0 16 1 | +0 18 24 | +0 16 33 | +0 19 49 | +0 17 55 |
| 8 10 | +0 21 22 | +0 19 24 | +0 21 56 | +0 19 55 | +0 23 19 | +0 21 14 |
| 8 20 | +0 24 49 | +0 22 44 | +0 25 22 | +0 23 15 | +0 26 44 | +0 24 32 |
| 8 30 | +0 28 13 | +0 26 2 | +0 28 46 | +0 26 32 | +0 30 4 | +0 27 46 |
| 8 40 | +0 31 35 | +0 29 17 | +0 32 6 | +0 29 46 | +0 33 22 | +0 30 56 |
| 8 50 | +0 34 52 | +0 32 28 | +0 35 23 | +0 32 56 | +0 36 36 | +0 34 5 |
| 9 0 | +0 38 3 | +0 35 35 | +0 38 35 | +0 36 2 | +0 39 45 | +0 37 8 |
| 9 10 | +0 41 15 | +0 38 39 | +0 41 42 | +0 39 4 | +0 42 50 | +0 40 7 |
| 9 20 | +0 44 20 | +0 41 38 | +0 44 44 | +0 42 2 | +0 45 49 | +0 43 2 |
| 9 30 | +0 47 19 | +0 44 32 | +0 47 43 | +0 44 55 | +0 48 44 | +0 45 52 |
| 9 40 | +0 50 13 | +0 47 22 | +0 50 36 | +0 47 43 | +0 51 32 | +0 48 36 |
| 9 50 | +0 53 2 | +0 50 5 | +0 53 23 | +0 50 25 | +0 54 15 | +0 51 14 |
| 10 0 | +0 55 44 | +0 52 44 | +0 56 3 | +0 53 2 | +0 56 53 | +0 53 48 |
| 10 10 | +0 58 20 | +0 55 16 | +0 58 38 | +0 55 33 | +0 59 23 | +0 56 15 |
| 10 20 | +1 0 49 | +0 57 42 | +1 1 6 | +0 57 57 | +1 1 45 | +0 58 36 |
| 10 30 | +1 3 11 | +1 0 0 | +1 3 27 | +1 0 15 | +1 4 2 | +1 0 49 |
| 10 40 | +1 5 27 | +1 2 13 | +1 5 40 | +1 2 26 | +1 6 12 | +1 2 57 |
| 10 50 | +1 7 35 | +1 4 19 | +1 7 47 | +1 4 30 | +1 8 15 | +1 4 57 |
| 11 0 | +1 9 35 | +1 6 17 | +1 9 46 | +1 6 26 | +1 10 12 | +1 6 51 |
| 11 10 | +1 11 27 | +1 8 7 | +1 11 37 | +1 8 16 | +1 11 59 | +1 8 37 |
| 11 20 | +1 13 11 | +1 9 50 | +1 13 19 | +1 9 58 | +1 13 37 | +1 10 15 |
| 11 30 | +1 14 48 | +1 11 25 | +1 14 55 | +1 11 32 | +1 15 9 | +1 11 47 |
| 11 40 | +1 16 15 | +1 12 52 | +1 16 20 | +1 12 58 | +1 16 32 | +1 13 10 |
| 11 50 | +1 17 34 | +1 14 11 | +1 17 38 | +1 14 15 | +1 17 48 | +1 14 25 |
| 12 0 | +1 18 44 | +1 15 21 | +1 18 47 | +1 15 24 | +1 18 54 | +1 15 33 |
| 12 10 | +1 19 24 | +1 16 23 | +1 19 26 | +1 16 25 | +1 19 31 | +1 16 31 |
| 12 20 | +1 20 37 | +1 17 16 | +1 20 39 | +1 17 18 | +1 20 43 | +1 17 22 |
| 12 30 | +1 21 21 | +1 18 1 | +1 21 22 | +1 18 2 | +1 21 24 | +1 18 4 |
| 12 40 | +1 21 55 | +1 18 36 | +1 21 55 | +1 18 37 | +1 21 56 | +1 18 39 |
| 12 50 | +1 22 27 | +1 19 3 | +1 22 27 | +1 19 3 | +1 22 27 | +1 19 4 |
| 13 0 | +1 22 35 | +1 19 21 | +1 22 35 | +1 19 21 | +1 22 35 | +1 19 22 |
| 13 10 | +1 22 41 | +1 19 30 | +1 22 41 | +1 19 30 | +1 22 42 | +1 19 30 |
| 13 20 | +1 22 38 | +1 19 30 | +1 22 38 | +1 19 30 | +1 22 38 | +1 19 30 |
| 13 30 | +1 22 25 | +1 19 21 | +1 22 25 | +1 19 21 | +1 22 26 | +1 19 22 |
| 13 40 | +1 22 4 | +1 19 3 | +1 22 4 | +1 19 3 | +1 22 5 | +1 19 4 |
| 13 50 | +1 21 32 | +1 18 36 | +1 21 34 | +1 18 37 | +1 21 35 | +1 18 39 |
| 14 0 | +1 20 52 | +1 18 1 | +1 20 55 | +1 18 2 | +1 20 58 | +1 18 4 |
| 14 10 | +1 20 23 | +1 17 16 | +1 20 26 | +1 17 18 | +1 20 31 | +1 17 22 |
| 14 20 | +1 19 4 | +1 16 23 | +1 19 8 | +1 16 25 | +1 19 15 | +1 16 31 |
| 14 30 | +1 17 57 | +1 15 21 | +1 18 1 | +1 15 24 | +1 18 10 | +1 15 33 |
| 14 40 | +1 16 41 | +1 14 11 | +1 16 47 | +1 14 15 | +1 16 58 | +1 14 25 |
| 14 50 | +1 15 17 | +1 12 52 | +1 15 23 | +1 12 58 | +1 15 37 | +1 13 10 |
| 15 0 | +1 13 43 | +1 11 25 | +1 13 50 | +1 11 32 | +1 14 8 | +1 11 47 |
| 15 10 | +1 12 2 | +1 9 50 | +1 12 10 | +1 9 58 | +1 12 31 | +1 10 15 |
| 15 20 | +1 10 12 | +1 8 7 | +1 10 22 | +1 8 16 | +1 10 46 | +1 8 37 |
| 15 30 | +1 8 14 | +1 6 17 | +1 8 26 | +1 6 26 | +1 8 53 | +1 6 51 |
| 15 40 | +1 6 9 | +1 4 19 | +1 6 22 | +1 4 30 | +1 6 53 | +1 4 57 |
| 15 50 | +1 3 56 | +1 2 13 | +1 4 10 | +1 2 26 | +1 4 45 | +1 2 57 |

## Correction for Pole Star.

| Mer. R. A. | Lat. 30°. | | Lat. 50°. | | Lat. 70°. | |
|---|---|---|---|---|---|---|
| | 1871. | 1881. | 1871. | 1881. | 1871. | 1881. |
| h. m. | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ | ° ′ ″ |
| 16 0 | +1 1 36 | +1 0 0 | +1 1 52 | +1 0 15 | +1 2 30 | +1 0 49 |
| 16 10 | +0 59 9 | +0 57 42 | +0 59 26 | +0 57 57 | +1 0 8 | +0 58 36 |
| 16 20 | +0 56 35 | +0 55 16 | +0 56 55 | +0 55 33 | +0 57 42 | +0 56 15 |
| 16 30 | +0 53 55 | +0 52 44 | +0 54 16 | +0 53 2 | +0 55 6 | +0 53 48 |
| 16 40 | +0 51 8 | +0 50 5 | +0 51 31 | +0 50 25 | +0 52 25 | +0 51 14 |
| 16 50 | +0 48 16 | +0 47 22 | +0 48 40 | +0 47 43 | +0 49 38 | +0 48 36 |
| 17 0 | +0 45 18 | +0 44 32 | +0 45 44 | +0 44 55 | +0 46 46 | +0 45 52 |
| 17 10 | +0 42 16 | +0 41 38 | +0 42 42 | +0 42 2 | +0 43 48 | +0 43 2 |
| 17 20 | +0 39 8 | +0 38 39 | +0 39 36 | +0 39 4 | +0 40 45 | +0 40 7 |
| 17 30 | +0 35 55 | +0 35 35 | +0 36 25 | +0 36 2 | +0 37 37 | +0 37 8 |
| 17 40 | +0 32 39 | +0 32 28 | +0 33 10 | +0 32 56 | +0 34 25 | +0 34 5 |
| 17 50 | +0 29 19 | +0 29 17 | +0 29 51 | +0 29 46 | +0 31 9 | +0 30 56 |
| 18 0 | +0 25 56 | +0 26 2 | +0 26 28 | +0 26 32 | +0 27 50 | +0 27 46 |
| 18 10 | +0 22 29 | +0 22 44 | +0 23 2 | +0 23 15 | +0 24 26 | +0 24 32 |
| 18 20 | +0 19 0 | +0 19 24 | +0 19 34 | +0 19 55 | +0 21 0 | +0 21 14 |
| 18 30 | +0 15 28 | +0 16 1 | +0 16 4 | +0 16 33 | +0 17 32 | +0 17 55 |
| 18 40 | +0 11 55 | +0 12 36 | +0 12 31 | +0 13 9 | +0 14 0 | +0 14 32 |
| 18 50 | +0 8 20 | +0 9 10 | +0 8 57 | +0 9 44 | +0 10 28 | +0 11 7 |
| 19 0 | +0 4 45 | +0 5 43 | +0 5 21 | +0 6 17 | +0 6 53 | +0 7 41 |
| 19 10 | +0 1 8 | +0 2 15 | +0 1 45 | +0 2 49 | +0 3 17 | +0 4 14 |
| 19 20 | −0 2 28 | −0 1 12 | −0 1 52 | −0 0 38 | −0 0 18 | +0 0 46 |
| 19 30 | −0 6 4 | −0 4 41 | −0 5 28 | −0 4 7 | −0 3 55 | −0 2 42 |
| 19 40 | −0 9 40 | −0 8 8 | −0 9 3 | −0 7 35 | −0 7 32 | −0 6 9 |
| 19 50 | −0 13 14 | −0 11 35 | −0 12 39 | −0 11 2 | −0 11 6 | −0 9 37 |
| 20 0 | −0 16 48 | −0 15 1 | −0 16 12 | −0 14 28 | −0 14 42 | −0 13 4 |
| 20 10 | −0 20 19 | −0 18 24 | −0 19 44 | −0 17 52 | −0 18 15 | −0 16 30 |
| 20 20 | −0 23 48 | −0 21 46 | −0 23 14 | −0 21 15 | −0 21 47 | −0 19 54 |
| 20 30 | −0 27 14 | −0 25 5 | −0 26 42 | −0 24 35 | −0 25 16 | −0 23 16 |
| 20 40 | −0 30 38 | −0 28 22 | −0 30 5 | −0 27 52 | −0 28 44 | −0 26 35 |
| 20 50 | −0 33 57 | −0 31 35 | −0 33 27 | −0 31 6 | −0 32 6 | −0 29 52 |
| 21 0 | −0 37 13 | −0 34 46 | −0 36 44 | −0 34 17 | −0 35 27 | −0 33 5 |
| 21 10 | −0 40 25 | −0 37 51 | −0 39 57 | −0 37 24 | −0 38 44 | −0 36 15 |
| 21 20 | −0 43 32 | −0 40 52 | −0 43 5 | −0 40 27 | −0 41 56 | −0 39 21 |
| 21 30 | −0 46 35 | −0 43 49 | −0 46 9 | −0 43 25 | −0 45 3 | −0 42 23 |
| 21 40 | −0 49 31 | −0 46 41 | −0 49 8 | −0 46 18 | −0 48 5 | −0 45 20 |
| 21 50 | −0 52 23 | −0 49 27 | −0 52 1 | −0 49 6 | −0 51 3 | −0 48 11 |
| 22 0 | −0 55 8 | −0 52 8 | −0 54 47 | −0 51 49 | −0 52 53 | −0 50 58 |
| 22 10 | −0 57 47 | −0 54 43 | −0 57 28 | −0 54 25 | −0 56 38 | −0 53 38 |
| 22 20 | −1 0 19 | −0 57 12 | −1 0 1 | −0 56 55 | −0 59 16 | −0 56 12 |
| 22 30 | −1 2 45 | −0 59 34 | −1 2 29 | −0 59 19 | −1 1 47 | −0 58 39 |
| 22 40 | −1 5 3 | −1 1 49 | −1 4 49 | −1 1 35 | −1 4 10 | −1 1 0 |
| 22 50 | −1 7 14 | −1 3 57 | −1 7 1 | −1 3 45 | −1 6 27 | −1 3 12 |
| 23 0 | −1 9 16 | −1 5 58 | −1 9 5 | −1 5 47 | −1 8 35 | −1 5 19 |
| 23 10 | −1 11 11 | −1 7 51 | −1 11 2 | −1 7 42 | −1 10 33 | −1 7 16 |
| 23 20 | −1 12 58 | −1 9 36 | −1 12 50 | −1 9 28 | −1 12 28 | −1 9 6 |
| 23 30 | −1 14 37 | −1 11 13 | −1 14 30 | −1 11 7 | −1 14 11 | −1 10 48 |
| 23 40 | −1 16 6 | −1 12 43 | −1 16 1 | −1 12 37 | −1 15 46 | −1 12 22 |
| 23 50 | −1 17 27 | −1 14 3 | −1 17 23 | −1 13 59 | −1 17 11 | −1 13 47 |

# LATITUDES AND LONGITUDES OF PLACES ON THE SEABOARD,

## HARBOURS, CAPES, ISLANDS, REEFS, &c.

* *Light.* ** *Two or more Lights.* *** *Three Lights.*

*S.M. Secondary Meridian.*

## DIRECTORY.

I. **England,** E. Long.
Greenwich to Newhaven.
Nore to Spurn Head.

II. **England,** W. Long.
Brighton—Land's-End—Bristol—Liverpool.
Berwick—Hull.

III. **Scotland.** Edinburgh—Dundee—Aberdeen.
Orkneys—Shetlands—Faroes.
Pentland Skerries—Hebrides—Glasgow.

IV. **Ireland.** Dublin—Wexford—Cork.
Cape Clear—Bantry—Valentia—Limerick.
Galway—Westport—Londonderry—Belfast.

V. **North Coast of Europe,** E. Long.
Belgium—Holland—Denmark—Sweden—Norway.

VI. **Baltic.**
Denmark—Prussia—Russia—Sweden.

VII. **France.**
Calais—Cherbourg—Brest—Bordeaux.
Golfe du Lion—Toulon—Nice.

VIII. **Spain.**
San Sebastian—Corunna—Oporto—Lisbon.
Cadiz—Gibraltar—Barcelona—Balearic Isles.

IX. **Italy.** Genoa—Leghorn—Naples.
Sicily—Sardinia, with Corsica—Malta.
Gulf of Tarento—Ancona—Ravenna.

X. **Austria—Greece—Turkey—South Russia.**

XI. **Africa.** Egypt—Tunis—Algiers—Morocco.
West Coast, with Canaries.
East Coast, with Madagascar—Mauritius—Red Sea.

XII. **Asia.** Turkey—Arabia—Persia.

XIII. **Asia**—*continued.* India—China.

XIV. **North Pacific.** Japan, and Islands above Equator—West Coast of America, N. Lat.

XV. **South Pacific.** Australia—Tasmania—New Zealand.

XVI. **South Pacific**—*continued.*
New Zealand—Polynesia—New Hebrides.
Java—Sumatra—Borneo.

XVII. **North America.**
Newfoundland—Canada—Northern States.

XVIII. **North America**—*continued.*
Southern States—Central America—West Indies.

XIX. **South America.**
Guatemala—Brazil—Windward and Leeward Isles.
Patagonia—Chili—Peru.

XX. **Arctic—Antarctic Oceans, &c.**

| I. ENGLAND, E. Long. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Greenwich** Observatory | 51 | 28·6 | 0 | 0 |
| Greenhithe, Ferry | 51 | 27·2 | 0 | 16·75 |
| Sheerness, Flag-staff | 51 | 26·8 | 0 | 44·75 |
| Chatham, King's Stairs | 51 | 23·8 | 0 | 35·0 |
| Nore* | 51 | 29 | 0 | 48 |
| Margate,* Church | 51 | 23·4 | 1 | 23·25 |
| North Foreland* | 51 | 22·5 | 1 | 26·75 |
| Ramsgate, South Pier* | 51 | 19·7 | 1 | 25·5 |
| Sandown Castle | 51 | 14·3 | 1 | 24·25 |
| Goodwin,* Gong | 51 | 19·5 | 1 | 35·5 |
| Gull Stream,* Gong | 51 | 16·6 | 1 | 29·5 |
| Safety Beacon | 51 | 14·7 | 1 | 33·75 |
| South Sand Head, S. Point,* Gong | 51 | 10·0 | 1 | 28·25 |
| South Foreland** | 51 | 8·4 | 1 | 22·5 |
| **Dover** Castle* | 51 | 7·8 | 1 | 19·5 |
| Folkstone* | 51 | 4·8 | 1 | 11·0 |
| Dungeness* | 50 | 55·0 | 0 | 58·0 |
| Rye,** Church | 50 | 57·0 | 0 | 43·5 |
| Hastings** | 50 | 51·5 | 0 | 36·0 |
| Beechy Head* | 50 | 44·4 | 0 | 12·75 |
| **Newhaven,** West Pier* | 50 | 47 | 0 | 4 |

| ENGLAND, E. Long. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Nore,*** Gong | 51 | 29 | 0 | 48 |
| Maplin* S.E. Point, Bell | 51 | 35 | 1 | 3 |
| Inner Gabbard | 51 | 56·8 | 1 | 56·0 |
| Outer Gabbard | 51 | 59·0 | 2 | 3·5 |
| Walton Tower | 51 | 51·8 | 1 | 17·25 |
| **Harwich**** | 51 | 56·6 | 1 | 17·5 |
| Landguard Fort | 51 | 56·3 | 1 | 19·25 |
| Orford Steeple | 52 | 5·7 | 1 | 32·25 |
| Orfordness**, | 52 | 4·8 | 1 | 34·25 |
| Aldborough Steeple | 52 | 9·2 | 1 | 36·0 |
| Southwold Church | 52 | 19·7 | 1 | 40·75 |
| Pakefield* | 52 | 26·2 | 1 | 43·5 |
| Lowestoff** | 52 | 29·3 | 1 | 45·5 |
| **Yarmouth** Spire | 52 | 36·8 | 1 | 43·75 |
| Winterton* | 52 | 43·0 | 1 | 41·0 |
| Hasborough Lights** | 52 | 49·4 | 1 | 32·0 |
| Cromer* | 52 | 55·7 | 1 | 19·0 |
| Hunstanton Point* | 52 | 57·1 | 0 | 29·75 |
| Lynn's Well* | 53 | 1·7 | 0 | 25·0 |
| Inner Dowsing, Beacon | 53 | 18·4 | 0 | 33·25 |
| **Spurn** Lights** | 53 | 34·7 | 0 | 7·25 |

| II. ENGLAND, W. Long. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| London, St. Paul's Cathedral | 51 30·8 | 0 5·75 |
| **Brighton** Pier * | 50 49 | 0 8 |
| Shoreham ** | 50 50·3 | 0 16·0 |
| Selsea Bill, High House | 50 43·8 | 0 48·5 |
| **Portsmouth** Royal Naval College | 50 48·0 | 1 6·25 |
| Bembridge,* Gong | 50 42 | 1 2 |
| Cowes Castle | 50 46·0 | 1 17·75 |
| St. Catherine's Point * | 50 34·5 | 1 18·0 |
| Needles Light * | 50 39·9 | 1 34·0 |
| Southampton, St. Michael's Spire | 50 54 | 1 24·25 |
| Hurst ** | 50 42·4 | 1 32·75 |
| Christchurch | 50 43·9 | 1 44·25 |
| Poole, Branksea Castle | 50 41·7 | 1 58·0 |
| St. Alban's Head | 50 35 | 2 3 |
| Weymouth,* Jetty Fort | 50 36·6 | 2 26·0 |
| **Portland** ** | 50 31·4 | 2 26·75 |
| Bridport | 50 42·7 | 2 44·5 |
| Exmouth | 50 37 | 3 23 |
| Torquay * | 50 28 | 3 30 |
| Berry Head, Flag-staff | 50 24 | 3 28 |
| Dartmouth * | 50 21 | 3 33 |
| Start Point * | 50 13·4 | 3 38 |
| Prawle Point | 50 12 | 3 43 |
| Salcombe, Fort Charles | 50 19·3 | 3 48·0 |
| Bolt Head, Flag-staff | 50 13·2 | 3 48·75 |
| Eddystone * | 50 10·9 | 4 16·0 |
| **Plymouth,** Mount Wise, Flag-staff | 50 22·0 | 4 10·25 |
| ,, Breakwater, W. end,* Bell | 50 20·3 | 4 9·5 |
| Rame Head | 50 19 | 4 13 |
| Fowey, Castle | 50 19·7 | 4 38·75 |
| **Falmouth,** Pendennis Castle | 50 8·8 | 5 2·75 |
| ,, St. Antony * | 50 8·3 | 5 1·0 |
| Lizard,** West Light | 49 57·7 | 5 12·0 |
| Penzance,* Pier | 50 7·1 | 5 31·5 |
| Rundlestone Beacon | 50 1·1 | 5 40·2 |
| Longships Light * | 50 4·1 | 5 44·7 |
| Seven Stones,* Gong | 50 3 | 6 7 |
| St. Agnes' Light * | 49 53·6 | 6 20·75 |
| Cape Cornwall | 50 7·7 | 5 42·5 |
| St. Ives Church | 50 12·8 | 5 26·5 |
| Trevose Head ** | 50 33 | 5 2 |
| Padstow Church | 50 32·5 | 4 56·0 |
| Tintagel Church | 50 39·8 | 4 45·5 |
| Hartland Point | 51 1·4 | 4 31·5 |
| Lundy Isle ** | 51 10·1 | 4 40·25 |
| Bideford Lights ** | 51 4·5 | 4 12·0 |
| Mort Point | 51 11·4 | 4 13·75 |
| Ilfracombe * | 51 12·8 | 4 7·0 |
| Burnham Lights ** | 51 15·0 | 3 0·0 |
| Flatholm Isle, South Point * | 51 22·6 | 3 7·0 |
| **Bristol** Cathedral | 51 26·8 | 2 35·5 |
| Newport, Usk Light * | 51 32·4 | 2 59·75 |
| Cardiff Custom-House | 51 28·6 | 3 10·0 |
| Nash Point ** | 51 24·0 | 3 33·0 |
| Mumbles * | 51 34·0 | 3 58·25 |
| Swansea Pier * | 51 37·0 | 3 56·0 |
| Worms Head | 51 34 | 4 20 |
| St. Govan's Head | 51 35·8 | 4 55·5 |
| St. Ann's Lights ** | 51 41·0 | 5 10·5 |
| Milford Church | 51 42·7 | 5 1·5 |
| **Pembroke** Dock Yard, N.W. Corner | 51 41·8 | 4 57·25 |
| St. David's Cathedral | 51 52·9 | 5 16·0 |
| Strumble Head | 52 1·7 | 5 3·5 |
| Cardigan Steeple | 52 5·2 | 4 39·5 |
| Aberystwith * Castle | 52 24·9 | 4 5·25 |
| Cader Idris, 3,549 feet | 52 42·0 | 3 54·5 |
| Bardsey Isle * | 52 45·0 | 4 48·0 |
| Snowdon, 3,580 feet | 53 4·1 | 4 4·5 |
| Caernarvon * | 53 8·5 | 4 24·7 |
| South Stack * | 53 18·3 | 4 42·0 |
| **Holyhead,*** Bell | 53 20·0 | 4 37·0 |
| Skerries * | 53 25·3 | 4 36·5 |
| Port Lynas * | 53 25·0 | 4 17·25 |
| Great Orme's Head, Signal-staff | 53 20·0 | 3 51·25 |

| ENGLAND, W. Long. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| Point of Air,* Bell | 53 21·9 | 3 19·0 |
| N.W.* Light, Bell, Blue Lights | 53 27·4 | 3 17·75 |
| Formby * Light | 53 31·0 | 3 9·5 |
| Hoylake ** | 53 23·7 | 3 11·0 |
| Bell Beacon | 53 31·2 | 3 15·5 |
| Bidston * Light | 53 24·1 | 3 4·75 |
| Leasowe * Light | 53 24·9 | 3 7·75 |
| Black Rock * Light, Bell | 53 26·7 | 3 2·75 |
| **Liverpool,** St. Paul's | 53 24·6 | 2 59·5 |
| Liverpool Observatory | 53 24·8 | 3 0·0 |
| Crosby * Light | 53 31·0 | 3 4·0 |
| Formby, S.E. mark | 53 32·3 | 3 4·0 |
| Rossall, sea mark | 53 55·2 | 3 3·0 |
| Wyre,* Bell | 53 57·3 | 3 1·75 |
| Fleetwood ** | 53 55·6 | 3 1·0 |
| Lancaster Castle | 54 3·0 | 2 48·25 |
| Walney Isle, South Point * | 54 2·9 | 3 10·5 |
| **Isle of Man,** Black Comb, 1,919 ft. | 54 15·5 | 3 19·5 |
| South Point, Calf ** | 54 3·2 | 4 50·0 |
| Castleton * | 54 4·4 | 4 39·0 |
| Douglas * | 54 9·0 | 4 28·0 |
| North Point, Ayr Point * | 54 25·0 | 4 22·0 |
| Peel * | 54 13·6 | 4 42·0 |
| St. Bees Head * | 54 30·8 | 3 88·0 |
| **Whitehaven** ** | 54 33·2 | 3 35·75 |
| Harrington Pier * | 54 36·7 | 3 34·25 |
| Workington ** | 54 38·9 | 3 34·5 |
| Maryport, South Pier | 54 43·0 | 3 30·5 |
| Solway Firth,* Bell | 54 47·7 | 3 31·75 |
| Carlisle Cathedral | 54 53·8 | 2 56·0 |
| **Berwick,*** Spire | 55 45·8 | 1 59·0 |
| Holy Island, Castle | 55 40·2 | 1 47·0 |
| Farne Island ** | 55 37·0 | 1 39·25 |
| Longstone Light * | 55 38·7 | 1 36·5 |
| Cheviot Hill | 55 29 | 2 9 |
| N. Sunderland Point, Mill | 55 34·7 | 1 38·25 |
| Coquet Isle * | 55 20·1 | 1 32·25 |
| Blyth * | 55 7·5 | 1 30·0 |
| Tynemouth * | 55 1·3 | 1 25·0 |
| North Shields Church | 55 0·7 | 1 26·75 |
| **Newcastle,** Bridge, North end | 54 58·7 | 1 35·5 |
| Sunderland, Pier ** | 54 54·5 | 1 21·5 |
| Hartlepool, Pier ** | 54 41·8 | 1 10·75 |
| Seaton, High * | 54 40·3 | 1 12·25 |
| Tees River, Bran Sand ** | 54 37·1 | 1 8·75 |
| Stockton, Church | 54 34·0 | 1 18·75 |
| Redcar, Church | 54 36·9 | 1 3·5 |
| Whitby * | 54 29·7 | 0 36·75 |
| Scarborough * | 54 17·0 | 0 23·5 |
| Flamborough Head * | 54 7·0 | 0 5·0 |
| Bridlington Quay, Mill | 54 5·2 | 0 11·75 |
| **Hull** Citadel | 53 44·6 | 0 20·0 |
| Killingholme,*** Outer Light | 53 38·7 | 0 12·7 |
| **Channel Islands.** | | |
| **Alderney,** St. Anne's Church | 49 42·9 | 2 12·25 |
| Pierre au Vrack, Rock | 49 41·6 | 2 17·0 |
| Caskets,*** Bell | 49 43·4 | 2 22·5 |
| **Guernsey,** Jerbourg Tower | 49 25·3 | 2 33·0 |
| Pleinmont, S.W. Point, Guard Ho. | 49 25·3 | 2 41·0 |
| St. Pierre,* South Jetty | 49 27·0 | 2 33·0 |
| Fort Doyle, N.E. Point | 49 30·1 | 2 31·25 |
| Herm Island, Mill | 49 28·0 | 2 27·75 |
| Sark, Telegraph | 49 25·5 | 2 22·75 |
| Etat de Sark | 49 23·6 | 2 23·0 |
| **Jersey,** St. Pierre, Church | 49 12·5 | 2 11·75 |
| St. Helier's ** | 49 11·3 | 2 7·0 |
| C. Grosnez, Ruin | 49 15·2 | 2 15·5 |
| N.E. Point, or Point De la Coupe | 49 13·9 | 2 2·3 |
| S.E. Point, Seymour Tower | 49 9·4 | 2 1·1 |
| Roches Douvres | 49 6·5 | 2 49 |
| Barnouic Rocks | 49 1 | 2 48 |
| Chausey Isles, Great Isle * | 48 52·2 | 1 49·25 |
| Minquiers Rocks | 48 59 | 2 19 |

| III. SCOTLAND. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| Berwick* | 55 46·2 | 2 0·0 |
| Eyemouth, Church | 55 52·3 | 2 5·5 |
| St. Abb's Head, Signal Station | 55 55 | 2 8 |
| Dunbar, Church | 55 59·9 | 2 31·0 |
| Bass Rock | 56 4·7 | 2 38·2 |
| North Berwick, Church | 56 3·4 | 2 43·25 |
| Inch Keith* | 56 2·0 | 3 8·0 |
| **Edinburgh** Observatory | 55 57·4 | 3 11·0 |
| Leith Pier** | 55 58·9 | 3 10·5 |
| May Island** | 56 11·1 | 2 33·25 |
| Fife Ness, Flag-staff | 56 16·7 | 2 35·0 |
| St. Andrew's, Church | 56 20·4 | 2 47·5 |
| Bell Rock,* Bell | 56 26·0 | 2 23·0 |
| **Dundee**** | 56 27·6 | 2 57·75 |
| Port-on-Craig** | 56 27 | 2 49 |
| Buddon Ness** | 56 28·1 | 2 45·0 |
| Arbroath,* Abbey | 56 33·7 | 2 35·0 |
| Red Head | 56 37 | 2 29 |
| Montrose** | 56 42·5 | 2 28·0 |
| Stonehaven** | 56 58·0 | 2 12·75 |
| Girdle Ness** | 57 8·2 | 2 3·0 |
| **Aberdeen,**** Observatory | 57 8·9 | 2 5·75 |
| Buchan Ness* | 57 28 | 1 46 |
| Peterhead, Keith Inch | 57 30·1 | 1 46·0 |
| Rattray Point | 57 37 | 1 49 |
| Fraserburgh** | 57 41·9 | 2 0·0 |
| Kinnaird's Head* | 57 41·7 | 2 1·5 |
| Troup Head, Point | 57 41·7 | 2 17·25 |
| Banff Pier* | 57 40·3 | 2 31·5 |
| Cullen, Castle Hill | 57 41·4 | 2 49·5 |
| Coversea Skerries* | 57 43·4 | 3 20·25 |
| Burgh Head | 57 42·1 | 3 30·0 |
| Inverness Gaol | 57 28·6 | 4 13·5 |
| Chanonry Point* | 57 34·5 | 4 5·5 |
| Fort George | 57 35·1 | 4 4·5 |
| Cromarty Point* | 57 41·0 | 4 2·0 |
| Tarbet Ness* | 57 50·9 | 3 48·5 |
| Tain, Spire | 57 48·7 | 4 3·2 |
| Ord of Caith Ness, Needle | 58 10·2 | 2 31·0 |
| Noss Head* | 58 28 | 3 4 |
| **Orkneys**—South Point, or Brimnes | 58 46·4 | 3 13·5 |
| Stour Roray | 58 52·4 | 3 25·5 |
| Sacquoy Head | 59 12·0 | 3 4·25 |
| Noup Head | 59 20·0 | 3 4·0 |
| Moul Head | 59 23·0 | 2 53 |
| Stromness, S. Pt. of N. Ronaldsay | 59 20 | 2 26 |
| North Ronaldsay Isle, East Point. | 59 23 | 2 24 |
| Tafts Ness | 59 18 | 2 25 |
| Start Light | 59 16·6 | 2 22·0 |
| Sanday Isle, Treaness | 59 13 | 2 28·5 |
| Stronsa Isle, Lamb Head | 59 4·9 | 2 32·0 |
| Auskery Isle | 59 2 | 2 34 |
| Copinsha Isle | 58 54 | 2 40 |
| Strom Ness, Church | 58 57·8 | 3 17·5 |
| Brough of Birsa | 59 8·2 | 3 20·0 |
| **Kirkwall*** | 58 59·2 | 2 57·25 |
| **Shetlands**—Foul Isle | 60 9 | 2 6 |
| Fitfiel Head | 59 54 | 1 24 |
| Skelda Ness | 60 8·8 | 1 28·0 |
| Ve Skerries | 60 22·5 | 1 49 |
| Fugloe Skerry | 60 20·4 | 1 45·0 |
| Esha Ness Skerry | 60 28·5 | 1 37·25 |
| Ossa Skerry | 60 33·0 | 1 35·5 |
| Roeness Hill | 60 32 | 1 27 |
| Uya, N.E. Point | 60 37 | 1 26 |
| Gloup Holm, Summit | 60 44·2 | 1 6·5 |
| N. exterior Outer Stack Rock | 60 51·5 | 0 52·5 |
| Balta Island, South Point | 60 44·4 | 0 47·75 |
| Fetlar Island, East Point | 60 36·2 | 0 46·0 |
| Burra Voe Ness | 60 29·5 | 1 2·0 |
| Brury Isle, North Summit | 60 25·7 | 0 45·0 |
| Halsey Island, South Summit | 60 20 | 1 0 |
| Noes Head | 60 8·3 | 1 0·5 |
| Lerwick Fort | 60 9·4 | 1 8·75 |

| SCOTLAND. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| Bard Head | 60 6·1 | 1 4·5 |
| Mousa Isle Summit | 60 0 | 1 11 |
| Sunburgh Head* | 59 51·3 | 1 17·0 |
| Fair Isle | 59 33 | 1 38 |
| **Faroes**—Thorshaven, Hill N. of Ft. | 62 0·7 | 6 45·25 |
| Nalsoe Island, North Point | 62 39 | 6 41 |
| Fugloe Island, East Point | 62 20 | 6 13 |
| Waderoe Island, North Point | 62 24 | 6 31 |
| Myggenoes, Western extremity | 62 6 | 7 37 |
| Great Diamond | 61 43 | 6 40 |
| Suderoe Island | 61 25 | 6 41 |
| Monk Rock | 61 20 | 6 41 |
| **Pentland Skerries,**** N. Point | 58 41·2 | 2 55·0 |
| Duncansby Head | 58 39 | 3 1 |
| Dunnet Head* | 58 40·4 | 3 21·25 |
| Holburn Head | 58 35 | 3 31 |
| Thurso | 58 33 | 3 31 |
| Strathy Head | 58 36·0 | 4 9·5 |
| Roan Island, middle | 58 33·3 | 4 19·25 |
| Far-out Head | 58 36·2 | 4 45·0 |
| Cape Wrath* | 58 37·5 | 4 59 |
| Bulgie Island | 58 33 | 5 7 |
| Handa Isle | 58 23·0 | 5 11·75 |
| Ru Stoer | 58 16 | 5 22 |
| Ru Coygach | 58 6 | 5 26 |
| Rea Head | 57 54 | 5 33 |
| Point of Aird | 57 39 | 6 18 |
| Dunvegan Head | 57 32 | 6 41 |
| Copnahow Head | 57 18 | 6 43 |
| Canna Island, West Point | 57 4 | 6 34 |
| Rum Isle, South Point | 56 56 | 6 23 |
| „ West Point | 57 0 | 6 30 |
| **Hebrides**—Barra Head* | 56 47·1 | 7 39·25 |
| Barra Isle, North Point | 57 2 | 7 34 |
| Eris Kay | 57 3 | 7 16 |
| South Uist, West Point | 57 9 | 7 35 |
| Stornaway* | 58 11·5 | 6 22·25 |
| Tiompan Head | 58 15 | 6 12 |
| Butt of Lewis | 58 31 | 6 14 |
| Gallen Head | 58 14 | 7 2 |
| Scarp, West Point | 57 59 | 7 9 |
| Flannen Isles, N.W. extremity | 58 13 | 7 37 |
| St. Kilda Peak | 57 49·0 | 8 34·75 |
| Glass Island* | 57 52 | 6 33 |
| Coll Isle, North and East Point | 56 42 | 6 27 |
| Tirey Isle, South extremity | 56 27 | 6 56 |
| Ben More, 3,168 feet | 56 25·5 | 6 0·75 |
| Isle of Mull, North-West Point | 56 36 | 6 20 |
| Iona, West Point | 56 19 | 6 29 |
| Ben Nevis, 4,368 feet | 56 48 | 5 0 |
| Fort William | 56 48 | 5 5 |
| Lismore Island* | 56 27 | 5 36 |
| Oban Free Church | 56 25·9 | 5 31·75 |
| Colonsay, North Point | 56 8 | 6 10 |
| Rhinns of Isla, Oersa Isle* | 55 40 | 6 31 |
| Mull of Oe, South extremity | 55 35 | 6 18 |
| Ben Tuirch, 1,516 feet | 55 34 | 5 34 |
| Mull of Cantyre* | 55 20 | 5 49 |
| Campbelton* | 55 25·0 | 5 35·5 |
| **Glasgow** New Bridge | 55 51·9 | 4 16 |
| Port Glasgow, Basin | 55 56·2 | 4 41 |
| Greenock Spire | 55 56·9 | 4 45·25 |
| Cumbrae* | 55 43 | 4 59·7 |
| Ardrossan** | 55 38·7 | 4 50·5 |
| Pladda Lights** | 55 25·6 | 5 7·0 |
| Ailsa Craig | 55 15·2 | 5 7·0 |
| Ayr*** | 55 28 | 4 38 |
| Stranraer Church | 54 54·5 | 5 2·0 |
| Lough Ryan* | 54 58·5 | 5 1·75 |
| Corsill Point* | 55 0·5 | 5 9·5 |
| Port Patrick* | 54 50·3 | 5 6·75 |
| Mull of Galloway* | 54 38·1 | 4 51·25 |
| Burrow Head | 54 41 | 4 23 |
| Annan, Church | 54 59·2 | 3 15·5 |

| IV. IRELAND. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| **Dublin** Observatory | 53 23·2 | 6 20·25 |
| Kingstown, East Light * | 53 18·2 | 6 7·5 |
| Kish Light,* Gong | 53 19·0 | 5 56·5 |
| Great Sugar-loaf | 53 9·2 | 6 9·0 |
| Wicklow Black Castle | 52 58·8 | 6 2·0 |
| Wicklow Head ** | 52 57·9 | 6 0·0 |
| Arklow Church | 52 47·8 | 6 9·25 |
| Arklow Light,* Gong | 52 42·0 | 5 59·75 |
| Cahore Point | 52 34 | 6 12 |
| **Wexford**, Rosslare Pt., CoastGuard | 52 19·9 | 6 22.25 |
| Wexford College, Tower | 52 20·1 | 6 28·25 |
| Tuskar Rock,* Bell | 52 12·1 | 6 12·25 |
| Greenmore Point | 52 15 | 6 20 |
| Carnsore Point | 52 10·3 | 6 21·75 |
| Saltees or Kennibeg,* Gong | 52 2·3 | 6 40·0 |
| Hook Light * | 52 7·4 | 6 55·75 |
| **Waterford** Bridge | 52 16 | 7 6 |
| Duncannon Fort ** | 52 13·7 | 6 56·5 |
| Dunmore Pier * | 52 9 | 6 59 |
| Brownston Head | 52 7 | 7 7 |
| Helwick Head | 52 3 | 7 33 |
| Dungarvan Pier | 52 5 | 7 38 |
| Clonmell | 52 22 | 7 44 |
| Youghal * | 51 57 | 7 52 |
| Roche Point * | 51 47·5 | 8 15·25 |
| Haulbowline I. Tower | 51 50·5 | 8 18·25 |
| **Cork** Custom-house | 51 53·8 | 8 27·75 |
| Barry Head | 51 42·1 | 8 23·25 |
| Charles Fort, Flag Staff | 51 41·8 | 8 29·75 |
| Kinsale Old Head * | 51 36·7 | 8 32·25 |
| Seven Heads, Telegraph | 51 34·2 | 8 42·75 |
| Galley Head, South Point | 51 31·8 | 8 57·0 |
| Stags, off Toe Head | 51 28·1 | 9 13·5 |
| Baltimore | 51 29 | 9 22 |
| **Cape Clear**, South-East Point | 51 26 | 9 29 |
| Fastnet Rock * | 51 23·3 | 9 36·6 |
| Crookhaven * | 51 28·6 | 9 42·6 |
| Mizen Head | 51 27 | 9 50 |
| Sheep Head | 51 33 | 9 52 |
| Bear Haven, Bear Island, Summit | 51 37·5 | 9 52·4 |
| Hungry Hill | 51 41 | 9 48 |
| **Bantry** Church | 50 40·8 | 9 27·4 |
| Roanharrick Island* | 51 39·2 | 9 44·9 |
| Crelogh Rocks | 51 32 | 10 10 |
| Calf Rock | 51 34 | 10 16 |
| Bull Rock | 51 36 | 10 18 |
| Cod's Head | 51 40 | 10 7 |
| Kenmare | 51 53 | 9 33 |
| Scara Rock | 51 44 | 10 15 |
| Lamb-Head Point | 51 45 | 10 7 |
| Bolus Head | 51 46 | 10 19 |
| Skelligs ** | 51 46 | 10 32 |
| Brea Head | 51 53 | 10 25 |
| **Valentia**, Cromwell's Fort,* S.M. | 51 55·8 | 10°19′9″·7 |
| Killarney | 52 4 | 9 30 |
| Ventry Head | 52 6 | 10 20 |
| Foze Rock | 52 1 | 10 40 |
| Tiraght Rock | 52 3 | 10 39 |
| Great Blaskett, North Point | 52 6 | 10 31 |
| Ennis Tuskar Rock | 52 7 | 10 35 |
| Dunorling Head | 52 12 | 10 25 |
| Brandon Hill, 3,125 feet | 52 14 | 10 15 |
| Brandon Head, Point | 52 18 | 10 10 |
| Tralee | 52 16 | 9 48 |
| **Shannon**, Kerry Head | 52 23 | 9 55 |
| Tarbert * | 52 35·5 | 9 21·9 |
| **Limerick** Bridge | 52 39·6 | 8 39 |
| Kilcradan Light * | 52 34·8 | 9 42·66 |
| Loup Head * | 52 34 | 9 56 |
| Ballard Point | 52 43 | 9 39 |
| Hag's Head | 52 57 | 9 28 |
| South Arran Island * | 53 7·6 | 9 42·4 |
| Black Head | 53 9 | 9 17 |

| IRELAND. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| **Galway**, Mutton Island Light * | 53 15·2 | 9 3·67 |
| Skird Rocks, Outer | 53 15 | 10 2 |
| Slyne Head ** | 53 24·0 | 10 14·16 |
| Shark Head | 53 36 | 10 29 |
| Clare Island, North Point * | 53 49·5 | 9 59 |
| Innisgort * | 53 49·5 | 9 41 |
| **Westport** | 53 48 | 9 31 |
| Newport | 53 53 | 9 33 |
| Bills Rock | 53 53 | 10 11 |
| Achil Head, 2,222 feet | 53 58 | 10 16 |
| Black Rock | 54 4 | 10 21 |
| Eagle Island ** | 54 17 | 10 6 |
| Erris Head | 54 17 | 10 0 |
| Stag Rocks, Northernmost | 54 22 | 9 48 |
| Downpatrick Head | 54 20 | 9 21 |
| Killala | 54 11 | 9 13 |
| Ballina Spire | 54 6·6 | 9 9·67 |
| Black Rock * | 54 18 | 8 37 |
| **Sligo** Bridge | 54 16 | 8 28 |
| Innis Murray Island | 54 26 | 8 40 |
| Ballyshannon, Church | 54 30·2 | 8 11·9 |
| Donegal | 54 39 | 8 7 |
| Enniskillen | 54 21 | 7 40 |
| St. John's Point,* Killibeg's Light | 54 34 | 8 28 |
| Rathlin O'Birne * | 54 40 | 8 50 |
| Teelen Head | 54 40 | 8 45 |
| Daurus Head Point | 54 49·6 | 8 34·16 |
| N. Arran Island, N.W. Point | 55 1·4 | 8 34·16 |
| Stag Rocks | 55 4·6 | 8 29·16 |
| Bloody Foreland Hill | 55 8·2 | 8 15·9 |
| Tory I.,* Light on N. and W. Point | 55 16·5 | 8 15·16 |
| Horn Head, East Summit | 55 12·5 | 7 57 |
| Melmore Point, Tower | 55 15·2 | 7 47·0 |
| Limeburner Shoal | 55 18 | 7 48 |
| Fannet Point * | 55 16·6 | 7 37·7 |
| Buncrana Church | 55 8·1 | 7 27·25 |
| Dunaff Head | 55 17·1 | 7 32 |
| Malin Head Tower | 55 22·8 | 7 22·25 |
| Innistrahul Light * | 55 25·9 | 7 13·7 |
| Slieve Sneacht, 2,239 feet | 55 12 | 7 20 |
| Innishowen Head ** | 55 13·8 | 6 55·5 |
| **Londonderry** Bridge | 54 59·6 | 7 19 |
| Portrush Pier | 55 12·4 | 6 39·7 |
| Giants' Causeway Point | 55 14·7 | 6 36·75 |
| Rachlin Island,* Church | 55 17·6 | 6 11·7 |
| Fair Head | 55 13·3 | 6 8·7 |
| Torr Point Rock | 55 11·8 | 6 3·5 |
| Knocklayd, 1,690 feet | 55 9·7 | 6 15·2 |
| Maiden Rocks ** | 54 55·8 | 5 44·25 |
| Black Head | 54 46·1 | 5 41·25 |
| Carrickfergus | 54 45·5 | 5 48·5 |
| **Belfast** Spire | 54 36·4 | 5 56·25 |
| Divis, 1,800 feet | 54 36·7 | 6 1·0 |
| Copeland Island * | 54 41·7 | 5 31·2 |
| Donaghadee * | 54 38·6 | 5 31·7 |
| Kircubbin | 54 29 | 5 34 |
| Portaferry | 54 23 | 5 34 |
| South Rocks * | 54 23·9 | 5 25·0 |
| Ardglass Pier * | 54 15·4 | 5 36·0 |
| Downpatrick Cathedral | 54 19·6 | 5 43·0 |
| St. John's Point * | 54 13 | 5 40 |
| Slieve Donard, 2,796 feet | 54 10·8 | 5 55·25 |
| Carlingford * | 54 2·0 | 6 7·75 |
| Blockhouse Island,** Bell | 54 1·2 | 6 4·75 |
| Newry Church | 54 10·6 | 6 19·75 |
| Dundalk Spire | 54 0·5 | 6 24·0 |
| Clogher Head | 53 47·6 | 6 13 |
| Drogheda *** | 53 42·8 | 6 15 |
| Balbriggan * | 53 36·8 | 6 10·75 |
| Rockabil Island | 53 35·8 | 6 0·25 |
| Lambay Island | 53 29·6 | 6 1·0 |
| Howth Bailey * Light | 53 21·7 | 6 3·0 |
| Rockal, a Rock N.W. of Ireland, in open sea | 57 36 | 13 41 |

## V. NORTH COAST OF EUROPE.

| | Lat. N. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| **Dunkirk*** | 51 3·1 | 2 22·0 |
| Nieuport,* N.W. of Town | 51 8·6 | 2 44 |
| **Ostend,**** West Light | 51 14·1 | 2 55·0 |
| Blankenburg * | 51 19·0 | 3 8·0 |
| Heyst* | 51 20·4 | 3 14·2 |
| Flushing * | 51 26·4 | 3 34·75 |
| West Kappel * | 51 31·8 | 3 27·0 |
| Middelburg | 51 30·0 | 3 37·0 |
| Schouwen,* West End | 51 42·6 | 3 41·75 |
| Bergen-op-Zoom Church | 51 29·7 | 4 17·5 |
| Goedereede Church * | 51 49·2 | 3 58·5 |
| Antwerp Cathedral | 51 13·2 | 4 24·25 |
| Helvoetsluys * | 51 49·2 | 4 8·0 |
| Brielle | 51 54·2 | 4 10·0 |
| Rotterdam Cathedral | 51 55·3 | 4 29·5 |
| The Hague, St. James's Church | 52 4·3 | 4 18·7 |
| Scheveningen * | 52 6·3 | 4 16·5 |
| Katwyk, Coast Light * | 52 12·0 | 4 23·75 |
| Nordwyk * Light | 52 14·6 | 4 26·0 |
| Alkmaar | 52 37·9 | 4 45·25 |
| Zandvort * | 52 22·3 | 4 32·0 |
| Egmont** | 52 37·2 | 4 38 |
| Kyk Down * | 52 57·1 | 4 43·5 |
| Helder | 52 57·7 | 4 45·0 |
| **Texel,** West Point | 53 3 | 4 42 |
| Medemblik Church | 52 46·4 | 5 6·5 |
| Marken Island * | 52 27·6 | 5 8·7 |
| **Amsterdam,** West Steeple | 52 22·5 | 4 53·25 |
| Haarlem, Great Church Tower | 52 22·9 | 4 38·5 |
| Leyden Observatory | 52 9·5 | 4 29·5 |
| Vlieland * | 53 17·8 | 5 3·7 |
| Ter Schelling * | 53 21·6 | 5 13·25 |
| Ameland Beacon | 53 27·0 | 5 42·0 |
| Schiermonckoog ** | 53 29·3 | 6 10·0 |
| Rottum Beacon | 53 32·0 | 6 32·0 |
| Borcum * | 53 35 | 6 40 |
| Emden, Hotel de Ville | 53 22·1 | 7 12·75 |
| Wangeroog * | 53 47·6 | 7 54 |
| Bremer or Weser,* Bell, Guns | 53 49 | 8 8 |
| Bremen Observatory | 53 4·6 | 8 49·0 |
| **Heligoland** * | 54 10·8 | 7 53·0 |
| Elbe, Outer Light, Bell, Gun | 54 0·0 | 8 18·0 |
| „ Inner Light, Bell | 53 58·8 | 8 26·0 |
| Eider,* Bell, Gun | 54 10·7 | 8 35·0 |
| Newark Isle ** | 53 55·2 | 8 30·0 |
| Cuxhaven * | 53 52·5 | 8 43·0 |
| Gluckstadt Pier * | 53 47·1 | 9 24·5 |
| **Altona** Observatory, S. M. | 53 32·7 | 9°56′·39″ |
| Hamburgh | 53 32·8 | 9 58·5 |
| Horn Point | 55 35 | 7 40 |
| Hantsholmen Point * | 57 6·8 | 8 36·2 |
| Harshall's Nist | 57 35 | 9 56 |
| The Skaw Point * | 57 43·8 | 10 36·5 |
| Hirtsholmen * | 57 29·2 | 10 37·5 |
| Fladstrand Church | 57 27·0 | 10 33·75 |
| Niedingen,** Bell | 57 19 | 11 53 |
| Trindelen,* Bell | 57 25·6 | 11 16 |
| Lessoe Isle, Byrum Church | 57 15·4 | 11 0·25 |
| Anholt, East Point * | 56 44·3 | 11 39·25 |
| Knobens * Light, Bell | 56 45·7 | 11 50·75 |
| Hesselo * | 56 11·7 | 11 43 |
| Aalborg | 57 2·7 | 9 55 |
| Forenas * | 56 26·7 | 10 57·5 |
| Aarhus, Cathedral | 56 9·5 | 10 13·0 |
| Thunoe Island * | 55 56·9 | 10 27·0 |
| Baagoe, South Point * | 55 17·7 | 9 48·0 |
| Apenrade | 55 2·6 | 9 25·25 |
| Assens, Church | 55 16·1 | 9 53·75 |
| Flensburg | 54 46·9 | 9 26·2 |
| Siællands, N.W. Point | 56 5 | 11 15 |
| Kyholm * | 55 56·0 | 10 40·7 |
| Refsnæs * | 55 44·7 | 10 52·5 |
| Sprogo * | 55 20 | 10 58 |

## NORTH COAST OF EUROPE.

| | Lat. N. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| Nyeborg * | 55 18·7 | 10 49·7 |
| Fakkeberg * | 54 44·4 | 10 43·0 |
| Spodsbierg * | 55 58·6 | 11 52·0 |
| Nakkehoved** | 56 7·2 | 12 21·0 |
| Elsinor, Kronberg * | 56 2·2 | 12 37·5 |
| **Copenhagen** Observatory | 55 40·9 | 12 34·75 |
| Malmo * | 55 36·1 | 13 0·0 |
| Landskrona * | 55 52·4 | 12 50·0 |
| Helsingborg * | 56 2·7 | 12 42·25 |
| Kullen * | 56 18·0 | 12 27·5 |
| Engelholm | 56 14·6 | 12 52·0 |
| Hallands Wadero, West extremity | 56 27·1 | 12 32 |
| Halmstadt, Fort | 56 40·4 | 12 51·75 |
| Falkenberg Church | 56 54·0 | 12 30·0 |
| Moruptange * Light | 56 55·2 | 12 21·75 |
| Warberg Castle | 57 6·4 | 12 14·5 |
| Niddingen,** Bell | 57 18·2 | 11 54·3 |
| Vanguard Shoal | 57 32 | 11 39 |
| Wingo** | 57 38·0 | 11 36·2 |
| Buskär * Light | 57 38·6 | 11 40·75 |
| **Gottenburg** | 57 42·3 | 11 56·5 |
| Marstrand * Light | 57 53·2 | 11 35·0 |
| Paternoster Isl., S. & W. extremity | 57 53·5 | 11 27 |
| Salo * Light | 58 20·2 | 11 16 |
| Rock | 58 42 | 10 53 |
| Torbjornskar Beacon | 58 58·7 | 10 47 |
| Foerder * Light | 59 4 | 10 32 |
| Fulehuk * Light, Bell | 59 11·4 | 10 37 |
| Frederiksteen | 59 7·5 | 11 24 |
| Frederikstadt | 59 13 | 10 57 |
| **Christiania,** New Observatory | 59 54·7 | 10 43·5 |
| Svenoe Langoe Sound * Light | 58 58 | 9 46 |
| Tvesteen | 58 56 | 9 57 |
| Reierskar Rock, Gun | 58 10·1 | 8 27 |
| Jomfrueland * | 58 52 | 9 36 |
| Arendal Torungen * | 58 23·2 | 8 52·5 |
| Oxo Light * | 58 3·7 | 8 6 |
| Christiansand | 58 8·1 | 7 59·0 |
| Flekkero Island | 58 2 | 7 57 |
| Ryvingen Island | 57 57·0 | 7 31 |
| Naze Light * | 57 57·8 | 7 2 |
| Listersteen Light * | 58 6 | 6 32 |
| Tungenæs Light * | 59 3 | 5 37 |
| Hvidingsoe Light * | 59 5 | 5 25 |
| Skuddesnæs Light * | 59 8·7 | 5 19 |
| Hoievarde Light * | 59 20 | 5 20 |
| Udsire** | 59 18·3 | 4 53·5 |
| Sor Hougoen Rock * | 59 25·2 | 5 15·25 |
| Bommeloe, South Point | 59 35 | 5 11 |
| Fugloe | 60 1 | 4 59 |
| Kors Fiord | 60 8 | 4 57 |
| **Bergen** | 60 24 | 5 18 |
| Stadtland, North-West Point | 62 11 | 5 8 |
| Rondo Light * | 62 24·6 | 5 36 |
| Quistholm Light * | 63 2·2 | 7 14 |
| Christiansund * | 63 7 | 7 39 |
| Trondheim Cathedral | 63 25·8 | 10 23·75 |
| Titterhead | 63 40 | 8 19 |
| Vigten Isles, West extremity | 64 46 | 10 24 |
| Proestoe Light * | 64 47·4 | 11 8 |
| Lekoe | 65 5 | 11 37 |
| Tranen Isles, Great Isle, N. Peak | 66 31 | 12 4 |
| Kunna | 66 57 | 13 32 |
| Lofoden Isles, South Point | 67 49·5 | 12 50 |
| West Vangoe Isle, North Point | 68 20·5 | 13 59 |
| Langoe Isle, West Point | 68 37 | 14 14 |
| Andoe, North Point | 69 20 | 16 8 |
| Tromsoe Observatory | 69 39·2 | 18 57·0 |
| Hammerfest Church | 70 40·0 | 23 42·0 |
| Vando, North Point | 70 17·6 | 19 36 |
| Arno, North-East Point | 70 13 | 20 49 |
| Soroea, West Point | 70 39 | 21 55 |
| North Cape | 71 10·3 | 25 46·0 |

| VI. BALTIC. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Copenhagen** Observatory | 55 | 40·9 | 12 | 34·75 |
| Steffens Klint * | 55 | 18 | 12 | 27 |
| Moen Island, East Point* | 54 | 57 | 12 | 33 |
| Giedserodde * | 54 | 33·8 | 11 | 58·0 |
| Trindelen | 54 | 30·5 | 12 | 4 |
| **Kiel** Observatory | 54 | 19·5 | 10 | 9·0 |
| Marienleuchte * | 54 | 29·7 | 11 | 14·25 |
| Staberhuk, S.E. Point of Fehmern | 54 | 24 | 11 | 19 |
| **Lubeck,** Church, St. Mary's | 53 | 52·1 | 10 | 41·5 |
| Wismar, Church, St. Mary's | 53 | 53·5 | 11 | 27·75 |
| Warnemunde * | 54 | 10·7 | 12 | 5·75 |
| Rostock | 54 | 5·5 | 12 | 9·0 |
| Dars Head * * | 54 | 28·6 | 12 | 30·5 |
| Stralsund | 54 | 18·3 | 13 | 5·5 |
| Arkona * | 54 | 40·9 | 13 | 26·2 |
| Bergen Church | 54 | 25·5 | 13 | 28·0 |
| Rugen, East Point | 54 | 21 | 13 | 48 |
| Griefswaldoe Light * * | 54 | 15·1 | 13 | 55·7 |
| Swinemunde * | 53 | 56·0 | 14 | 17·0 |
| **Stettin** | 53 | 25·1 | 14 | 34·0 |
| Colberg, Fort | 54 | 10·8 | 15 | 35 |
| Jershoft Light * | 54 | 32·5 | 16 | 33·0 |
| Hela Light * | 54 | 36·1 | 18 | 49·25 |
| Rexhoft * | 54 | 49·9 | 18 | 20·5 |
| Neufahrwasser * | 54 | 24·2 | 18 | 40·25 |
| **Dantzig** Observatory | 54 | 21·3 | 18 | 41·2 |
| Pillau * | 54 | 38·4 | 19 | 54·0 |
| Konigsberg Observatory | 54 | 42·8 | 20 | 30·25 |
| Brusterort * | 54 | 57·6 | 19 | 59·25 |
| **Memel** * | 55 | 43·7 | 21 | 6·2 |
| Libau | 56 | 31·6 | 20 | 57·0 |
| Windau Church | 57 | 23·9 | 21 | 34·0 |
| Lyserort Light * | 57 | 34 | 21 | 44 |
| Domesness * * | 57 | 45·6 | 22 | 37 |
| Runo Island * | 57 | 48 | 23 | 16 |
| **Riga,** * * Cathedral | 56 | 57·0 | 24 | 6·5 |
| Pernau, German Church | 58 | 23·1 | 24 | 30·25 |
| Arensburg | 58 | 15·1 | 22 | 30 |
| Svalfe Rort, Œsel Isl., S. Point * | 57 | 54·6 | 22 | 5 |
| Filsand, W. Point of Great Island | 58 | 23 | 21 | 51 |
| Dagerort Light * | 58 | 55·0 | 22 | 12·0 |
| Winkova, White Beacon | 59 | 12 | 22 | 18 |
| Odensholm Light * | 59 | 18·3 | 23 | 22·0 |
| Packerort Light * | 59 | 23·5 | 24 | 2 |
| Surop Light * | 59 | 27·9 | 24 | 23·25 |
| Nargen, North Point * | 59 | 36·4 | 24 | 31·0 |
| **Revel,** * * St. Olaus Church | 59 | 26·6 | 24 | 45·25 |
| Kokskar Light * | 59 | 42·0 | 25 | 2 |
| Ekholm Light * | 59 | 41·2 | 25 | 49 |
| Stoneskar Beacon | 59 | 49·5 | 26 | 21 |
| Rothskar Island * | 59 | 58·2 | 26 | 42·0 |
| Little Tiouters, West Point | 59 | 50·0 | 26 | 53·0 |
| Great Tiouters, East Point | 59 | 51·0 | 27 | 14·5 |
| Hogland * * | 60 | 6·3 | 26 | 58·5 |
| Lavenskar Island, North Point | 60 | 2·3 | 27 | 51·0 |
| Peni Island, East Point | 60 | 1·1 | 28 | 5·0 |
| Seskar Island, North-West Point * | 60 | 2·1 | 28 | 23·5 |
| Cape Kolganpia | 59 | 50·9 | 28 | 34·75 |
| Dolgoi Noss | 59 | 54·8 | 29 | 0·5 |
| Tolboukhin Light * | 60 | 2·6 | 29 | 34·0 |
| London Shoal * | 60 | 0·0 | 29 | 32·5 |
| **Kronstadt,** Cathedral | 59 | 59·7 | 29 | 46·5 |
| Elaghin Channel Light * | 59 | 58·3 | 30 | 10·5 |
| Ship Channel Light * | 59 | 55·3 | 30 | 10·7 |
| **St. Petersburg** Observatory | 59 | 56·5 | 30 | 19·0 |
| Poulkova Observatory | 59 | 46·3 | 30 | 19·75 |
| Grekova Beacon | 60 | 11·6 | 28 | 42·5 |
| Wiborg | 60 | 42·7 | 28 | 46 |
| Aspo Beacon * | 60 | 17·7 | 27 | 13 |
| Nerva Tower | 60 | 14·8 | 27 | 58·5 |
| Sommers Island * | 60 | 12·4 | 27 | 39·5 |
| Lippu Island Beacon | 60 | 14·3 | 27 | 3·0 |
| Fredericksharnm | 60 | 34 | 27 | 16 |
| Lovisa | 60 | 27·6 | 26 | 16 |

| BALTIC. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Biorko Island, South Point | 60 | 15·7 | 28 | 43·2 |
| Styrsudd Head, Beacon | 60 | 12·0 | 29 | 0·0 |
| Orrengrund, Beacon | 60 | 16·6 | 26 | 27·25 |
| Great Pellinge or Gloskolm * | 60 | 11·2 | 25 | 50 |
| Soderskar Tower | 60 | 6·2 | 25 | 24 |
| Kallbaden | 59 | 59 | 25 | 37 |
| **Helsingfors** Observatory | 60 | 9·7 | 24 | 57·5 |
| **Sveaborg** | 60 | 8·4 | 24 | 59·75 |
| Ronskar Light * | 59 | 56 | 24 | 24 |
| Jussari, Pilot's House | 59 | 49·7 | 23 | 34 |
| Segelskar, Beacon | 59 | 46 | 23 | 22 |
| Hango Light * | 59 | 46·0 | 22 | 58 |
| Abo Observatory | 60 | 27·0 | 22 | 17·5 |
| Uto * | 59 | 46·5 | 21 | 22 |
| Lagskar * | 59 | 50·5 | 19 | 55·25 |
| Enskar * | 60 | 43 | 21 | 2 |
| Sabbskar, Beacon | 61 | 27·7 | 21 | 22 |
| Bjorneborg | 61 | 29·0 | 21 | 48 |
| Torngund Beacon | 62 | 13·0 | 21 | 20 |
| Christinestad | 62 | 16·2 | 21 | 23 |
| Storkalle Shoal, South Point | 62 | 45 | 20 | 50 |
| Fallskar Beacon | 63 | 4 | 20 | 49 |
| Wasa Church | 63 | 4·3 | 21 | 43 |
| Korsoran Beacon | 63 | 11·8 | 21 | 10 |
| Nordskaren * | 63 | 14 | 20 | 38 |
| Tankar Beacon | 63 | 57·3 | 22 | 52 |
| Gamla Karleby | 63 | 50 | 23 | 9 |
| Kalla Rock, Outer Rock | 64 | 20·0 | 23 | 29 |
| Carlo Island Beacon, West Point | 65 | 2·0 | 24 | 33 |
| Uleaborg Church | 65 | 1·0 | 25 | 30 |
| Ulkogrunni Beacon | 65 | 24 | 24 | 51 |
| Malorn * | 65 | 31 | 23 | 38 |
| Tornea | 65 | 50·8 | 24 | 14 |
| Rodkallen Rocks | 65 | 20 | 22 | 23 |
| Pitea | 65 | 19·2 | 21 | 30·0 |
| Great Fjäderäg * Island | 63 | 48 | 21 | 1 |
| Gadd,* on South Point of Island | 63 | 36·0 | 20 | 46 |
| Umea | 63 | 49·5 | 20 | 18 |
| Hernosand | 62 | 37·9 | 17 | 57 |
| Stor Jungfrun,* East Point | 61 | 10 | 17 | 20 |
| Soderhamm | 61 | 17·7 | 17 | 5 |
| Gefle | 60 | 40·3 | 17 | 9 |
| Eggrund * | 60 | 43 | 17 | 32 |
| Orskar * | 60 | 31·5 | 18 | 22 |
| Svartklubb * | 60 | 9·8 | 18 | 50 |
| Soderarm Light * | 59 | 45·2 | 19 | 28 |
| Svenska Hogarne | 59 | 27 | 19 | 31 |
| **Stockholm** Observatory | 59 | 20·6 | 18 | 3·75 |
| Korsö Light *, | 59 | 17·3 | 18 | 58 |
| Gronskar Light * | 59 | 17 | 19 | 2 |
| Landsort * | 58 | 44·5 | 17 | 52·75 |
| Westerwyk | 57 | 45·6 | 16 | 38 |
| Kalmar, Church | 56 | 39·5 | 16 | 22 |
| Gottska Sando, West Point | 58 | 24 | 19 | 11 |
| Faro Island, Holm Head * | 57 | 58 | 19 | 23 |
| Gothland, South Point, Hoborg * | 56 | 55·2 | 18 | 9 |
| Ostergarnsholm Light * | 57 | 26·5 | 18 | 59 |
| Wisby | 57 | 38·6 | 18 | 16 |
| South Carlso | 57 | 19 | 17 | 59 |
| Oland, North Head* | 57 | 22 | 17 | 6 |
| „ South Head * | 56 | 11·8 | 16 | 25 |
| Christianopol | 56 | 15·5 | 16 | 3·0 |
| Utklipporna Rocks * | 55 | 56·5 | 15 | 42 |
| Carlscrona | 56 | 9·7 | 15 | 35·5 |
| Carlshamn * | 56 | 10·3 | 14 | 52·0 |
| Hano Island | 56 | 1·0 | 14 | 51 |
| Ahus | 55 | 55·5 | 14 | 18 |
| Cimbrishamn | 55 | 33·5 | 14 | 21·25 |
| Ystad, Church | 55 | 25·8 | 13 | 49·5 |
| Earthholms, North Point * | 55 | 19 | 15 | 12 |
| Bornholm, North Point * | 55 | 17·7 | 14 | 46 |
| „ South Point | 54 | 59 | 15 | 5 |
| „ Könne * | 55 | 6 | 14 | 42 |
| Falsterbo * | 55 | 23·1 | 12 | 49·25 |

| VII. FRANCE. | Lat. N. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| Gravelines* | 51 0·3 | 2 6·5 |
| **Calais,*** Bell | 50 57·6 | 1 51·04 |
| Cape Grisnez* | 50 52·2 | 1 35·04 |
| Boulogne, Column | 50 44·5 | 1 37·04 |
| Boulogne,** Jetty | 50 43·9 | 1 35·0 |
| Port Alpreck* | 50 41·9 | 1 3·75 |
| Etaples | 50 32·9 | 1 38·5 |
| Port Lornel* | 50 33·6 | 1 34·5 |
| Port de Touquet** | 50 31·7 | 1 35·5 |
| Port de Berck* | 50 24·0 | 1 33·5 |
| Abbeville, Nôtre Dame | 50 7·1 | 1 49·75 |
| St. Valery-sur-Somme | 50 11·4 | 1 37·75 |
| Cayeux* | 50 11·7 | 1 30·75 |
| Tréport* | 50 3·9 | 1 22·0 |
| Dieppe, West Jetty* | 49 56·0 | 1 5·04 |
| Cape Ailly* | 49 55·1 | 0 57·5 |
| St. Valery-en-Caux | 49 52·4 | 0 42·5 |
| Fecamp, Mont de la Vierge | 49 46·1 | 0 22·0 |
| Cape de la Heve** | 49 30·7 | 0 4·0 |
| Havre, North Jetty,* Bell | 49 29·3 | 0 6·54 |
| Port du Hoc* | 49 28·7 | 0 11·3 |
| **Paris** Observatory | 48 50·2 | 2°20′ 9″ |
| Quillebœuf* | 49 28·4 | 0 31·5 |
| Honfleur** | 49 25·5 | 0 13·5 |
| Mouth of the Toucques** | 49 21·7 | 0 4·75 |
| | Lat. N. | Long. W. |
| Mouth of the Orne** | 49 16·6 | 0 15·5 |
| Port Corseulles* | 49 20·3 | 0 27·5 |
| Caen, Abbey | 49 11·2 | 0 21·2 |
| Port de Ver* | 49 20·5 | 0 31·2 |
| Carentan | 49 18·4 | 1 14·7 |
| St. Marcouf Island* | 49 29·9 | 1 9·0 |
| La Hougue** | 49 34·3 | 1 16·5 |
| Cape Barfleur* | 49 41·8 | 1 16·0 |
| Port Barfleur** | 49 40·1 | 1 15·7 |
| Pelee Island, Port Royal* | 49 40·3 | 1 35·0 |
| **Cherbourg,** Church | 49 38·6 | 1 37·45 |
| Cape La Hague* | 49 43·4 | 1 57·8 |
| Maitresse Isle | 48 58·3 | 2 4·0 |
| St. Germain | 49 14·2 | 1 36·0 |
| Cape Carteret* | 49 22·4 | 1 48·5 |
| Coutances Cathedral | 49 2·9 | 2 26·7 |
| Granville, Cape Lihou* | 48 50·1 | 1 37·0 |
| Mont St. Michel | 48 38·2 | 1 30·7 |
| Concale, Church | 48 40·7 | 1 51·0 |
| Herpin Rock | 48 43 | 1 50 |
| St. Malo* | 48 39·0 | 2 1·7 |
| La Conchee Rock | 48 41 | 2 3 |
| Cape Frehel* | 48 41·1 | 2 19·2 |
| Grand Lejon Rock | 48 45·0 | 2 40·0 |
| St. Brieuck, Cathedral | 48 30·9 | 2 46·0 |
| Horaine Rock, Beacon | 48 53·6 | 2 57·2 |
| Heaux de Brehat* | 48 54·5 | 3 5·2 |
| Treguier, Cathedral | 48 47·3 | 3 14·0 |
| Les Sept Isles* | 48 52·8 | 3 29·45 |
| Triagoz Shoal, West extremity | 48 53 | 3 44 |
| Morlaix** | 48 38·2 | 3 53 |
| St. Pol de Leon, Cathedral | 48 41·0 | 3 59·2 |
| Ile de Batz,* West side | 48 44·8 | 4 1·7 |
| Ile Vierge* | 48 38·4 | 4 34·2 |
| Abervrach* | 48 36·9 | 4 34·7 |
| Plougnereau* | 48 36·8 | 4 29·2 |
| Port St. Matthew | 48 19·8 | 4 46·4 |
| Ushant* | 48 28·5 | 5 3·45 |
| Kermorvan* | 48 21·7 | 4 47·45 |
| **Brest** Observatory | 48 23·6 | 4 29·45 |
| Ile de Sein* | 48 2·7 | 4 52·2 |
| Outer Rock | 48 3 | 5 15·2 |
| Bec du Raz* | 48 2·4 | 4 44·0 |
| Audierne Church | 48 1·4 | 4 32·7 |
| Penmarc'h Rocks* | 47 47·9 | 4 22·45 |
| Ile Glenan, Penfret Ile* | 47 43·3 | 3 57·2 |
| Quimper River, Benodet, Church | 47 52·6 | 4 7·0 |

| FRANCE. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| **L'Orient,** Tower | 47 44·7 | 3 21·21 |
| Port Louis, Church | 47 42·5 | 3 21·2 |
| Ile de Groix* | 47 38·9 | 3 30·7 |
| Port Haliguen,* East Jetty | 47 29·2 | 3 6·2 |
| Teignouse* | 47 27·5 | 3 2·7 |
| Port Navale* | 47 32·9 | 2 55·2 |
| Penlan Point* | 47 31·0 | 2 30·2 |
| Belle Ile* | 47 18·7 | 3 13·7 |
| ,, Port de Palais* | 47 20·9 | 3 9·2 |
| Hoedic Ile* | 47 20·5 | 2 52·2 |
| Le Four Roche* | 47 17·9 | 2 38·2 |
| Vannes St. Pierre | 47 39·5 | 2 45·4 |
| Guerande, Church | 47 19·7 | 2 25·7 |
| Croisic, Church* | 47 17·7 | 2 31·0 |
| Aiguillon, Tower | 47 14·6 | 2 16·0 |
| Port St. Nazairn, Mole* | 47 16·3 | 2 12·0 |
| Paimbœuf, Church | 47 17·3 | 2 2·2 |
| **Nantes,** Cathedral | 47 13·1 | 1 33·2 |
| Le Pilier Ile* | 47 2·6 | 2 21·7 |
| Noirmoustier, South Point | 46 53·8 | 2 9·0 |
| Ile Dieu, St. Sauveur Church | 46 42·4 | 2 20·0 |
| St. Gilles-sur-Vie Church | 46 41·7 | 1 56·2 |
| Sables d'Olonne Church | 46 29·8 | 1 47·2 |
| Le Chaume* | 46 29·7 | 1 47·7 |
| Roche Bonne, West | 46 13 | 2 29 |
| Port de Grouin de Cou* | 46 20·8 | 1 28·2 |
| Port de l'Aiguillon* | 46 16·1 | 1 12·7 |
| **Ile Re,** North Point* | 46 14·7 | 1 33·7 |
| Port St. Martin* | 46 12·4 | 1 22·0 |
| South Port de Chauveau* | 46 8·0 | 1 16·5 |
| Rochelle,** Tower | 46 9·4 | 1 9·5 |
| Oleron Ile, North Point* | 46 2·8 | 1 24·7 |
| Aix Ile* | 46 0·6 | 1 10·7 |
| Rochefort, Hôpital | 45 56·6 | 0 58·0 |
| Port de la Coubre* | 45 41·5 | 1 15·5 |
| River Gironde, Cordouan Light* | 45 35·2 | 1 10·46 |
| Terre Négre,* Tower | 45 38·8 | 1 6·46 |
| Port Royan* | 45 37·1 | 1 2·0 |
| Pointe de Grave* | 45 34·1 | 1 3·7 |
| **Bordeaux,** St. André | 44 50·3 | 1 34·7 |
| Bassin d'Arcachon, Cape Ferret* | 44 38·7 | 1 15·2 |
| Port St. Martin de Biarritz | 43 29·6 | 1 33·2 |
| Bayonne, Cathedral | 43 29·5 | 1 28·7 |
| St. Jean de Luz | 43 23·3 | 1 40·0 |
| | Lat. N. | Long. E. |
| Cape Bearn* | 42 31·0 | 3 7·25 |
| Port Vendres* | 42 31·3 | 3 6·8 |
| La Nouvelle* | 43 0·8 | 3 3·8 |
| Fort Brescou,* S.E. Bastion | 43 15·5 | 3 29·8 |
| Agde Harbour,* East Jetty | 43 16·7 | 3 26·5 |
| Cette,* Fort Louis | 43 23·8 | 3 42·0 |
| Aigues Mortes* | 43 32·0 | 4 7·8 |
| Camargue,* West Mouth of Rhone | 43 20·7 | 4 40·8 |
| Port de Bouc** | 43 23·6 | 4 59·0 |
| **Marseille,**** Fort St. Jean | 43 17·7 | 5 21·54 |
| Planier Ile* | 43 11·9 | 5 13·8 |
| Mont St. Michael, Semaph., 1341 ft. | 43 13 | 5 22 |
| Ile Riou | 43 10 | 5 23 |
| Port Cassis* | 43 12·8 | 5 31·8 |
| Cassidaigne | 43 8·7 | 5 32·8 |
| Cape Sicie, Semaphore | 43 3·2 | 5 51 |
| **Toulon,** Semaphore | 43 4·4 | 5 56·3 |
| Grand Ribeau* | 43 1 | 6 9 |
| Porquerolles Isle, South Point* | 42 59·0 | 6 12·3 |
| Titan Isle, N.E. Port* | 43 2·8 | 6 30·5 |
| Cape Camorat* | 43 12·0 | 6 40·5 |
| Frejus | 43 25 | 6 46 |
| Cape Roux | 43 28 | 6 55 |
| Cannes, South Tower | 43 32·9 | 7 0·8 |
| Cape Garoupe* | 43 33·8 | 7 8 |
| Antibes* | 43 35·1 | 7 7·5 |
| St. Laurent du Var | 43 40·7 | 7 10·8 |
| Nice, St. Francis Church | 43 42·0 | 7 16·8 |

| VIII. SPAIN. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| Fontarabia,* Church | 43 21·7 | 1 47·25 |
| Cape Figuier | 43 23·7 | 1 47·25 |
| Port Passages,* Church | 43 19·7 | 1 55·25 |
| **St. Sebastian** * | 43 19·2 | 2 0·5 |
| Cape Machichaco * | 43 23 | 2 49 |
| Cape Villano | 43 27 | 2 58 |
| Bilbao, St. Nicholas | 43 15·8 | 2 54 |
| Portugalete | 43 20·2 | 3 3 |
| Monte Serrantes | 43 21 | 3 5 |
| Santona | 43 27 | 3 27 |
| Cape Ajo | 43 31·4 | 3 36 |
| **Santander** | 43 27·9 | 3 48·75 |
| Cape Mayor * | 43 30 | 3 47 |
| Cape Hoyambre | 43 25 | 4 21 |
| Cape Prieto | 43 28 | 4 51 |
| Point del Caballo | 43 30 | 5 6 |
| Lastres | 43 33 | 5 16 |
| Cape Penas * | 43 42·0 | 5 47·75 |
| Cape Busto | 43 36 | 6 25 |
| Cape Blanco | 43 35 | 6 47 |
| Ile Pancha, West extremity | 43 34·7 | 6 59·25 |
| Rivadeo | 43 34 | 7 5 |
| Monte Mondigo | 43 32 | 7 5 |
| Point de los Caios | 43 36 | 7 13 |
| Cape Burela | 43 42 | 7 21 |
| Monte Faro | 43 44 | 7 35 |
| Port Barquero | 43 45 | 7 43 |
| Port Vivero | 43 40·5 | 7 36 |
| Cape Vares | 43 48 | 7 41 |
| Point de la Estaca * | 43 48 | 7 42 |
| Cape Ortegal, Tower | 43 45·2 | 7 56 |
| Cape Prior * | 43 34·1 | 8 19 |
| Monte Ventoso | 43 29 | 8 20 |
| Ferrol, Mole | 43 29·5 | 8 12·75 |
| **Corunna**, Castle, St. Antonio | 43 22·5 | 8 22·7 |
| Cisargas Isles | 43 21·5 | 8 50 |
| Cape Villano, North-East Point | 43 10 | 9 12 |
| Cape Torifiana | 43 2 | 9 17 |
| Cape Finisterre * | 42 53 | 9 15 |
| Monte Louro | 42 44 | 9 44 |
| Cape Corrobido* | 42 35 | 9 4 |
| Ons Isle | 42 20 | 8 55 |
| Cies Isle, South-West extremity | 42 11 | 8 53 |
| Cape Silleiro, West Point | 42 6 | 8 52 |
| **Vigo** Light * | 42 15 | 8 40 |
| Monte Nossa Senora del Alba | 42 14 | 8 45 |
| Monte Tecla, River Minho | 41 53 | 8 50 |
| Caminha | 41 52·7 | 8 45·0 |
| Vianna, Fort St. Jago * | 41 42·6 | 8 43·25 |
| Villa de Conde | 41 21·3 | 8 35·75 |
| Monte Ornellas | 40 50 | 8 21 |
| **Oporto**, Fort St. John | 41 8·8 | 8 37·25 |
| „ Light * | 41 9·1 | 8 37·5 |
| Aveiro | 40 38·4 | 8 37·7 |
| New Bar | 40 38 | 8 43 |
| Old Bar | 40 33 | 8 46 |
| Monte Caramulo | 40 32 | 8 12 |
| Coimbra University | 40 12·5 | 8 25 |
| Cape Mondago * | 40 12 | 8 54 |
| Figueira * | 40 10 | 8 51 |
| Port de Paredes | 39 54 | 8 59 |
| Farilhoens Rocks, Great Rock | 39 29·3 | 9 32·7 |
| Berlengas Isles * | 39 25 | 9 50·75 |
| Cape Carvoeira * | 39 21·8 | 9 25 |
| Monte Junto | 39 10 | 9 3 |
| Cape Roca * | 38 46 | 9 30 |
| Monte Cintra | 38 47·2 | 9 25 |
| Fort Sanxete | 38 42 | 9 29 |
| Da Guia * | 38 41·8 | 9 27·5 |
| Bugio * | 38 39·6 | 9 18·75 |
| St. Juliao,* Fort | 38 40·3 | 9 20·5 |
| **Lisbon**, Marine Observatory | 38 42·4 | 9 8·25 |
| Cape Espichel * | 38 24·9 | 9 13 |

| SPAIN. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| Fort Arrabida | 38 27·5 | 8 59 |
| Outao Light * | 38 27 | 8 56 |
| St. Ubes, or Setuval | 38 31 | 8 53 |
| Cape Sines, Fort | 37 57·5 | 8 52·5 |
| Odemira, Tower | 37 39·8 | 8 49 |
| Cape St. Vincent * | 37 2·9 | 9 0 |
| Lagos, Cathedral | 37 7·7 | 8 40·75 |
| Cape Carvoeira, Tower | 37 6·5 | 8 21 |
| Cape Sta. Maria * | 36 56 | 7 46 |
| Monte Figo | 37 10 | 7 42 |
| River Guadiano | 37 10 | 7 18 |
| San Lucar, Guadalquivir | 36 44 | 6 24 |
| Rota, Pier | 36 36·6 | 6 16·25 |
| **Cadiz** Observatory | 36 32·0 | 6 17·25 |
| St. Sebastian * | 36 31·6 | 6 18·5 |
| Cape Trafalgar | 36 10 | 6 1 |
| Tarifa | 36 0 | 5 36 |
| Algeciras | 36 8·0 | 5 26·0 |
| **Gibraltar** | 36 7·3 | 5 21·25 |
| Europa Point * | 36 6·7 | 5 22·0 |
| Cape Sardina, Tower | 36 18 | 5 14 |
| Estapona | 36 25 | 5 9 |
| Malaga, Mole * | 36 43·5 | 4 26 |
| Motril | 36 45 | 3 34 |
| Cape Sacratif | 36 41 | 3 28 |
| Almeria | 36 50 | 2 32 |
| Cape de Gata, Castle | 36 43 | 2 12 |
| Mojacar | 36 58 | 1 55 |
| Cape Tinosa | 37 31 | 1 9 |
| Cartagena, Mole * | 37 36 | 0 56 |
| Cape de Palas, Tower | 37 37·5 | 0 40 |
| Cape Servera | 38 0 | 0 38 |
| Cape Sta. Pola, South Point | 38 11 | 0 29 |
| Alicanta,* Castle | 38 20·7 | 0 26 |
| Benidorme | 38 29 | 0 6 |
| Cape Cullera, Tower | 39 12 | 0 13 |
| Valencia,* Cathedral | 39 28·7 | 0 24 |
| Cape Canet, Tower | 39 43 | 0 9 |
| | Lat. N. | Long. E. |
| Cape Oropesa, Tower | 40 5·2 | 0 10 |
| Peniscola, Tower | 40 23 | 0 25 |
| Port Alfaques, San Carlos | 40 37·7 | 0 35 |
| Ebro, North Passage | 40 43·0 | 0 54 |
| „ South Passage | 40 41 | 0 53 |
| Tortosa, Cathedral | 40 48·8 | 0 33 |
| Salau Light, Mole * | 41 4 | 1 9 |
| Tarragona * | 41 7 | 1 16 |
| **Barcelona**, Mole * | 41 22·6 | 2 11 |
| Cape St. Sebastian | 41 53 | 3 13 |
| Cape Norfeo, East Point | 42 14 | 3 17 |
| Cadaques, Church | 42 17 | 3 17 |
| Cape de Creux, Ruin | 42 19·2 | 3 20 |
| Cape Nao, East Point | 38 44 | 0 14 |
| Cape St. Antonio * | 38 48·5 | 0 10 |
| Mongo Monte | 38 48 | 0 8 |
| **Balearic Isles.** | | |
| **Iviza**, Castle | 38 54·3 | 1 29·25 |
| Port De Serra, or North Point | 39 8 | 1 34·5 |
| Port St. Antonio, Conjera Grande, North Point | 39 0·4 | 1 16·5 |
| **Formentera**, S. Pt., or Pt. Aguila | 38 38 | 1 25·5 |
| **Majorca**—Cabrera, South Point | 39 5 | 2 55·5 |
| Cape Salinas | 39 14 | 3 6·5 |
| Palma, Mole | 39 34·1 | 2 41 |
| Dragonera Isle * | 39 36 | 2 20·5 |
| North Point, or Cape Formenton | 39 57 | 3 17·5 |
| East Point, or Cape Pera | 39 42 | 3 29·5 |
| **Minorca**—Mahon, Mole * | 39 52·5 | 4 23·5 |
| Cape Mola, or East Point | 39 52·7 | 4 27·0 |
| Port Fornelles | 40 3·5 | 4 11·2 |
| Cape Bajoli, or West Point | 40 1 | 3 50 |
| Cape Dortuch | 39 55 | 3 53·5 |

| IX. ITALY. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Port Maurizio, Mole Head | 43 | 53·2 | 7 | 59·0 |
| Cape della Mele | 43 | 58 | 8 | 11 |
| Finale, Church | 44 | 9·9 | 8 | 19·0 |
| Noli, Convent St. Francisco | 44 | 11·9 | 8 | 22·75 |
| Vado, Fort St. Lorenzo | 44 | 15·5 | 8 | 24·5 |
| Savona, Citadel | 44 | 18·4 | 8 | 27·75 |
| Polla Rock | 44 | 25·0 | 8 | 46·0 |
| **Genoa** * * * | 44 | 24·9 | 8 | 53·0 |
| Point Chiapa | 44 | 20·0 | 9 | 10·5 |
| Cape Porto Fino, Fort | 44 | 18·2 | 9 | 14·25 |
| Sestri di Levante, Fort | 44 | 16·4 | 9 | 25·5 |
| Port Venere, North Entrance | 44 | 3·2 | 9 | 52·75 |
| Tino Isle * | 44 | 2·4 | 9 | 52·0 |
| Spezzia, Castle | 44 | 6·3 | 9 | 52·25 |
| Pisa, Leaning Tower | 43 | 43·5 | 10 | 24·0 |
| **Florence** Cathedral | 43 | 46·6 | 11 | 15·5 |
| Leghorn * | 43 | 32·7 | 10 | 17·75 |
| Gorgona Isle | 43 | 25·8 | 9 | 53·5 |
| Capraia Isle, Castle, East side | 43 | 2·6 | 9 | 50·75 |
| Piombino, Palace | 42 | 55·7 | 10 | 31·75 |
| **Elba**, North extremity | 42 | 52·5 | 10 | 25 |
| „ West extremity | 42 | 46·2 | 10 | 6·5 |
| „ Porto Ferrajo * | 42 | 49·1 | 10 | 20·5 |
| Palmajola Isle * | 42 | 52·0 | 10 | 28·5 |
| Pianosa Isle, West Point | 42 | 32·7 | 10 | 5·25 |
| Giglio Isle, South Point | 42 | 19·2 | 10 | 56·0 |
| Civita Vecchia * | 42 | 5·7 | 11 | 44·0 |
| Cape Linaro, Reef | 42 | 2 | 11 | 49 |
| Tiber, Fiumicino * | 41 | 45·8 | 12 | 11·75 |
| **Rome**, St. Peter's, Dome | 41 | 54·1 | 12 | 27·25 |
| Port Anzo * | 41 | 26·9 | 12 | 42·25 |
| Monte Circello, Church | 41 | 12·7 | 13 | 5·25 |
| Terracina, Palace | 41 | 17·1 | 13 | 15·5 |
| Gaeta,* Orlando Tower | 41 | 12·4 | 13 | 34·75 |
| Ponza Isle * | 40 | 53·0 | 12 | 57·5 |
| Ischia Isle, Castle, East Point | 40 | 43·9 | 13 | 57·7 |
| Cape Miseno * | 40 | 46·5 | 14 | 5·25 |
| Pozzuoli, Church | 40 | 49·2 | 14 | 7·25 |
| **Naples** Observ., Capo di Monte | 40 | 51·8 | 14 | 15·5 |
| „ Mole Light* | 40 | 59·3 | 14 | 15·75 |
| Mount Vesuvius, 3,900 feet | 40 | 49 | 14 | 26 |
| Castellamare * | 40 | 41·5 | 14 | 28·25 |
| Point Campanella * | 40 | 33·0 | 14 | 19·5 |
| Capri Isle, South Point * | 40 | 32·0 | 14 | 11·75 |
| Salerno | 40 | 40 | 14 | 45 |
| Cape Licosa | 40 | 14 | 14 | 53 |
| Point Spartimento | 39 | 59 | 15 | 15 |
| Policastro | 40 | 1 | 15 | 33 |
| St. Eufemia | 39 | 8 | 16 | 15 |
| Cape Vaticano, Tower | 38 | 27·2 | 15 | 52 |
| Gioja | 38 | 24 | 15 | 56 |
| Scylla | 38 | 14·5 | 15 | 45·0 |
| **Lipari Isles**, Stromboli | 38 | 46·7 | 15 | 13·75 |
| Lipari Isle, Church | 38 | 29·3 | 14 | 56·25 |
| Vulcano Isle, Sulphur Works | 38 | 23·3 | 14 | 56·0 |
| Alicudi Isle, Church | 38 | 32·7 | 14 | 16·5 |
| Ustica Isle, N.E. Point, Fort | 38 | 43·3 | 13 | 11·25 |
| Faro Isle, East extremity * | 38 | 15·8 | 15 | 41·25 |
| **Messina** * | 38 | 11·0 | 15 | 34·75 |
| Milazzo * | 38 | 16·1 | 15 | 14·0 |
| Cefalu, Signal Station | 38 | 2·2 | 14 | 1·75 |
| Termini, Fort | 37 | 57·5 | 13 | 41·0 |
| **Palermo** Observatory, S.M. | 38 | 6·6 | 13° | 21′ 20″ |
| Palermo * | 38 | 8·2 | 13 | 22·25 |
| Maritimo Isle, North Point, Castle | 37 | 59·5 | 12 | 4·0 |
| Trapani, Columbara * | 38 | 1·8 | 12 | 31·25 |
| Marsala, Cathedral * | 37 | 47·8 | 12 | 26·25 |
| Mazzara, Cathedral | 37 | 38·7 | 12 | 35·5 |
| Cape Sorello, or Granitola * | 37 | 33·9 | 12 | 38·0 |
| Cape San Marco, Fort, Tower | 37 | 29·3 | 13 | 0·5 |
| Cape Bianco, Tower | 37 | 22·4 | 13 | 16·5 |
| Girgenti, Mole * * | 37 | 15·6 | 13 | 31·75 |
| Palma, Marina | 37 | 8·8 | 13 | 43·25 |
| Alicata, Castle * | 37 | 4·0 | 13 | 56·0 |

| ITALY. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Cape Scalambra, Tower | 36 | 46·2 | 14 | 30·5 |
| **Passaro** Isle,* Cape Passaro | 36 | 41·5 | 15 | 9·0 |
| Cape Murro di Porco, Point | 37 | 0·0 | 15 | 19·0 |
| Syracuse * | 37 | 3·0 | 15 | 16·5 |
| Cape Panagia, Point | 37 | 6·5 | 15 | 17·0 |
| Egosta * | 37 | 12·8 | 15 | 13·25 |
| Catania, Mole * | 37 | 28·3 | 15 | 5·2 |
| Mount Ætna, 10,874 feet | 37 | 43·5 | 15 | 0·0 |
| Taormina, Telegraph | 37 | 48·2 | 15 | 17·75 |
| Scaletta, Fort | 38 | 1·7 | 15 | 27·75 |
| **Malta**, Valetta, Palace | 35 | 53·8 | 14 | 31·25 |
| St. Elmo,* | 35 | 54·1 | 14 | 31·5 |
| Spencer's Monument | 35 | 53·0 | 14 | 30·75 |
| S.E. extremity, Point della Mare. | 35 | 49·7 | 14 | 34·75 |
| Cape Demitri | 36 | 4 | 14 | 8 |
| **Sardinia**, Cagliari, St. Pancras | 39 | 13·2 | 9 | 7·75 |
| Cape Spartivento, South Point | 38 | 52·5 | 8 | 52·5 |
| Cavoli Isle, Cape Carbonara | 39 | 6·1 | 9 | 31·5 |
| Cape Teulada | 38 | 51·9 | 8 | 39·25 |
| St. Pietro Isle | 39 | 9·7 | 8 | 17·75 |
| Asinara Isle | 41 | 5·8 | 8 | 18·25 |
| Port Torres * | 40 | 50·2 | 8 | 24·75 |
| Cape della Testa * | 41 | 14·2 | 9 | 9·25 |
| Razzoli Isle * | 41 | 18·3 | 9 | 20·75 |
| Caprera Isle | 41 | 12·9 | 9 | 29·0 |
| Cape Comino | 40 | 31·4 | 9 | 50·5 |
| Calvi, Point Rivellata * | 42 | 35·2 | 8 | 43·5 |
| Giraglia Isle * | 43 | 1·8 | 9 | 24·25 |
| **Corsica**, Sanguinares * Isles | 41 | 52·8 | 8 | 35·75 |
| Ajaccio, Cathedral | 41 | 55·0 | 8 | 44·75 |
| Cape Muro, S.W. Point | 41 | 44·5 | 8 | 39·5 |
| Bonifacio | 41 | 23·8 | 9 | 9·25 |
| S. extremity, Mount Pertusato * | 41 | 22·2 | 9 | 11·25 |
| Porto Vecchio * | 41 | 35·2 | 9 | 20·75 |
| East extremity, Fiorentino Tower | 42 | 17·0 | 9 | 33·75 |
| Bastia, Mole * | 42 | 41·8 | 9 | 27·0 |
| Finocchiarola Tower | 42 | 59·3 | 9 | 28·0 |
| **Reggio** | 38 | 5·9 | 15 | 40·0 |
| Cape Spartivento | 37 | 56 | 16 | 4 |
| Cape Stilo | 38 | 29·3 | 16 | 37 |
| Cape Rizzuto * | 38 | 57 | 17 | 1 |
| Cape Nau or Colonna | 39 | 6 | 17 | 14 |
| Point de Tronta, Tower | 39 | 35 | 16 | 47 |
| Roseto | 39 | 59 | 16 | 34 |
| Tarento Citadel | 40 | 27 | 17 | 14 |
| Cape St. Vito * | 40 | 24 | 17 | 13 |
| Gallipoli, St. Andrea Isle, N. Pt.* | 40 | 3 | 17 | 56 |
| Cape Leuca, Church | 39 | 47·9 | 18 | 22·65 |
| Cape Otranto, Telegraph | 40 | 8·7 | 18 | 30·0 |
| Brindisi,* Castello di Mare | 40 | 39·4 | 17 | 58·6 |
| Monopoli * Telegraph | 40 | 57·3 | 17 | 18·55 |
| Mola, Telegraph | 41 | 3·9 | 17 | 6·0 |
| Bari,* Belfry | 41 | 7·9 | 16 | 52·6 |
| Barletta,* Telegraph | 41 | 19·4 | 16 | 17·75 |
| Manfredonia, Telegraph | 41 | 37·9 | 15 | 55·25 |
| Varano, Tower | 41 | 55·0 | 15 | 48·25 |
| Termoli, Telegraph | 42 | 0·4 | 15 | 0·25 |
| Vasto Ammone, Belfry | 42 | 6·8 | 14 | 42·9 |
| Ortona, Belfry | 42 | 21·5 | 14 | 24·4 |
| Pescaro, Tower | 42 | 27·0 | 14 | 13·8 |
| Tronto River, Torre Nuova | 42 | 54·4 | 13 | 54·8 |
| Fermo, Cathedral | 43 | 9·9 | 13 | 43·6 |
| Pianosa Isle, Signal, East end | 42 | 13·7 | 15 | 45·1 |
| Pelagosa Isle, Signal, West Point. | 42 | 23·7 | 16 | 15·8 |
| Conero Mount, Telegraph | 43 | 33·3 | 13 | 36·5 |
| **Ancona**, Mole Head * | 43 | 37·7 | 13 | 30·2 |
| Sinigaglia,* Cathedral | 43 | 43·0 | 13 | 12·9 |
| Fano * | 43 | 51·3 | 13 | 0·9 |
| Pesaro * | 43 | 55·7 | 12 | 54·4 |
| Rimino,* Casa Garimpi | 44 | 3·8 | 12 | 33·8 |
| Cesenatico * * | 44 | 13 | 12 | 24 |
| Cervia,* Città Tower | 44 | 15·8 | 12 | 20·9 |
| **Ravenna**,* Città Tower | 44 | 25·3 | 12 | 11·9 |
| Po di Maestra, Battery | 44 | 59·5 | 12 | 26·0 |

| X. AUSTRIA, GREECE. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Venice**, San Marco | 45 | 25·9 | 12 | 20·15 |
| Grado,* Church | 45 | 40·3 | 13 | 22·9 |
| **Trieste**, Castle Clock | 45 | 38·6 | 13 | 46·2 |
| Cape d'Istria, San Lazzaro Belfry. | 45 | 32·7 | 13 | 43·6 |
| Point Bassania * | 45 | 27·3 | 13 | 28·9 |
| Port Pirano, San George's Belfry. | 45 | 31·6 | 13 | 33·9 |
| Rovigno,* Steeple | 45 | 4·9 | 13 | 37·7 |
| Pola, San Francesco Belfry | 44 | 52·3 | 13 | 50·4 |
| Cape Promontore,* Mt. Gradina . | 44 | 48·8 | 13 | 54·3 |
| Mount Maggiore, Signal | 45 | 17·2 | 14 | 11·9 |
| Fiume, Clock Tower | 45 | 19·6 | 14 | 26·33 |
| Porto Re, Castel Nuovo | 45 | 16·7 | 14 | 33·8 |
| Cherso, Cathedral | 44 | 57·7 | 14 | 23·8 |
| Unie Island, Church | 44 | 38·3 | 14 | 14·1 |
| Lossini Isle, Mount d'Osero | 44 | 40·5 | 14 | 21·5 |
| Sansego Isle, Mount Garbe | 44 | 30·9 | 14 | 7·9 |
| Premuda Isle, Summit Signal | 44 | 20·2 | 14 | 36·5 |
| Nona, Cathedral | 44 | 14·6 | 15 | 10·8 |
| Lunga Isle, Port Tajer, Tajer Rock | 43 | 51·9 | 15 | 11·3 |
| **Zara**, San Simone Steeple | 44 | 6·8 | 15 | 13·5 |
| Spalatro, Cathedral | 43 | 30·4 | 16 | 26·3 |
| St. Andrea Isle, Summit | 43 | 1·6 | 15 | 45·23 |
| Pomo Islet, Summit | 43 | 5·4 | 15 | 27·4 |
| Lissa, Mount Hum, Signal | 43 | 1·7 | 16 | 6·63 |
| Lagosta I.,* Mt. San Giorgio, Chap. | 42 | 45·0 | 16 | 51·5 |
| Cazza Isle, Summit, Signal | 42 | 46·0 | 16 | 30·63 |
| Meleda Isle, Port Palazza, Palace. | 42 | 47·0 | 17 | 22·6 |
| Ragusa, Fort on Mole | 42 | 38·3 | 18 | 6·63 |
| Port Ostro * | 42 | 22·8 | 18 | 30·6 |
| **Cattaro**, Sanità | 42 | 25·4 | 18 | 46·0 |
| Antivari, South Point | 42 | 2·3 | 19 | 6·15 |
| Dulcigno, Mole | 41 | 53·8 | 19 | 10·4 |
| Durazzo, Mole | 41 | 17·5 | 19 | 26·3 |
| Aulona, Dogana | 40 | 27·2 | 19 | 26·06 |
| Cape Linguetta, 2,290 feet | 40 | 26·7 | 19 | 17·0 |
| Palermo, Fort | 40 | 2·9 | 19 | 47·9 |
| Fano Isle, S.W. Summit | 39 | 50·2 | 19 | 19·5 |
| **Corfu**,* Lighthouse | 39 | 37·6 | 19 | 56·2 |
| „ Vido, Landing Cove | 39 | 38·7 | 19 | 56·2 |
| „ Lefchimo Point * | 39 | 28·1 | 20 | 4·0 |
| Parga, Citadel | 39 | 16·4 | 20 | 23·0 |
| Prevesa, Fort Giorgio | 38 | 56·2 | 20 | 44·2 |
| Paxo Isle, Laka * | 39 | 13·2 | 20 | 9·0 |
| „ Port Gajo * | 39 | 11·5 | 20 | 12·5 |
| Antipaxo Isle, East Point | 39 | 8·7 | 20 | 5·75 |
| Santa Maura * | 38 | 50·5 | 20 | 42·75 |
| „ S. extr. Cape Ducato | 38 | 33·5 | 20 | 32·75 |
| **Cephalonia**, North extremity | 38 | 28·5 | 20 | 33·0 |
| „ Port Argostoli, Hook Point | 38 | 11·2 | 20 | 28·5 |
| „ South Point, Cape Skala | 38 | 3·0 | 20 | 46·5 |
| Zante, North Point, Cape Skinari. | 37 | 56·5 | 20 | 41·5 |
| „ South Point, Cape Kieri | 37 | 38·5 | 20 | 49·5 |
| „ Port * | 37 | 47·5 | 20 | 55·0 |
| Krio Nero * | 37 | 48·7 | 20 | 54·5 |
| Oxia Isle, Peak, 1,247 feet | 38 | 18·7 | 21 | 7 |
| Messalonghi | 38 | 21·9 | 21 | 25·75 |
| Roumelia, Castle | 38 | 19·5 | 21 | 46·25 |
| Lepanto, Centre, Minaret | 38 | 23·4 | 21 | 50·0 |
| **Corinth**, Acropolis | 37 | 53·4 | 22 | 52·75 |
| Morea Castle, Centre | 38 | 18·5 | 21 | 47·0 |
| Patras | 38 | 14·5 | 21 | 44·75 |
| Cape Papas, Ruined Fort | 38 | 12·7 | 21 | 23·5 |
| Cape Charenza, Ruin | 37 | 56·5 | 21 | 9·5 |
| Cape Katakolo | 37 | 37·7 | 21 | 19·0 |
| Stamfanes Isle * | 37 | 15·3 | 21 | 1·5 |
| Cape Koanelo | 37 | 10·4 | 21 | 35·5 |
| **Navarino**, Mosque | 36 | 54·6 | 21 | 41·75 |
| Modon * | 36 | 48·4 | 21 | 41·5 |
| Cape Gallo | 36 | 42·9 | 21 | 52·75 |
| Cape Kephali | 36 | 53·5 | 22 | 8·0 |
| Cape Grosso, Summit | 36 | 29·1 | 22 | 22·25 |
| Cape Matapan | 36 | 23·0 | 22 | 29·2 |
| Eurotas River, Mouth | 36 | 48·2 | 22 | 41 |
| Cerigo Isle, South extremity | 36 | 7·7 | 22 | 59·75 |

| TURKEY, S. RUSSIA. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Cerigotto Isle, Summit | 35 | 50·1 | 23 | 18·0 |
| Spezzia Isle, 812 feet | 37 | 15·3 | 23 | 8·75 |
| **Napoli di Romania** | 37 | 33·6 | 22 | 48·0 |
| Hydra, Summit, 1,939 feet | 37 | 19·5 | 23 | 28·0 |
| Poros Isle, St. Nicolaus | 37 | 30·9 | 23 | 28·25 |
| Egina Isle, Mount St. Elias | 37 | 41·9 | 23 | 30·0 |
| Megara, Tower | 37 | 59·8 | 23 | 20·5 |
| Piræus * * | 37 | 56·2 | 23 | 38·0 |
| **Athens**, Parthenon | 37 | 58·1 | 23 | 43·75 |
| Cape Colonna, Temple | 37 | 38·8 | 24 | 1·75 |
| Macronisi Isle, South Point | 37 | 38·5 | 24 | 6·75 |
| Cape Marathon | 38 | 7·1 | 24 | 3·75 |
| Zea Isle, Mount St. Elias | 37 | 37·3 | 24 | 21·75 |
| „ Port St. Nicolao * | 37 | 39·4 | 24 | 20·0 |
| Thermia Isle, Summit | 37 | 26·2 | 24 | 23·75 |
| Piperi Isle, Summit | 37 | 18·2 | 24 | 32·0 |
| Siphanto Isle, North Point | 37 | 2·7 | 24 | 38·5 |
| **Milo**, Mount St. Elias | 36 | 40·5 | 24 | 23·5 |
| Policandro Isle, Summit | 36 | 37·1 | 24 | 55·25 |
| Nio Isle, Summit | 36 | 42·7 | 25 | 21·0 |
| Santorin Isle, Mount St. Elias | 36 | 22·0 | 25 | 28·75 |
| Amorgo Isle, Summit near middle | 36 | 50·7 | 25 | 55·75 |
| Stampalia, S.W. Summit | 36 | 32·2 | 26 | 19·75 |
| Naxos Isle, Mount Zia, 3,290 feet | 37 | 1·8 | 25 | 31·25 |
| Paros Isle, Mount St. Elias | 37 | 2·7 | 25 | 11·5 |
| Syra Isle, Gaidaro * | 37 | 25·5 | 24 | 39·0 |
| Tinos Isle, Summit, East part | 37 | 35·0 | 25 | 14·5 |
| Andros Isle, Mt. Kovari, 3,900 ft. | 37 | 50·1 | 24 | 50·5 |
| **Negropont**, Fort Karababa | 38 | 27·7 | 25 | 35·25 |
| „ Cape Doro, Islet off | 38 | 9·4 | 24 | 36·3 |
| „ Cape Koumi | 38 | 38·7 | 24 | 9·7 |
| Volo, Fort | 39 | 24·0 | 22 | 56·5 |
| Skyros Isle, Summit | 38 | 49·7 | 24 | 37·25 |
| Skopelos Isle, Summit | 39 | 8·2 | 23 | 42·0 |
| Skiathos, Summit | 39 | 10·4 | 23 | 29 |
| Mount Pelion (Patras), 5,310 feet | 39 | 26·5 | 23 | 3 |
| Mount Ossa (Kissova), 6,407 feet | 39 | 48·0 | 22 | 42·0 |
| **Salonika** | 40 | 38·8 | 22 | 57·25 |
| Cape Cassandra | 39 | 56·7 | 23 | 22·0 |
| Cape Paillari | 39 | 55·2 | 23 | 45·25 |
| Cape Drapano, 880 feet | 39 | 56·5 | 23 | 57·25 |
| Mount Athos, Summit, 6,349 feet | 40 | 9·5 | 24 | 20·0 |
| Thaso Isle, Summit | 40 | 41·7 | 24 | 42·75 |
| Enos | 40 | 42·0 | 26 | 5·0 |
| Xeros Isle | 40 | 36·5 | 26 | 44·0 |
| Samothraki, West Point | 40 | 28·2 | 25 | 27·0 |
| Lemnos, West Point | 39 | 58·7 | 25 | 2·0 |
| Imbros, West Point | 40 | 7·2 | 25 | 40·0 |
| Dardanelles, Asia Castle | 40 | 9·0 | 26 | 24·5 |
| Gallipoli * | 40 | 24·0 | 26 | 39·75 |
| **Constantinople**, St. Sophia | 41 | 0·3 | 28 | 59·25 |
| Bosphorus, Europe * | 41 | 14 | 29 | 7·25 |
| Varna, Mosque | 43 | 12·0 | 27 | 56·5 |
| Cape Shabler * | 43 | 32·7 | 28 | 37·7 |
| Danube River, Soulineh Mouth * | 45 | 9·3 | 29 | 40·5 |
| Serpents' Isle * | 45 | 15·5 | 30 | 14·2 |
| Tsaregradskoe Mouth * * | 46 | 4·8 | 30 | 29·75 |
| Cape Fontane * | 46 | 22·8 | 30 | 44·5 |
| **Odessa**, Cathedral | 46 | 28·9 | 30 | 45·5 |
| Kinbourn * | 46 | 35·4 | 31 | 29·25 |
| Nicolaeff, Observatory | 46 | 58·2 | 31 | 58·0 |
| Kherson, Cathedral | 46 | 37·7 | 32 | 38·0 |
| Cape Eskiforos * | 45 | 20·7 | 32 | 29·7 |
| Eupatoria | 45 | 11·7 | 33 | 21·75 |
| Cape Khersones * | 44 | 35 | 33 | 22·25 |
| **Sebastopol**, Church | 44 | 37·9 | 33 | 29·5 |
| Cape Aitodor * | 44 | 25·3 | 34 | 7·7 |
| Kaffa, or Theodosia | 45 | 1·6 | 35 | 24·0 |
| Cape Takli * | 45 | 5·9 | 36 | 27 |
| Yenikaleh * | 45 | 23·1 | 36 | 39·25 |
| Cape Berdianski * | 46 | 38·2 | 36 | 48·25 |
| Taganrog, St. Michael Church | 47 | 12·2 | 38 | 57 |
| Anapa, Church | 44 | 54·1 | 37 | 18·5 |
| Soukoun Kaleh, Fort | 42 | 59·3 | 40 | 59·75 |

| XI. AFRICA. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Nile, West or Old Boghaz Mouth | 31 | 30·5 | 30 | 25·75 |
| Rosetta, Enghsh Consulate | 31 | 24·3 | 30 | 28·0 |
| Damietta | 31 | 25 | 31 | 47 |
| Cairo, Tower of Janissaries | 30 | 2·1 | 31 | 15·5 |
| Aboukir Castle | 31 | 20·5 | 30 | 5·75 |
| **Alexandria**, Point Eunostos * | 31 | 11·5 | 29 | 51·5 |
| Ras el Kanais | 31 | 17 | 27 | 53 |
| Dernah Marabout | 32 | 46·0 | 22 | 40·75 |
| Marsa Sousa, Arsenal | 32 | 54·9 | 21 | 56·5 |
| Benghazi, Castle | 32 | 6·8 | 20 | 2·75 |
| Tripoli, Pasha's Castle | 32 | 53·9 | 13 | 11·0 |
| Monastir, Fort Ghadir | 35 | 45·4 | 10 | 49 |
| Cape Bon | 37 | 4·8 | 11 | 3·5 |
| Pantellaria Isle | 36 | 51·2 | 11 | 54·75 |
| **Tunis**, Fondouc | 36 | 48·0 | 10 | 24·25 |
| Cape Carthage * | 36 | 52·4 | 10 | 20·25 |
| Bona, Lion Point * | 36 | 54·5 | 7 | 46·3 |
| Ras el Hamrah * | 36 | 58·0 | 7 | 47·3 |
| Philippeville * | 36 | 52·8 | 6 | 52·8 |
| Zrigina Isle * | 36 | 56 | 6 | 52 |
| Cape Boujaroun, North Point | 37 | 6·3 | 6 | 25·8 |
| Djidjeli * | 36 | 50·0 | 5 | 43·8 |
| Bougie * | 36 | 45·5 | 5 | 4·3 |
| Cape Carbon (provisionally) * | 36 | 47 | 5 | 5 |
| Dellys, N.W. part of City * | 36 | 55·5 | 3 | 55·0 |
| **Algiers**, Mole * | 36 | 47·3 | 3 | 4·3 |
| Cherchel, Fort * | 36 | 36·8 | 2 | 11·8 |
| Cape Tennez * | 36 | 32·0 | 1 | 20 |
| Mostagenem * | 35 | 56·0 | 0 | 5·3 |
| | Lat. N. | | Long. W. | |
| Arzeu Fort * | 35 | 51·7 | 0 | 17·2 |
| Cape Ferrat | 35 | 54·3 | 0 | 22·7 |
| Oran * | 35 | 44·3 | 0 | 41·2 |
| Cape Tres Forcas | 35 | 28 | 3 | 0 |
| Ceuta * | 35 | 54 | 5 | 18 |
| Tangier, Consul's House * ? | 35 | 47·2 | 5 | 48·5 |
| **Madeira**, East Point | 32 | 43·4 | 16 | 39·5 |
| **Funchal**, British Consulate S.M. | 32 | 37·7 | 16° | 54′ 45″ |
| Teneriffe, Santa Cruz, Brit. Cons. | 28 | 28·2 | 16 | 14·75 |
| Ferro, West extremity of Canaries | 27 | 42·5 | 18 | 9·7 |
| **Azores**, St. Michael, Delgada * | 37 | 44·2 | 25 | 40·7 |
| Pt. Ferraria, * W. Pt. St. Michael | 37 | 51·7 | 25 | 52·2 |
| Terceira Angra, Custom House | 38 | 38·9 | 27 | 13·75 |
| **Cape Verds**, St. Antonio, N. Point | 17 | 12·0 | 25 | 5·75 |
| St. Vincent, Porto Grande, Bird Isle | 16 | 54·7 | 25 | 1·25 |
| Mogador, West Coast of Africa | 31 | 30·5 | 9 | 46·25 |
| Cape Blanco | 20 | 46·5 | 17 | 4 |
| Senegal, St. Louis * | 16 | 0·8 | 16 | 33·0 |
| Cape Verd, extremity | 14 | 43·1 | 17 | 34 |
| Goree Isle * | 14 | 39·9 | 17 | 24·5 |
| River Gambia, Bathurst, Flag-st. | 13 | 28·0 | 16 | 35·0 |
| De Los Isles, Crawford, Eng. Estab. | 9 | 27·4 | 13 | 48·0 |
| **Cape Sierra Leone** * | 8 | 30·0 | 13 | 18 |
| Freetown, North Battery | 8 | 29·2 | 13 | 14·5 |
| River Gallinas, Kamasoun Isle, West Elbow | 7 | 0·1 | 11 | 38·75 |
| Monrovia, Government House | 6 | 19·1 | 10 | 49·0 |
| Bassa, American Agent's House | 5 | 54·1 | 10 | 4·0 |
| River Sanguin, Point Sanguin | 5 | 12·7 | 9 | 20·2 |
| Cape Palmas * | 4 | 22·1 | 7 | 44·25 |
| Cape Coast Castle * | 5 | 5·4 | 1 | 13·75 |
| Accra, Fort James | 5 | 31·8 | 0 | 11·5 |
| Lagos, East Point | 6 | 26 | 3 | 26·25 E |
| River Benin, N.W. Point | 5 | 46·0 | 5 | 4 E |
| River Forcados, Entrance, S. Pt. | 5 | 22·0 | 5 | 19·25 E |
| River Quorra or Niger, E. Point | 4 | 17 | 6 | 4 E |
| River Bonny, East Point | 4 | 28 | 7 | 8 E |
| Old Calebar, Tom Shot's Point | 4 | 36 | 8 | 19 E |
| Cape Cameroons | 3 | 55 | 9 | 30 E |
| Fernando Po, Clarence Cove, Adelaide Isle | 3 | 46·0 | 8 | 47·5 E |
| **Ascension**, Barrack Square | 7 | 55·5s | 14 | 25·5 |
| St. Helena, Observatory | 15 | 55·0s | 5 | 44·0 |
| Tristan d'Acunha, Waterfall N. s. | 37 | 1·9s | 12 | 17 |

| AFRICA. | Lat. S. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Cape Lopez | 0 | 36·0 | 8 | 43 |
| River Loango, Entrance | 4 | 39·5 | 11 | 45 |
| Congo or Zaire River, S. Entrance | 6 | 4·6 | 12 | 15 |
| San Paolo de Loando | 8 | 48·1 | 13 | 13·5 |
| San Filippo de Benguela | 12 | 33·9 | 13 | 24 |
| Cape Negro, Diaz's Pillar | 15 | 40·7 | 11 | 58 |
| St. Helena Bay, West Point | 32 | 42·2 | 17 | 54·25 |
| Saldanha Bay, Schapen Isle, W. Pt. | 33 | 4·2 | 18 | 1·0 |
| Table Bay, Green Point * * | 33 | 54·2 | 18 | 24·5 |
| Devil's Peak, 3,315 feet | 33 | 57·2 | 18 | 31·75 |
| **Cape Observatory**, S.M. | 33 | 56·0 | 18° | 28′ 45″ |
| Simon's Bay, Dockyard | 34 | 11·3 | 18 | 26·0 |
| Cape Agulhas * | 34 | 49·7 | 20 | 0·75 |
| Cape Recif * | 34 | 1·0 | 25 | 41·75 |
| Algoa Bay, Commandant's House | 33 | 57·5 | 25 | 39·5 |
| ,, St. Croix Isle, Peak | 33 | 47·6 | 25 | 46·5 |
| Bird Isle, East Point * * | 33 | 52 | 26 | 14 |
| Cape Natal | 29 | 53·0 | 31 | 2·25 |
| Delagoa Bay, Cape Collato | 26 | 4·0 | 33 | 1·0 |
| Cape Corrientes | 24 | 7·5 | 35 | 30·5 |
| Sofala River, Fort | 20 | 10·7 | 34 | 46·0 |
| Quillimane or Zambesi R., N. Point | 18 | 1·4 | 37 | 1·5 |
| **Mozambique**, St. George's Isle | 15 | 2·2 | 40 | 48·5 |
| Cape Delgado | 10 | 41·2 | 40 | 39·75 |
| Zanzibar, South Point | 6 | 27·7 | 39 | 33·0 |
| **Madagascar**, S. extr. C. St. Mary | 25 | 38·9 | 45 | 7·0 |
| Cape St. Vincent | 21 | 54·4 | 43 | 20·5 |
| N.W. extremity, Cape St. Andrew | 16 | 11·4 | 44 | 31·0 |
| Noss Beh, North Point | 13 | 12·2 | 48 | 18·75 |
| North extremity, Cape Amber | 11 | 57·5 | 49 | 19·0 |
| East Cape, outer Island | 15 | 15·8 | 50 | 31·5 |
| St. Marie Isle, Quail Isle, Estabmt. | 17 | 0·0 | 49 | 54·0 |
| Europa Isle, Bassas da India | 22 | 22·5 | 40 | 24·25 |
| San Juan da Nova | 17 | 3·5 | 42 | 50 |
| Johanna, Town | 12 | 11·0 | 44 | 25·1 |
| ,, Peak, East Part | 12 | 15 | 44 | 27·1 |
| Comoro, S.E. Point | 11 | 54 | 43 | 33 |
| Glorioso Isles, West one | 11 | 34·8 | 47 | 24 |
| Assumption Isle, Hummock, S.E. Pt. | 9 | 46 | 46 | 34 |
| Aldabra Isles, N.W. Point | 9 | 23 | 46 | 12 |
| **Mauritius**, Pt. Louis, Cooper's I. SM | 20 | 9·7 | 57° | 31′ 45″ |
| ,, Grand Port, Queen's Batt. | 20 | 22·6 | 57 | 45·75 |
| ,, Peter Botte, 2,600 feet | 20 | 11·7 | 57 | 36·75 |
| Bourbon, St. Denis * * | 20 | 51·5 | 55 | 29·75 |
| ,, Point of Bel Air * | 20 | 53·2 | 55 | 38·75 |
| Rodriguez Isle | 19 | 41 | 63 | 25 |
| Bank of Nazareth, Cocoa Isle | 16 | 48·9 | 59 | 32·75 |
| Tromelin Isle | 15 | 52 | 54 | 37 |
| Saya da Malha Bank | 8 | 35 | 59 | 58 |
| Agalegas Isles and Reefs | 10 | 21·5 | 56 | 38 |
| Farquhar Isles, North Point | 10 | 7 | 51 | 8 |
| S ychelles, N. extremity, Bird Isle | 3 | 42·7 | 55 | 15·75 |
| ,, E. extremity, Frigate Isle | 4 | 35·2 | 56 | 1·25 |
| ,, **Mahè Isle**, Victoria | 4 | 37·5 | 55 | 30·25 |
| Almirante Isles, West extremity | 6 | 6 | 52 | 58 |
| ,, S. extremity, Isle de Neuf | 6 | 13 | 53 | 13 |
| Isle Platte | 5 | 49 | 55 | 28 |
| Chagos, Salomon Isles, I. de Passe | 5 | 18 | 72 | 12·75 |
| Di go Garcia, East Entrance | 7 | 13·5 | 72 | 23·0 |
| | Lat. N. | | Long. E. | |
| Megadoxo, East Coast of Africa | 2 | 1·8 | 45 | 24·7 |
| Rás al Khyl | 7 | 43·7 | 49 | 46·0 |
| Rás Haftin, East Point | 10 | 27·0 | 51 | 22·3 |
| Rás 'Asir, East Point | 11 | 50·5 | 51 | 16·1 |
| **Socotra**, Gollonsir, Mosque | 12 | 41·3 | 53 | 29·4 |
| ,, E. extremity, Rás R'dresseh | 12 | 24·3 | 54 | 30·75 |
| ,, Tamarida, Mosque | 12 | 39·0 | 53 | 59·25 |
| Meyet, or Burnt Isle, Centre | 11 | 13·0 | 47 | 13·9 |
| Berbereh, extr. of Sandy Point | 10 | 26·3 | 44 | 57·6 |
| Ghubbet Kharab, Entrance Islet | 11 | 33·0 | 42 | 39·7 |
| **Perim** Isle, Lighthouse * | 12 | 39·0 | 43 | 20·1 |
| Suakim | 19 | 7 | 37 | 20 |
| Jubal Isle, East Summit | 27 | 37·7 | 33 | 48·0 |
| **Suez** | 29 | 58·6 | 32 | 34·25 |

| XII. ASIA. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Trebizonde**, E. extremity | 41 | 1·0 | 39 | 46·0 |
| Cape Yazon | 41 | 8·5 | 37 | 41·5 |
| Samsoun, N. extremity City | 41 | 18·2 | 36 | 21·25 |
| Sinope, Castle | 42 | 2·2 | 35 | 12·5 |
| Cape Kerempeh, N.W. Point | 42 | 12 | 33 | 17·25 |
| Pendérakli * | 41 | 17·1 | 31 | 27 |
| Kephken Adassi Isle, Fort | 41 | 13·2 | 30 | 17·5 |
| Asia * | 41 | 13·0 | 29 | 9·4 |
| Tenedos, Cape Baba Fort | 39 | 28·2 | 26 | 4·5 |
| Mount Ida, 5,750 feet | 39 | 42·0 | 26 | 50·5 |
| Mitylene, East Point | 39 | 0·7 | 26 | 37·7 |
| ,, Mount Olympus, 3,079 ft | 39 | 4·2 | 26 | 22·0 |
| ,, West Point, Cape Sigri | 39 | 10·7 | 25 | 50·0 |
| **Smyrna**, Mill on Daragaz Pt., S.M. | 38 | 26·5 | 27° | 9′42″ |
| Vourla Scala, Fountain | 38 | 21·7 | 26 | 47·5 |
| Cape Karabournou, Point | 38 | 39·9 | 26 | 22·75 |
| Scio, North Summit | 38 | 33·7 | 26 | 1·25 |
| Venetico Isle, off S. Point of Scio | 38 | 8·0 | 26 | 2·0 |
| Ipsara, Fort at South Point | 38 | 32 | 25 | 35 |
| Cape Blanco | 38 | 16·6 | 26 | 14·75 |
| Cape Koraka | 38 | 6·5 | 26 | 36·75 |
| Scalanuova, Koosh Isle | 37 | 52·0 | 27 | 16·5 |
| **Samos**, West Summit | 37 | 43·8 | 26 | 38·5 |
| ,, South Point, Cape Colonna | 37 | 38·3 | 26 | 52·7 |
| Nicaria, West Point | 37 | 31·2 | 25 | 59·5 |
| ,, Beacon, 3,390 feet | 37 | 32·2 | 26 | 4·7 |
| Gaidaro, Summit | 37 | 28·1 | 26 | 58·75 |
| Arki, North Point | 37 | 24·9 | 26 | 44·5 |
| Patmos, Prasso Isle, South Point | 37 | 16·0 | 26 | 34·75 |
| Lipso, S.W. Point | 37 | 18·2 | 26 | 44·25 |
| Lexo, Mount Klidi | 37 | 10·7 | 26 | 51·5 |
| Kalymno, Mount Passiva | 36 | 58·8 | 27 | 0·0 |
| Mount Samsoun | 37 | 39·8 | 27 | 9·0 |
| Cape Monodendri, Ruin | 37 | 21·3 | 27 | 13·0 |
| Kos, West Point | 36 | 43·0 | 26 | 49·5 |
| Nicero, Summit, 2,270 feet | 36 | 35·2 | 27 | 11·0 |
| ,, West Islet off, North Point | 36 | 35·6 | 27 | 3·5 |
| Piscopia, Summit | 36 | 26·1 | 27 | 21·0 |
| Karki, S.W. Point | 36 | 12·2 | 27 | 33·25 |
| **Rhodes** * | 36 | 26·9 | 28 | 16·25 |
| ,, W. Point, Cape Monolitho | 36 | 8·7 | 27 | 43·25 |
| ,, S. Point, C. Prasso Nisi | 35 | 52·4 | 27 | 47·0 |
| Khina Isle, Rock | 35 | 51·2 | 27 | 56·0 |
| Scarpanto Isle, South Point | 35 | 23·5 | 27 | 10 |
| **Candia**, Town, Minaret * | 35 | 21·0 | 25 | 8·25 |
| ,, Cape Krio | 35 | 16 | 23 | 31 |
| ,, Sordi Isle | 35 | 34·3 | 23 | 27·25 |
| ,, N. extremity Cape Spada | 35 | 40·5 | 23 | 44·25 |
| ,, Khania * | 35 | 30·8 | 24 | 0·0 |
| ,, Cape Meleka | 35 | 35 | 24 | 8·5 |
| ,, Cape Sidera, Summit | 35 | 17·7 | 26 | 18·75 |
| ,, E. extremity C. Salomon | 35 | 9·2 | 26 | 19·5 |
| ,, Christiana Isles, S'most | 34 | 53·1 | 26 | 7·7 |
| ,, Cape Matala | 34 | 55·1 | 24 | 45·25 |
| ,, Mount Ida | 35 | 13·3 | 24 | 47·0 |
| ,, Sphakia | 35 | 14 | 24 | 13 |
| Gozzo Isle, West Point | 34 | 52·0 | 24 | 2·2 |
| **Boudroom**, Castle | 37 | 2·0 | 27 | 27·5 |
| Cape Crio, West Point | 36 | 41·0 | 27 | 23·5 |
| Makri, Theatre | 36 | 37·2 | 29 | 9·75 |
| Khelidonia Isle, South Islet | 36 | 9·5 | 30 | 26·25 |
| Adalia, South Pier Head | 86 | 52·2 | 30 | 45 |
| Cape Anamour | 36 | 0·8 | 32 | 49 |
| Cape Cavaliere | 36 | 7·5 | 33 | 43·7 |
| Lamas River | 36 | 33·8 | 34 | 17·75 |
| Alexandretta, Consulate Flag-staff | 36 | 35·3 | 36 | 9 |
| Cape Possidi | 35 | 52·2 | 35 | 49·0 |
| Latakia * | 35 | 30·5 | 35 | 46·0 |
| **Bairout**, British Consulate | 33 | 54·5 | 35 | 28·25 |
| Sidon, Castle | 33 | 34·1 | 35 | 21·75 |
| St. John d'Acre, Bastion Mar. Gate | 32 | 55·0 | 35 | 2·5 |
| Cape Carmel | 32 | 51·2 | 34 | 57·7 |
| Ascalon, Ruins | 31 | 39·0 | 34 | 34·0 |
| El Arish | 31 | 5·5 | 33 | 55·75 |

| ASIA. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Cyprus**, Larnaka, Consulate | 34 | 55·2 | 33 | 37·75 |
| ,, W. extr. C. Epiphanius | 35 | 6·3 | 32 | 14·5 |
| ,, N.E. extr. C. Andrea | 35 | 41·7 | 34 | 35·5 |
| ,, S'most extr. C. Gatto | 34 | 32·8 | 32 | 59·75 |
| **Toor**, Harbour | 28 | 14 | 33 | 36·25 |
| Jubal Isle, East Summit | 27 | 37·7 | 33 | 48·0 |
| Kosseir, Town | 26 | 6·8 | 34 | 16·25 |
| Tirahu Isle, Peak | 27 | 55·2 | 34 | 34 |
| Moilah, High Peak, 9,000 feet | 27 | 37 | 35 | 45 |
| Palinurus Reefs | 24 | 6 | 37 | 7 |
| Jeddah, Mosque E'ward of Town | 21 | 28·3 | 39 | 13·0 |
| **Mocha** | 13 | 20 | 43 | 12·0 |
| Bab-el-Mandeb, Peak | 12 | 41·2 | 43 | 23·75 |
| Rás 'Arah, Low Point | 12 | 37·5 | 43 | 53·26 |
| C. St. Antonio, S. Bluff, 2,085 ft. | 12 | 41·0 | 44 | 7·6 |
| Rás K'au, Cape | 12 | 39·7 | 44 | 24·1 |
| Mount Hasan, Sugar-loaf | 12 | 44·8 | 44 | 50·25 |
| Rás Majallab Heldi | 12 | 43·1 | 44 | 50·6 |
| 'Aden, Back Bay, Steamer Point | 12 | 46·6 | 44 | 57·6 |
| Mount Shamshan, Summit | 12 | 45·5 | 44 | 59·6 |
| Cape 'Aden, South Point | 12 | 45·1 | 45 | 0·6 |
| **'Aden**, North Point of Sirah Isle | 12 | 46·25 | 45 | 1·3 |
| Sughra, Sheikh's Castle | 13 | 21·5 | 45 | 37·6 |
| Mount Fudhli, West Summit | 13 | 31·5 | 45 | 50·6 |
| Maghatain, Point | 13 | 24·5 | 46 | 23·6 |
| Mount Hisn Ghorab, East Point | 13 | 59·3 | 48 | 16·1 |
| Makalleh, Government House | 14 | 13·7 | 49 | 3·25 |
| Rás Sharmah, Point | 14 | 48·5 | 49 | 53·9 |
| Merbat, Town | 16 | 59·0 | 54 | 38·6 |
| Hallaniyah Isle, N.E. Bluff | 17 | 32·7 | 56 | 2·45 |
| Cape Isolette, Islet off | 19 | 0·4 | 57 | 48·6 |
| San Carlos Banks, S.W. extremity | 19 | 20·0 | 57 | 48·6 |
| ,, N.E. extremity | 19 | 32·5 | 58 | 4·9 |
| Hamar-al-Nafur Isle | 19 | 47·6 | 57 | 46·3 |
| Palinurus Bank, South Point | 19 | 49·5 | 58 | 14·9 |
| Rás Abu-rasas, Masirah Isle | 20 | 10 | 58 | 36·45 |
| Rás Shebali | 20 | 57·5 | 58 | 47·9 |
| **Persian Gulf**, Rás-al-Hed | 22 | 32·6 | 59 | 47·9 |
| Rás Jibsh | 21 | 27·5 | 59 | 21·5 |
| Rás Abu Daud, Rocky Point | 23 | 19·1 | 58 | 55·5 |
| **Maskat**, Saddle Hill, 1,340 feet | 23 | 35·1 | 58 | 35·05 |
| Mount Nakli, Gt. Peak, 6,270 ft. | 23 | 25·0 | 57 | 56·8 |
| Rás Jashk, Tomb on Point | 25 | 38·0 | 57 | 46·2 |
| Great Quoin, highest part | 26 | 30·0 | 56 | 30·9 |
| Rás-al-Kuh, extreme S. of Creek | 25 | 47·4 | 57 | 18·8 |
| Kuh-i-Mubarek | 25 | 50·6 | 57 | 18·73 |
| Ummal Fyarin, highest part | 26 | 10·8 | 56 | 33·1 |
| Hormuz, S.E. Bastion, Fort | 27 | 5·8 | 56 | 27·6 |
| **Bander Abbas**, S.W. Bastion | 27 | 10·5 | 56 | 17·0 |
| Henjam Isle, White Mosque | 26 | 40·8 | 55 | 53·9 |
| Basiduh, Portuguese Chapel | 26 | 29·2 | 55 | 16·3 |
| Mt. Bostaneh, Tower Pk., 1,750 ft. | 26 | 32·9 | 54 | 41·7 |
| Tumb I., N.E. Corner, Hummock | 26 | 16·2 | 55 | 19·7 |
| Kais Isle, West Point | 26 | 32·7 | 53 | 54·4 |
| Sheikh Sho'aib, West Point | 26 | 50·4 | 53 | 9·6 |
| Rás Nabend, Tree above | 27 | 21·3 | 52 | 37·9 |
| Asluh Notch, 4,870 feet | 27 | 33·6 | 52 | 37·7 |
| Barn Hill, 4,660 feet | 27 | 48·0 | 52 | 13·9 |
| Asses' Ears, South Peak, 2,500 ft. | 28 | 29·0 | 51 | 11·7 |
| **Bu-shehr**, British Flag-staff | 28 | 59·1 | 50 | 50·05 |
| Khareg Isle, Flag-staff | 29 | 15·4 | 50 | 20·6 |
| **Basrah**, Ma'kil, Consulate | 30 | 34·0 | 47 | 48·9 |
| Koweit, Hill Fort to S.E. | 29 | 16·9 | 48 | 3·5 |
| Karachi, Minorah Point * | 24 | 47·3 | 66 | 58·2 |
| Diu, Town, Flag-staff | 20 | 42·3 | 71 | 0·1 |
| Perim Isle * | 21 | 35·3 | 72 | 20 |
| Vaux's Tomb, Taptee * | 21 | 5·7 | 72 | 37·6 |
| **Bombay**, Observatory, S.M. | 18° | 53′ 7 | 72° | 48′45 |
| ,, Lighthouse * | 18 | 53·7 | 72 | 48·75 |
| New Goa, St. Ann's Light * | 15 | 28·3 | 73 | 52·1 |
| Mangalur, Flag-staff | 12 | 52 | 74 | 49·9 |
| Kananur, Point, Flag-staff | 11 | 51·2 | 75 | 21·65 |
| Tellicherri ** | 11 | 44·9 | 75 | 29·15 |
| Kolikod,* Flag-staff | 11 | 15·2 | 75 | 46·4 |

| XIII. ASIA. | Lat. N. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| Trevandrum Pagoda | 8 29·0 | 76 55·8 |
| Cape Kumarin, Peak | 8 23·2 | 77 30·5 |
| Colombo* | 6 56·1 | 79 49 |
| **Point de Galle,*** Ceylon | 6 1·8 | 80 13 |
| Adam's Peak, 7,000 feet | 6 52 | 80 29 |
| Trincomali,* Fort Frederick | 8 36 | 81 14 |
| **Laccadives,** Padua Bank, N.Pt. | 13 37 | 72 32 |
| East extrem. Elikalpeni Bank | 11·13 | 73 56 |
| Seuheli Par, South extremity | 9 56 | 72 9 |
| Minicoy, betw. 8° & 9° Channels | 8 17 | 73 3 |
| **Maldives,** North extremity | 7 6 | 72 53 |
| S.extr. Addoo Atoll, Gung I., E.Pt | 0 41·5s | 73 6 |
| Nagapatam, Flag-staff | 10 45·6 | 79 50·25 |
| Tallangambadi (Tranquebar) | 11 1·5 | 79 50·25 |
| Kudalur, Town and River | 11 43·5 | 79 46·0 |
| Pudicheri* (Pondicherry) | 11 55·7 | 79 49·5 |
| **Madras,** Observatory, S.M | 13 4·1 | 80°14′19″·5 |
| ,, Light, Fort St. George | 13 4·7 | 80 16·5 |
| Pulicat, Flag-staff | 13 25·1 | 80 18·25 |
| Point Divy* | 15 57·5 | 81 11 |
| Godavari Point* | 16 48 | 82 18 |
| Vishakpatnam, Battery | 17 40 8 | 83 16·75 |
| False Point* | 20 19·4 | 86 44 |
| Mypurra Isle, South Point | 20 41·3 | 87 7·25 |
| Pilot Ridge* | 20 50 | 87 39 |
| East Channel* | 21 3 | 88 12 |
| Kedjeri* | 21 50·3 | 87 56·0 |
| Saugor Isle,* West Point | 21 38 | 88 1 |
| **Calcutta,** Fort William, Fl.-st. | 22 33·5 | 88°19′ 40″ |
| Chittagong, or Islamabad, Fl.-st. | 22 20 | 91 48·0 |
| Kutubdea Isle* | 21 52·6 | 91 50·25 |
| Elephant Point | 21 10 | 92 3 |
| Mosque, or Fakir's Point* | 20 6·7 | 92 54·0 |
| Akyab Harbour, Flag-staff | 20 8·4 | 92 54·25 |
| Great Savage* | 20 5·2 | 92 54·0 |
| Kyok Phyu, Flag-staff | 19 26·4 | 93 32·75 |
| Cape Negrais | 16 1·5 | 94 12 |
| **Andamans,** Preparis Isle, N.end | 14 56 | 93 38 |
| Little Andaman, South Point | 10 26. | 92 38 |
| Cor Nicobar, S. of 10° Channel | 9 10 | 92 46 |
| Great Nicobar, South Point | 6 45 | 93 54 |
| Rangoon, Dagon Pagoda | 16 47 | 96 10 |
| Amherst | 16 5 | 97 33 |
| **Merguis,** St. Matthew's I., Sum. | 9 58·0 | 98 11·25 |
| ,, Hasting's Harbour, Peak | 10 5·1 | 98 11·0 |
| Junk Seilon, or Salang I., S. Pt. | 7 46 | 98 18 |
| Achin Head, or King's Point | 5 36 | 95 11 |
| Diamond Cape | 5 14 | 97 38 |
| Penang I., George, Ft. Cornwallis | 5 25·1 | 100 20·25 |
| Malacca,* Flag-staff | 2 10·5 | 102 15 |
| **Singapore,** Fort Fullarton | 1 17 | 103 51′ 18″ |
| Pedra Branca, Horsburgh* | 1 20 | 104 26 |
| Tambelan Isles. Great Tambelan | 1 0 | 107 35 |
| Anambas, N.E. extreme. | 3 15 | 106 35 |
| Natunas, S. extrem. Sededap Isle | 3 34 | 108 1 |
| Great Natuna, North Point | 4 16 | 108 12 |
| **Labuan** Isle, West Point | 5 15·1 | 115 7 |
| Kuching Hill, E.entr. Sarawak R. | 1 33·4 | 110 22 |
| Balabac Isle, South Point | 7 48 | 117 52 |
| Boulanhow Hill, North extr. | 8 40 | 117 26 |
| Louisa Shoal | 6 20 | 113 18 |
| Palawan, South extremity | 8 20. | 117 12 |
| **Manila*** | 14 35·1 | 120°57′21″ |
| Bashees, San Domingo, Bantan | 20 27·5 | 121 28·5 |
| Pratas Isle, N.E. part | 20 42·0 | 116 42·6 |
| **Formosa,** Ape Hill | 22 38·0 | 120 15·7 |
| Port Kok-si-kou, Obs. Point | 23 6·0 | 120 4·8 |
| Sano Bay (South Point) | 24 36·0 | 121 52·2 |
| Tamsui Harbour, Sand Point | 25 10·1 | 121 5·3 |
| Ruin Rock, Kelung Harbour | 25 9·0 | 121 46·2 |
| **Pescadores,** Makung Harb., O.P. | 23 32·9 | 119 29·4 |
| Luchu Isle, Deep Bay, Head | 26 35·6 | 127 58·9 |
| **Siam Gulf,** Pulo Kapas, SW.Pt. | 5 13·0 | 103 16·0 |
| ,, Gt. Redang I., Bukit Mara | 5·44·3 | 103 1·6 |

| ASIA. | Lat. N. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| Kalantan, Entr. of R. to E—d. | 6 11·9 | 102 20·8 |
| Cape Patani, N.E. Point | 6 58·0 | 101 18·6 |
| Singora, Pulo Ticos, S.W. Pt. | 7 13·9 | 100 36·2 |
| Koh Krah, S.E. Point | 8 24·8 | 100 45·5 |
| Sing I., White Rock, East side | 11 3·7 | 99 31·4 |
| Bangkok, Patnam Flag-staff | 13 35·9 | 100 35·6 |
| C. Liant, Mesan I., N.W. Rock | 12 35·1 | 100 56·9 |
| Luemor Pilot Isle, Peak | 12 57·5 | 100 39·0 |
| Chentaban River, Chula Isle | 12 27·7 | 102 4·4 |
| Pulo Obi, Square Rk., S.W. Pt. | 8 25·6 | 104 48·8 |
| Pulo Panjang, S.W. Bay | 9 18·2 | 103 28·2 |
| Rocky Isle, Kamput, Centre | 10 27·9 | 104 11·9 |
| Tecksou, N.W. side | 9 57·2 | 104 49·1 |
| Cape St. James | 10 17 | 107 5 |
| False Cape, Varela, Camranh | 11 44 | 109 12 |
| Quinhone Harbour, Entrance | 13 44 | 109 14 |
| Pulo Condore Isles | 8 40 | 106 41 |
| **Hainan,** Tinhosa Isle | 18 39·7 | 110 27·4 |
| Taya Isles, North Isle | 19 58·8 | 111 16·0 |
| ,, South Isle | 19 48 | 111 11·4 |
| Hailingshen I., Twins at S.W.Pt. | 21 34 | 111 49·5 |
| Grand Ladrone | 21 57 | 113 42·5 |
| Macao, Flag-staff | 22 11·4 | 113 31·2 |
| **Canton,** English Factory | 23 6·9 | 113 14·2 |
| Hong Kong, Point Albert, S.M. | 22°16′27″ | 114° 9′57″ |
| ,, Kowloon Point, W. Battery | 22°17′20″ | 114° 9′22″ |
| Raleigh Rock | 22 2·0 | 113 46·2 |
| Ninepin Rock | 22 15·7 | 114 21·3 |
| Mendoza Island, Summit | 22 30·7 | 114 49·2 |
| Pedro Blanco Rock | 22 18·5 | 115 6·1 |
| Chino **Peak** | 22 44·4 | 115 46·0 |
| Cupchi Point, Hill | 22 48·1 | 116 3·5 |
| Cape of Good Hope | 23 14·0 | 116 46·2 |
| Tongsang Harbour, Fall Peak | 23 47·3 | 117 36·0 |
| **Amoy** Isle, Citadel | 24 28·0 | 118 3·2 |
| Dodd Island, Summit | 24 26·3 | 118 28·3 |
| Chin-chu Harbour, Pisai Isle | 24 49·2 | 118 40·2 |
| Lam-yit Isle, High Cone | 25 12·0 | 119 34·2 |
| Haitan Isle, Kiangshan Peak | 25 36·3 | 119 49·9 |
| River Min, Temple Point | 26 8·4 | 119 36·9 |
| Changchi Isle, highest Peak | 26 14·0 | 120 0·9 |
| Tungying Isle, Peak | 26 23·2 | 120 30·8 |
| Double Peak Isle, highest | 26 36·1 | 120 10·4 |
| Tae Isles, Eastmost | 26 59·2 | 120 43·0 |
| Pihquan Peak | 27 18·8 | 120 28·0 |
| Namquan Harbour, Bate Isle | 27 9·3 | 120 25·0 |
| Port Namki, East Horn | 27 20·3 | 121 5·8 |
| Tai-chau Islands, Heachu Isle | 28 23·3 | 121 54·4 |
| Chuh-seu Isle, Summit | 28 40·5 | 121 46·6 |
| Kweshan Isles, Patahecock | 29 21·9 | 122 12·9 |
| Buffalo's Nose Isle, Summit | 29 36·2 | 122 0·6 |
| Nimrod Sound, Middle Isle | 29 34·3 | 121 42·5 |
| **Chusan** Isle, Tinghae—Ob.Spot | 30 0·4 | 122 4·5 |
| Chukea Isle, Peak | 29 54·0 | 122 24·5 |
| Cairnsmore Rock | 30 42·2 | 122 33·8 |
| Chapu, Battery | 30 36·0 | 121 2·2 |
| Yung River, Chinhai Citadel | 29 57·1 | 121 42·3 |
| Shaweishan Isle, Summit | 31 25·2 | 122 14·2 |
| Wusung River, Fort A | 31 23·5 | 121 29·4 |
| **Shanghai,** British Cons. Fl.-st. | 31 14·7 | 121 28·1 |
| Hankau, Mouth of Han River | 30 32·8 | 114 19·1 |
| Whangho River, Entrance | 34 2·0 | 119 50·2 |
| Wang-kia-tai Bay, Lungwang Temple | 35 39·0 | 119 47·2 |
| Staunton I., landing pl. N. side | 36 45·5 | 122 12·0 |
| Shan-tung Promontory, extr. | 37 24·5 | 122 38·2 |
| Lungmun Harbour, Ta-shan | 37 27·3 | 121 32·1 |
| **Chifu** or Yentai, Fort in Vill. B. | 37 35·9 | 121 21·7 |
| Miautau Islands, N.Isle, Peak | 38 23·6 | 120 51·2 |
| ,, South extreme | 37 56·0 | 120 36·4 |
| Talienwhan B., Obs. Spot | 38 52·6 | 121 48·7 |
| Shaluitieu Isle, Joss House | 38 53·0 | 118 28·2 |
| Pei-ho, South Taku Fort | 38 59·8 | 117 38·5 |
| Great Wall, at Sea-side | 39 58·0 | 119 45·2 |

| XIV. NORTH PACIFIC. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Quelpart** Isle, Obs. Spot, W. side of Beaufort Isle | 33 | 7 | 126 | 57·6 |
| Montravel Isle, Centre | 33 | 59·0 | 126 | 56·1 |
| Ross Isle, Peak | 34 | 6·0 | 125 | 6·2 |
| Guérin Isle, Summit | 36 | 7·0 | 126 | 0·3 |
| Marjoribanks Harb., Mauzac I. | 36 | 26·7 | 126 | 27·1 |
| Caroline Bay, West Point | 37 | 1·5 | 126 | 24·2 |
| Port Adams, Entry Isle | 39 | 16·0 | 121 | 31·1 |
| Hulu Shan Bay, Obs. Place | 39 | 40·8 | 121 | 13·2 |
| Liauho, Yinkoa Pagoda | 40 | 43·2 | 122 | 9·9 |
| Liauti Shan Prom., S.W. Point | 38 | 43·0 | 121 | 4·2 |
| Round Isle, Summit | 38 | 40·0 | 122 | 9·1 |
| Thornton Haven, Obs. Spot | 39 | 4·0 | 123 | 8·2 |
| Kuper H., Josling I., N.E. Extr. | 34 | 17·3 | 126 | 34·6 |
| **Port Hamilton**, Obs. I., W. Pt. | 34 | 1·4 | 127 | 17·9 |
| Simonoseki, Mozi Saki, S. Point | 33 | 58·0 | 130 | 57·6 |
| Wilson Isle, Summit | 33 | 54·5 | 130 | 23·5 |
| Firando Harbour, Entrance | 33 | 23·0 | 129 | 27·2 |
| Goto Is., Obs. I., Hardy Harbour | 32 | 49·0 | 128 | 55·8 |
| Tamanoura, Entrance Harbour | 32 | 43·5 | 128 | 37·0 |
| Cape Goto, Extreme | 32 | 39·5 | 128 | 34·7 |
| **Nagasaki**, Minage Point | 32 | 44·5 | 129 | 50·7 |
| Kusa-kaki, Ear's Peak | 32 | 3·0 | 128 | 24·2 |
| Udsi-sima, High Peak | 30 | 39·0 | 129 | 28·2 |
| Cape Chichakoff, Extreme | 30 | 39·0 | 130 | 43·3 |
| Oösima Harb. of Kii, Pisayama Rock | 33 | 29·8 | 135 | 47·7 |
| Urakami Harbour, Village Point | 33 | 33·6 | 135 | 54·2 |
| Simidzu Harbour, Miosaki | 35 | 0·8 | 138 | 30·3 |
| Eno-ura Bay, Centre | 35 | 3·0 | 138 | 51·8 |
| Mount Fuziyama | 35 | 21·1 | 138 | 42·3 |
| Cape Idsu, S.E. Extreme | 34 | 35·0 | 138 | 50·8 |
| Rock Island, Centre | 34 | 34·3 | 138 | 56·0 |
| Simoda Hasbour, Centre Isle | 34 | 39·8 | 138 | 56·3 |
| **Yedo** Bay, Cape Sagami | 35 | 8·0 | 139 | 40·8 |
| Yokohama, West Pier | 35 | 26·2 | 139 | 38·2 |
| **Hakodadi** Harb., Entr. to Kamida Creek | 41 | 47·1 | 140 | 43·8 |
| Cape Matsumæ, Islet off | 41 | 24·9 | 140 | 6·1 |
| Cape Nambu, Islet on W. side | 41 | 25·4 | 141 | 27·4 |
| Red Cliff Point, extremity | 41 | 28·1 | 141 | 7·8 |
| Toriwisaki, Low Isle off | 41 | 33·6 | 140 | 55·4 |
| Tatsupisaki, North side | 41 | 16·3 | 140 | 21·4 |
| Cape Greig, Rock off South side | 41 | 5·6 | 140 | 19·1 |
| Fatsizio Isle, Centre | 33 | 6·0 | 139 | 49·4 |
| Vries Isle, North Head | 34 | 47·3 | 139 | 21·0 |
| Tabusima, East extremity | 39 | 11·9 | 139 | 33·4 |
| Awasima, N.E. extremity | 38 | 29·6 | 139 | 15·3 |
| Sado Isle, Yasaki | 38 | 19·9 | 138 | 26·2 |
| Yutsi-sima | 37 | 50·5 | 136 | 54·2 |
| Cape Louisa | 34 | 40 | 131 | 35·2 |
| **Seto Uchi**, Tomo, S. Pier | 34 | 22·6 | 133 | 22·7 |
| ,, Osaki, Tree Isle, S. Pt. | 34 | 7·7 | 135 | 7·8 |
| Tsusima, Obs. Islet | 34 | 18·9 | 129 | 12·5 |
| Chosan Harbour, Obs. Spot | 35 | 6·1 | 129 | 2·4 |
| Port Lazarof, Obs. Point | 39 | 19·2 | 127 | 32·0 |
| St. Vladimir Bay, Low Point | 43 | 53·7 | 135 | 27·3 |
| **Kuril** Islands, Kunashir, Peak | 44 | 31·0 | 145 | 46·0 |
| ,, Iturup, Cape Okebets | 45 | 38·5 | 149 | 14·0 |
| ,, Urup, Cape Kastrikum | 46 | 16·0 | 150 | 22·0 |
| ,, Simusir, Prevost Peak | 47 | 2·8 | 151 | 52·8 |
| Risiri, Pic de Langle | 45 | 11·0 | 141 | 12·3 |
| Refunsiri, Cape Hieber | 45 | 27·8 | 141 | 0·0 |
| Cape Notoro | 45 | 54·3 | 142 | 1·0 |
| Cape Nossysh | 45 | 25·8 | 141 | 33·5 |
| Barracouta Harbour, Tullo Isle | 49 | 1·8 | 140 | 19·0 |
| Castries Bay, Quoin Point | 51 | 28·0 | 140 | 49·5 |
| Jonquiere Bay | 50 | 54·0 | 142 | 7·0 |
| **Saghalin** Isle, Cape Aniva | 46 | 2 | 143 | 30 |
| Cape Tapaniva, or Patience | 48 | 52 | 144 | 46·3 |
| Cape Elizabeth, North extremity | 54 | 24·5 | 142 | 46·5 |
| Robben Isle, N.E. edge of Reef | 48 | 36·0 | 144 | 33·0 |
| ,, S.W. edge of Reef | 48 | 28·0 | 144 | 10·0 |
| Great Shantar Isle, North Point | 54 | 24·5 | 142 | 46·5 |

| NORTH PACIFIC. | Lat. N. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Port Aian, Cape Vneshni | 56 | 25·4 | 138 | 25·8 |
| Avatcha Bay, East Entrance * | 52 | 52·5 | 158 | 47 |
| **Petropaulski**, Church | 53 | 0·9 | 158 | 43·5 |
| Ohosima, N. extreme | 28 | 31·7 | 129 | 40·2 |
| Powhattan, Reef | 30 | 41·0 | 130 | 19·0 |
| Bonin Is., Port Lloyd, Peel Isle | 27 | 5·6 | 142 | 10·7 |
| Sebastian Lobos, S.W. Isle | 25 | 10·0 | 146 | 39·2 |
| **Luchu** Is., Napha, Abbey Point | 26 | 12·4 | 127 | 41·7 |
| Meiacosima, Port Haddington | 24 | 25·0 | 124 | 5·9 |
| Volcanos, Sulphur Isle | 24 | 48·0 | 141 | 13·0 |
| Marshall, or Los Jardines Islands | 21 | 40·0 | 151 | 35·0 |
| Ladrones, Asuncion Isle, Peak | 19 | 41·0 | 145 | 27·0 |
| ,, Seypan Isle, Peak | 15 | 13·0 | 145 | 49·0 |
| ,, Guam Isle, Fort San Luis | 13 | 26·0 | 144 | 45·0 |
| Borodino Islands, South Isle | 25 | 52·7 | 131 | 12·3 |
| **Luzon**, Volcano of Ysarog | 13 | 37 | 123 | 24 |
| Samar, South and East extreme | 11 | 2 | 125 | 47 |
| Port Mindanao | 5 | 39 | 125 | 18 |
| Sooloos, South extreme | 5 | 1 | 119 | 55 |
| **Borneo**, Banguey, Peak | 7 | 29 | 117 | 9 |
| Celebes, Manado, Fort | 1 | 29·5 | 124 | 50 |
| Gilolo, Morty, North Point | 2 | 44 | 128 | 25 |
| Pellew Islands, North extremity | 8 | 45 | 134 | 5 |
| Marshall Islands, East Chain | 11 | 48 | 170 | 7 |
| ,, West Chain | 4 | 39 | 168 | 50 |
| ,, Chatham, N. Group | 9 | 30 | 170 | 16 |
| ,, Mulgrave, S. Point. | 6 | 7 | 171 | 57 |
| Carolines, Prudence | 9 | 31 | 161 | 8 |
| ,, Mortlock | 5 | 29·3 | 153 | 58 |
| | Lat. N. | | Long. W. | |
| **Sandwich** Is., Honolulu, Fort | 21 | 18·2 | 157 | 55·0 |
| ,, Hanalae Bay, Brit. Cons. | 22 | 14 | 159 | 32·75 |
| Christmas Isle, S.E. Point | 1 | 41 | 157 | 15 |
| Galera Point, Columbia | 0 | 50·2 | 80 | 4·7 |
| Cape Corrientes | 5 | 28·8 | 77 | 32·5 |
| Buenaventura River, Basan Pt. | 3 | 49·5 | 77 | 10·8 |
| Cupica Bay, Cupica River | 6 | 41·3 | 77 | 29·6 |
| Isla del Rey, Coocs Point | 8 | 12·5 | 78 | 53·7 |
| Cape Mala, Extremity | 7 | 27·1 | 79 | 59·0 |
| **Panama**, N.E. Bastion | 8 | 56·9 | 79°31′9″ | |
| Gulf of Dulce, Cape Matapol | 8 | 16 | 83 | 17 |
| Cape Blanco | 9 | 32 | 85 | 7 |
| Calebra, Entrance | 10 | 34·3 | 85 | 40·0 |
| Salinas River, Salinas Isle | 11 | 2·8 | 85 | 40·75 |
| Realejo, Cardon Isle | 12 | 27·9 | 87 | 9·5 |
| Acapulco, Fort St. Diego | 16 | 50·8 | 99 | 52·0 |
| Manzanilla Bay, South side | 19 | 3·5 | 104 | 16 |
| San Blas, Arsenal | 21 | 52·5 | 105 | 15·5 |
| Mazatlan, Custom House | 23 | 11·8 | 106 | 23·7 |
| Guaymas, Morro | 27 | 54 | 110 | 50 |
| San Jose Mission | 23 | 3·5 | 109 | 41 |
| Cape St. Lucas | 22 | 52 | 109 | 53 |
| Magdalena Bay, Entrada Point | 24 | 32·3 | 112 | 3·0 |
| Port St. Bartholomew | 27 | 39·8 | 114 | 53·5 |
| St. Quintin, West Point | 30 | 21·5 | 115 | 58·5 |
| St. Diego, Point Loma | 32 | 38·8 | 117 | 14·75 |
| Point Concepcion * | 34 | 31 | 120 | 30 |
| Monterey, Fort | 36 | 36·4 | 121 | 53·0 |
| Point Pinos * | 36 | 38·5 | 121 | 55 |
| **St. Francisco**, Yerba Buena Cove | 37 | 38·5 | 122°24′0″ | |
| ,, Fort, South side, Entrance | 37 | 48·5 | 122 | 28·5 |
| Cape Mendocino | 40 | 29 | 124 | 32 |
| Cape Flattery, Tatouch Isle * | 48 | 23·2 | 124 | 45·2 |
| New Dungeness,* N. end of Spit | 48 | 11·0 | 123 | 6·1 |
| Blunt Isle,* highest part | 48 | 19 | 122 | 51·5 |
| Admiralty Inlet,* Whedbey Isle | 48 | 9·3 | 122 | 39·5 |
| **Vancouver** I., Gt. Race Rock * | 48 | 17·7 | 123 | 32·2 |
| Esquimalt Head, Duntze Head | 48 | 25·8 | 123 | 26·7 |
| Victoria, Laurel Point | 48 | 27·4 | 123 | 23·0 |
| New Westminster, Barracks | 49 | 13·0 | 122 | 54·4 |
| Nootka Sound, Friendly Cove | 49 | 35·5 | 126 | 37·5 |
| Queen Charlotte Islands, S. Pt. | 55 | 55 | 131 | 2 |
| Port Stewart, S'most Isle | 55 | 38·3 | 131 | 47 |
| Port Protection, Port Baker | 56 | 20·5 | 133 | 36 |

| XV. SOUTH PACIFIC. | Lat. S. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ ″ |
| **Australia**, Sydney, Ft. M'Quarrie | 33 | 51·7 | 151 | 14·0 |
| **Paramatta** Observatory, S.M. . | 33 | 48·7 | 151 | 1' 0" |
| Sow and Pigs,** N.W. edge ... | 33 | 50 | 151 | 17 |
| Port Jackson * ..... | 33 | 51·2 | 151 | 18·25 |
| Botany Bay, N. Pt. of Entrance. | 34 | 0 | 151 | 16 |
| Jervis Bay, N. Pt. of Entrance . | 35 | 6 | 150 | 53 |
| Twofold Bay, Red Point* ..... | 37 | 6·2 | 149 | 58·2 |
| Cape Howe, Islet off ..... | 37 | 31 | 150 | 0 |
| Corner Inlet, S. Pt. of Entrance. | 38 | 47 | 146 | 30 |
| Cape Wilson..... | 39 | 8 | 146 | 23 |
| Kent Isles, S.E. Isle * ..... | 39 | 30 | 147 | 19 |
| Glennie Isles, South Point ..... | 39 | 12 | 146 | 15 |
| Cape Liptrap, Point ..... | 38 | 55 | 145 | 57 |
| Williamstown, Jetty ..... | 37 | 51·2 | 144 | 54·75 |
| Grant Isle, West Point ..... | 38 | 31·6 | 145 | 11 |
| Cape Schank..... | 38 | 30 | 144 | 57 |
| Western Port, Phillip I., N.E. Pt. | 38 | 26·7 | 145 | 18·25 |
| Point Gellibrand * ..... | 37 | 52·7 | 144 | 55·75 |
| **Melbourne**, Bateman's Hill ... | 37 | 48·6 | 144 | 57·75 |
| Shortland Bluff* ..... | 38 | 16·5 | 144 | 43·2 |
| Port Phillip, Port Nepean ..... | 38 | 18·5 | 144 | 42·75 |
| Cape Otway *..... | 38 | 51 | 143 | 33 |
| King Isle, Harbinger Rocks .... | 39 | 34 | 143 | 52 |
| „ S. Point, Cape Stokes. | 40 | 10 | 143 | 50 |
| Cape Nelson, South Point ..... | 38 | 26 | 141 | 32 |
| Cape Bridgewater ..... | 38 | 22 | 141 | 32 |
| Cape Northumberland, Pointed Rocks ..... | 38 | 3 | 140 | 37 |
| Murray River, Mouth ..... | 35 | 31 | 138 | 58 |
| Kangaroo Isle, North Point .... | 35 | 36 | 137 | 44 |
| „ Mount Torrens ..... | 35 | 50 | 136 | 38 |
| „ Cape Bedout, W. extrem. | 35 | 57 | 136 | 37 |
| Cape Willoughby *..... | 35 | 51 | 138 | 12 |
| Cape Jervis ..... | 35 | 38 | 138 | 9 |
| Glenelg, Flag-staff ..... | 34 | 58·8 | 138 | 32·75 |
| Mount Lofty, 2,200 feet ..... | 34 | 58·5 | 138 | 43·75 |
| **Adelaide**, Town ..... | 34 | 55 | 138 | 36 |
| Port Adelaide * ..... | 34 | 48 | 138 | 28 |
| Cape Spencer, S'most Point .... | 35 | 18 | 136 | 55 |
| Corny Point..... | 34 | 52 | 137 | 3 |
| Port Lincoln..... | 34 | 43 | 135 | 53 |
| K. George's S., New Gov. Build. | 35 | 2·2 | 117 | 53·75 |
| Point d'Entrecasteaux ..... | 34 | 52 | 116 | 1 |
| Cape Leeuwin, Rocks 2 leagues out | 34 | 21 | 115 | 6 |
| **Swan R.**, Freemantle, Scott's Jet. | 32 | 3·3 | 115 | 45·5 |
| Perth, Government House ..... | 31 | 57·4 | 115 | 52·75 |
| Garden Isle, N.W. Point..... | 32 | 8·9 | 115 | 40·5 |
| Rottenest Isle *..... | 32 | 0·3 | 115 | 31·25 |
| Champion Bay, Moore Point ... | 28 | 47·1 | 114 | 36·25 |
| Wizard Peak, 640 feet..... | 28 | 29·7 | 114 | 47·0 |
| Mount Fairfax, 583 feet..... | 28 | 45·4 | 114 | 41·7 |
| Dirk Hartog's Isle, North Point. | 25 | 31 | 112 | 54 |
| Shark's Bay, Cape Lesueur .... | 25 | 44 | 113 | 26 |
| N.W. Cape, North Point ..... | 21 | 48 | 114 | 3 |
| Exmouth Gulf, Bay of Rest .... | 22 | 17 | 114 | 0 |
| Depuch Isle ..... | 20 | 38·4 | 117 | 41·0 |
| Cape Leveque, Islet off..... | 16 | 23 | 113 | 1 |
| **King's Sound**, Point Torment . | 17 | 5·5 | 123 | 41·75 |
| „ Fitzroy R. Mo., Escape Pt. | 17 | 24·4 | 123 | 39·75 |
| „ Pt. Cunningham, N.W. part | 16 | 41·5 | 123 | 14·25 |
| Cape Londonderry (rocks 3 m. off) | 13 | 44 | 126 | 57 |
| Victoria R., Pt. Pearce, S.W. extr. | 14 | 25·1 | 129 | 20·7 |
| Paterson's Bay, Quail Isle ..... | 12 | 30·9 | 130 | 28·5 |
| Port Essington, Govt. House... | 11 | 22·3 | 132 | 10·75 |
| Wessel Isles, N. Pt., Cape Wessel | 10 | 59 | 136 | 45 |
| Groote Eylandt, S.E. Point .... | 14 | 16 | 136 | 58 |
| Wellesley Isles, North extremity | 16 | 18 | 139 | 40 |
| **Cape York**, Rocky Islet ..... | 10 | 41·6 | 142 | 34 |
| Booby Isle, Post-office ..... | 10 | 36·7 | 141 | 54·0 |
| Raine Isle, Beacon ..... | 11 | 36 | 144 | 4·25 |
| Sir Charles Hardy's Isles, N. Isle | 11 | 54·7 | 143 | 30·75 |
| C. Weymouth, Restoration Isle, West Point..... | 12 | 37·5 | 143 | 27·5 |
| Lizard Isle, Summit, 1,200 feet | 14 | 41·4 | 145 | 28·5 |

| SOUTH PACIFIC. | Lat. S. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Rockingham Bay, Gould Isle ... | 18 | 9·9 | 146 | 11·5 |
| Halifax Bay, Bay Rock ..... | 19 | 7·2 | 146 | 44·7 |
| Cape Upstart, N.W. Point..... | 19 | 42·8 | 147 | 47 |
| Cumberland Isles, S.E. Isle (K. 1) | 21 | 7 | 149 | 58 |
| Port Bowen, Entrance Isle .... | 22 | 29·0 | 150 | 48·5 |
| Port Curtis, Facing Isle ..... | 23 | 50 | 151 | 24 |
| Cape Moreton, N. Point of Island | 27 | 3 | 153 | 26 |
| Shoal Bay, Entrance ..... | 29 | 26 | 153 | 24 |
| Port Macquarrie, Entrance .... | 31 | 25 | 152 | 57 |
| Port Stephens, Barroinee Head . | 32 | 40·7 | 152 | 4·25 |
| Port Hunter, Court House..... | 32 | 55·8 | 151 | 48·75 |
| **Tasmania**, Hobarton, Mulgrave | 42 | 53·5 | 147 | 21·5 |
| Port Arthur, Semaphore ..... | 43 | 9·1 | 147 | 50·7 |
| Cape Pillar, Tasman's Isle ..... | 43 | 12 | 148 | 0 |
| Schouten Isle, South Islet ..... | 42 | 21 | 148 | 18 |
| St. Patrick's Head ..... | 41 | 34 | 148 | 18 |
| Swan Island, East Point * ..... | 40 | 44 | 148 | 9 |
| Furneaux Islands, Clarke I., S. Pt. | 40 | 35 | 148 | 10 |
| **Port Dalrymple**, Low Head *.. | 41 | 3·4 | 146 | 48·25 |
| „ George Town, Flag-staff | 41 | 6·3 | 146 | 50·25 |
| Table Cape..... | 40 | 56 | 145 | 42 |
| Circular Head ..... | 40 | 43 | 145 | 17 |
| Three Hummock Isle, S.W. side | 40 | 26·5 | 144 | 51·0 |
| Albatross Isle..... | 40 | 22 | 144 | 39 |
| Cape Grim ..... | 40 | 40 | 144 | 42 |
| West Point..... | 40 | 57 | 144 | 35 |
| **Macquarrie** Harbour, Entr. Isle | 42 | 11·6 | 145 | 14 |
| Point Hibbs ..... | 42 | 39 | 145 | 17 |
| Rocky Point ..... | 43 | 1 | 145 | 30 |
| **Port Davey**, Pyramid Rock, Entr. | 43 | 21 | 145 | 56 |
| Maatsuyker Is., S.W. Needle Rk. | 43 | 41 | 146 | 11 |
| Bruni Isle, Tasman's Head..... | 43 | 32 | 147 | 21 |
| „ S.W. Pt., C. Bruni . | 43 | 28·7 | 147 | 8 |
| **N. Zealand**, Auckland, Depôt Pt. | 36° | 50″5′ | 174° | 49′10″ |
| Kawau I. Bon Accord, Momona Jy. | 36 | 26·0 | 174 | 50·25 |
| Great Barrier Isle, Needles Point | 36 | 1·25 | 175 | 26·5 |
| Wangari Harbour, Lort Point .. | 35 | 51·15 | 174 | 32·17 |
| Tutukaka Harbour, North Head | 35 | 37·9 | 174 | 34·3 |
| Wangararu Harbour, Grove Pt.. | 35 | 23·8 | 174 | 22·3 |
| Bay of Islands, Motu Mea Isle.. | 35 | 17·0 | 174 | 7·03 |
| Wangaroa Harbour, Peach Isle.. | 35 | 1·7 | 173 | 46·7 |
| Manganui, White's Point ..... | 35 | 0·3 | 173 | 33·6 |
| Cape Karakara, extremity ..... | 34 | 47·3 | 173 | 25·3 |
| Parenga-renga Harbour, Coal Pt. | 34 | 31·0 | 173 | 1·8 |
| North Cape (Cape Otou), Islet.. | 34 | 25·1 | 173 | 4·5 |
| Cape Maria Von Diemen, Islet.. | 34 | 28·3 | 172 | 38·7 |
| Herekino, South Point..... | 35 | 18·2 | 173 | 11·1 |
| Hokianga River, Flag-staff..... | 35 | 32·1 | 173 | 22·9 |
| Kaipara Harbour, N. Entr. Head | 36 | 24·3 | 174 | 7·0 |
| Manukau Harbour, Flag-staff .. | 37 | 3·0 | 174 | 32·2 |
| Waikato River, Maratai Village. | 37 | 24·3 | 174 | 47·3 |
| Whangaroa Harb., S. Entr. Point | 37 | 40·4 | 174 | 53·2 |
| Ka Whia Harbour, South Head . | 38 | 4·8 | 174 | 49·0 |
| Albatross Point, North extremity | 38 | 6·2 | 174 | 43·5 |
| **New Plymouth**, Flag-staff .... | 39 | 3·6 | 174 | 4·9 |
| Mount Egmont, 8,270 feet .... | 39 | 18·0 | 174 | 4·9 |
| Manawatu River, N. Entr. Point | 40 | 27·2 | 175 | 14·7 |
| Farewell Spit, Bush End, extr. . | 40 | 33·3 | 173 | 2·0 |
| Cape Farewell, extremity..... | 40 | 20·8 | 172 | 42·2 |
| Cape Foulwind, 3 steeples, N. one | 41 | 43·3 | 171 | 35·3 |
| Bold Head, extremity..... | 42 | 57·0 | 170 | 42·3 |
| Mount Cook, 13,200 feet..... | 43 | 36·5 | 170 | 12·2 |
| George Sd., Anchor. Cove, N. side | 44 | 55·3 | 167 | 26·8 |
| Thompson Sound, Deas Cove, Head | 45 | 11·7 | 166 | 58·2 |
| Breaksea Isle, N.E. Point ..... | 45 | 34·7 | 166 | 38·7 |
| Milford Sound, Freshwater Basin | 44 | 35·0 | 167 | 47·2 |
| Five-fingers' Pt., W. of Dusky Bay | 45 | 44·3 | 166 | 27·7 |
| West Cape, extremity ..... | 45 | 54·3 | 166 | 26·5 |
| Chalky Inlet, N. Port, Little I.. | 45 | 59·0 | 166 | 34·7 |
| Stewart Isle, Black Rock Point . | 46 | 41·5 | 167 | 53·7 |
| „ S.W. Cape ..... | 47 | 17·0 | 167 | 30·3 |
| Pt. Pegasus, Cove abrst. Anchor. I. | 47 | 11·7 | 167 | 41·8 |
| Paterson's Inlet, Glory Cove ... | 46 | 58·5 | 168 | 10·8 |
| Snares, S.W. Isle ..... | 48 | 6·7 | 166 | 28·3 |

| XVI. SOUTH PACIFIC—*cont.* | Lat. S. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Pt. Adventure, White Beach, S.end | 47 | 3·9 | 168 | 11·9 |
| Nuggett Pt., extremity of Rocks. | 46 | 27·5 | 169 | 51·5 |
| Taeri Isle, East Point..... | 46 | 3·7 | 170 | 14·3 |
| **Otago**, Tairoa Head..... | 45 | 46·9 | 170 | 44·9 |
| Koputai Bay, South Point ... . | 45 | 49·3 | 170 | 39·2 |
| Waitangi River, Entr. N. Head . | 44 | 55·0 | 171 | 12·1 |
| Timaru, Flag-staff, Landing-pl.. | 44 | 23·0 | 171 | 17·3 |
| Akaroa Harbour, Obs. Head.... | 43 | 49·6 | 172 | 58·3 |
| **Lyttleton**, Custom House..... | 43 | 36·7 | 172 | 44·28 |
| Kaikora Peninsula, East Point .. | 42 | 26·5 | 173 | 48·8 |
| Cape Campbell, extremity..... | 41 | 43·3 | 174 | 18·5 |
| Cape Jackson ..... | 40 | 59·8 | 174 | 20·0 |
| Pelorus Sound, Ohingaroa Bay . | 41 | 14·4 | 173 | 51·6 |
| D'Urville Isle, Port Hardy..... | 40 | 46·6 | 173 | 55·0 |
| Current Basin, Cross Point .... | 40 | 56·3 | 173 | 52·3 |
| **Nelson**, Magazine on Boulder Bk. | 41 | 15·6 | 173 | 17·0 |
| Astrolabe Road, Adele I., N.E. Pt. | 40 | 58·9 | 173 | 5·25 |
| Massiere Bay, Tasman Corner .. | 40 | 31·8 | 172 | 45·2 |
| Porirua Harb., Mana I., N.W. Pt. | 41 | 5 | 174 | 48 |
| **Wellington**, Head, 2,190 feet . | 41 | 11·3 | 174 | 23·0 |
| Cape Palliser ('Kawa Kawa) ... | 41 | 37·8 | 175 | 17·0 |
| Flat Point ..... | 41 | 10·8 | 176 | 1·5 |
| Cape Turnagain (Teporo), E. extr. | 40 | 22·0 | 176 | 45·3 |
| Cape Kidnappers (Matauamaui). | 39 | 38·0 | 177 | 7·7 |
| Ahuriri Harbour, Maori Pah ... | 39 | 28·7 | 176 | 55·2 |
| Portland Isle (Tehoura), S. extr. | 39 | 17·7 | 177 | 53·1 |
| Poverty (Turanga) Bay, S. Point | 38 | 45·0 | 177 | 59·4 |
| Tolago Bay, Motu-Heka Isle ... | 38 | 20·8 | 178 | 21·2 |
| East Cape (Wai-Apu) Islet .... | 37 | 40·0 | 178 | 36·1 |
| Cape Runaway (Tewaka) ..... | 37 | 30·7 | 178 | 0·5 |
| Tauranga, Mount Monganui ... | 37 | 36·4 | 176 | 11·2 |
| Cape Colville, North Point .... | 36 | 28·3 | 175 | 22·0 |
| **Auckland** Isles, South Cape ... | 50 | 51 | 166 | 7 |
| ,, West extreme ..... | 50 | 50 | 165 | 55 |
| Campbell Isle, E. side, S. Harb.. | 52 | 34·4 | 169 | 12·75 |
| Macquarrie Isle, North Point... | 54 | 19 | 158 | 56 |
| Bounty Isle..... | 47 | 44 | 179 | 7 |
| Antipodes Isle ..... | 47 | 32 | 179 | 42 |
| Chatham Isle, Port Waitengi ... | 43 | 57 | 176 | 44w |
| Kermadec Isle, Sunday Isle .... | 29 | 15 | 177 | 56w |
| Norfolk Island, Sydney B., Fl.-st. | 29 | 3·7 | 167 | 57·25 |
| Lord Howe Island ..... | 31 | 37 | 159 | 14 |
| Middleton Reef..... | 29 | 28 | 159 | 4 |
| **Feejees**, Vanua Levou, E. Point | 16 | 8 | 179 | 55 |
| Ovalau, Levuka, Mission. School | 17 | 40·7 | 178 | 49·0 |
| Viti Levou, Rewa Rds., Nukulau I. | 18 | 10 | 178 | 31·0 |
| **New Caledonia**, East Point ... | 22 | 16 | 166 | 55 |
| West extremity, Point Tonnerre. | 20 | 24 | 164 | 0 |
| Balade Harbour, Isle ..... | 20 | 17·2 | 164 | 25·0 |
| Britannia Isle (Mare), E. Point | 21 | 26 | 168 | 10 |
| Chabrol Isle (Lifu), East Point . | 21 | 5 | 167 | 26 |
| **New Hebrides**, Tanna Isle, Port Resolution, Cook's Pyramid. | 19 | 30·9 | 169 | 28·7 |
| Erromango Isle, Traitor's Head . | 18 | 46 | 169 | 15 |
| Sandwich Isle (Vati), S.E. Point | 17 | 52 | 168 | 35 |
| Mullicollo, Port Sandwich ..... | 16 | 25 | 167 | 46 |
| St. Bartholomew, Islet, S.E. Pt. | 15 | 44 | 167 | 20 |
| Espiritu Santo, S.W. Pt., Cape Lisburne..... | 15 | 40 | 166 | 44 |
| ,, N. Point, C. Cumberland | 14 | 43 | 166 | 40 |
| Banks Isle East, or Sugarloaf... | 13 | 53 | 168 | 45 |
| La Perouse (Varikoro), Summit. | 11 | 37 | 166 | 49 |
| Sta. Cruz Isle (Ndendi), E. Point | 10 | 41 | 166 | 10 |
| **Salomons** Isle, Rennel I., S.E. Pt. | 11 | 38 | 160 | 41 |
| San Christoval (Arossi), E. Point | 10 | 51 | 162 | 24 |
| Malayta, N.W. Point..... | 8 | 22 | 160 | 37 |
| Gundalcanar, East Point ..... | 9 | 50 | 160 | 54 |
| Yebel, South Point, Cape Prieto. | 8 | 34 | 159 | 54 |
| Choiseul, E. Point, Cape Labbee. | 7 | 29 | 157 | 55 |
| ,, N.W. Point, C. Alexander | 6 | 42 | 156 | 32 |
| Bougainville, North Point ..... | 5 | 30 | 155 | 7 |
| **New Ireland**, Port Carteret, Cocos Isle, N.E. Point ..... | 4 | 42 | 152 | 44·5 |
| ,, Port Praslin, S.E. Corner. | 4 | 49·8 | 152 | 54·7 |

| SOUTH PACIFIC. | Lat. S. | | Long. E. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| North Britain, South Cape, Islet | 6 | 30 | 149 | 48 |
| Rossel Isle, N.E. Point..... | 11 | 22 | 154 | 26 |
| Admiralty Isle, N'most Islet ... | 1 | 54 | 146 | 49 |
| **New Guinea**, Riche Isle, N. Pt. | 8 | 2 | 147 | 55 |
| C. K. William, high land to w'ward | 6 | 11 | 147 | 43 |
| Dampier Isle..... | 4 | 40 | 145 | 56 |
| D'Urville I., Peak near W. end . | 3 | 19·8 | 143 | 29·3 |
| Cape Ambarnoh (Pt. D'Urville). | 1 | 26 | 137 | 45 |
| Mysory Isle, East Point ..... | 1 | 4 | 136 | 11 |
| Jobie Isle, East Point... ..... | 1 | 48 | 136 | 48 |
| Port Dorei, East Pt., near Head. | 0 | 51·5 | 133 | 58·1 |
| Mispalu Isles, S.E. Point ..... | 0 | 19 | 132 | 7·1 |
| Waigeoe, S.E. Point..... | 0 | 21 | 131 | 16·1 |
| Boni Isle, North Point..... | 0 | 1·4 | 131 | 3 |
| Pigeon Isle ..... | 0 | 39·4 | 130 | 32·25 |
| Amsterdam and Middleburgh, S.E. extremity ..... | 0 | 19·9 | 132 | 7·1 |
| M'Cluer's Inlet, East Head .... | 2 | 26 | 133 | 58 |
| Triton Bay, Fort Dubus ..... | 3 | 47 | 134 | 2 |
| C. Valsche, W. Pt. of Fred. Hen. I. | 8 | 22 | 137 | 38 |
| Cape Possession ..... | 8 | 32·2 | 146 | 25 |
| Cape Rodney, Point ..... | 10 | 10 | 148 | 28 |
| Great Kei Isle, North Point.... | 5 | 15 | 133 | 6 |
| Aroe Isle, Dobbo Harbour, Point | 5 | 45·4 | 134 | 17 |
| Timor Laut, W. Limit, Woody I. | 8 | 21 | 130 | 40 |
| Ceram, Wahaay Harbour Fort.. | 2 | 45·2 | 129 | 28 |
| Boeroe, Cajeli Bay, Fort Defence | 3 | 22·3 | 127 | 14·25 |
| **Amboyna**, City, Fort Victoria . | 3 | 41·5 | 128 | 8·1 |
| Xullo Talyabo, Haycock Isle ... | 1 | 47 | 124 | 22 |
| Obi Major, S.E. Point ..... | 1 | 27 | 127 | 54 |
| Mysol, West Point ..... | 1 | 57 | 129 | 39 |
| Batjan, Fort Barneveldt..... | 0 | 37 | 127 | 34 |
| Celebes, Peling Isle, S.E. Point . | 1 | 50 | 123 | 13 |
| Boeton Isle, Bolio Town, Fort.. | 5 | 28 | 122 | 33 |
| **Macassar**, Fort, N. Bastion ... | 5 | 7·9 | 119 | 21·1 |
| Timor, Koepang, Fort Concordia | 10 | 9·6 | 123 | 33·8 |
| Dilly, Town, Flag-staff ..... | 8 | 33 | 125 | 32·1 |
| Flores, Head, Iron Cape..... | 8 | 1 | 122 | 48 |
| Wetter, Dog Isle, N.W. Point .. | 7 | 41 | 125 | 54 |
| Lomblem, East Point..... | 8 | 14 | 123 | 33 |
| Pantar, N.E. Point ..... | 8 | 10 | 124 | 18 |
| Ombay, Islet off S.W. Point.... | 8 | 30 | 124 | 15 |
| Sumba, or Sandalwood, W. Pt.. | 9 | 42 | 118 | 58 |
| Sumbawa, S.W. Point ..... | 9. | 2 | 116 | 43 |
| Lomboc, Pk. N.E. part, 11,400 ft. | 8 | 26 | 116 | 23 |
| Bali, Peak on E. part, 11,319 ft. | 8 | 21 | 115 | 25 |
| Madura, N.W. or Klampis Point | 6 | 54 | 112 | 43 |
| Sourabaya, Kalemaas Fort, Fl.-st. | 7 | 14·5 | 112 | 42·7 |
| Samarang, Flag-staff ..... | 6 | 57·3 | 110 | 25 |
| **Batavia**, Observatory, S.M. .... | 6 | 7·7 | 106 | 48·6 |
| Bantam, Flag-staff..... | 6 | 1·7 | 106 | 8·7 |
| Anjer (Light * S.W'ward), Fl.-st. | 6 | 3·2 | 105 | 55 |
| Java Head ..... | 6 | 47 | 105 | 11 |
| Krakatoa Peak ..... | 6 | 9 | 105 | 27 |
| Bencoolen, Fort Marlborough .. | 3 | 47·3 | 102 | 17 |
| N. Pageh I., vis. 15 leag. N. Pt. | 2 | 32 | 100 | 4 |
| Banca, South extrem. (Rock off) | 3 | 8 | 106 | 29 |
| Billiton, South Point ..... | 3 | 15 | 107 | 29 |
| Borneo, South extr. C. Salatan . | 4 | 10 | 114 | 40 |
| Kumpal, S.W. Point * ..... | 2 | 44·2 | 110 | 7 |
| Keeling Isle ..... | 11 | 50 | 96 | 51 |
| | Lat. S. | | Long. W. | |
| **Friendly Is.**, Lafouka, Miss. Stat. | 19 | 48·2 | 174 | 20 |
| Tongatabou, N. side, Niukalofa. | 21 | 8·0 | 175 | 14·7 |
| Vavao, West Point..... | 18 | 39·0 | 174 | 1·0 |
| Navigators, Upolu, Apiahad ... | 13 | 48·9 | 171 | 41·2 |
| Cook's Is., Rarotonga, N.W. Pt.. | 21 | 11·6 | 159 | 47 |
| Bass Islands, or Four Crowns... | 27 | 40 | 143 | 30 |
| **Society Is., Tahiti**, Pt. Venus, Flag-staff..... | 17 | 29·2 | 149 | 29·0 |
| ,, Papeete Harbour, Flag-staff | 17 | 32·1 | 149 | 34·0 |
| Bora Isle, Oteavamea, House... | 16 | 31·6 | 151 | 46·0 |
| Marquesas, Nukahiva, St. Anne B. | 8 | 55·3 | 140 | 6·0 |
| Gambier's, Manga, Mount Duff. | 23 | 8·0 | 134 | 55·0 |

| XVII. N. AMERICA. | Lat. N. | | Long. W. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Newfoundland**, St. John's, S. Head, Fort Townshend | 47 | 33·6 | 52 | 43·0 |
| Cape Spear * | 47 | 30 | 52 | 39 |
| Cape Race | 46 | 40 | 53 | 7 |
| Cape Pine * | 46 | 37 | 53 | 36 |
| Cape St. Mary | 46 | 50 | 54 | 15 |
| St. Pierre Isle, S.E. Point * | 46 | 45 | 56 | 12 |
| S.W. extremity Cape Ray | 47 | 37 | 59 | 18 |
| St. Paul Isle, North Point * | 47 | 14·0 | 60 | 9·0 |
| Magdalen Isles, Bird Isles, E. one | 47 | 51·0 | 61 | 9·75 |
| „ Bryon or Cross I., E. Pt. | 47 | 48·0 | 61 | 25·25 |
| „ East Isle, E. extremity | 47 | 37·7 | 61 | 24·5 |
| Mingan Isle, Clearwater Point, S.W. extremity | 50 | 12·6 | 63 | 27·7 |
| River St. John (Labrador), Entr. East Point | 50 | 17·2 | 64 | 21·0 |
| Seven Isles Bay, Store | 50 | 13·1 | 66 | 24·75 |
| Point Monts, South Light * | 49 | 19·7 | 67 | 22 |
| **Quebec**, N.E. Bastion | 46 | 49·1 | 71 | 13·75 |
| Wolfe and Montcalm's Monument | 46 | 48·6 | 71 | 13·5 |
| Green Isle * | 48 | 3·4 | 69 | 26·0 |
| Cape Chatte, extremity | 49 | 6·0 | 66 | 46·0 |
| Cape Magdalen (River E-d) | 49 | 15·6 | 65 | 22·0 |
| Cape Gaspé, Flower-pot, Rock off | 48 | 45·2 | 64 | 10 |
| Anticosti Isle, E. or Heath Point * | 49 | 5·4 | 61 | 45·2 |
| S.W. Point * | 49 | 23·8 | 63 | 36·0 |
| Ellis Bay, W. Entrance | 49 | 47·8 | 64 | 23·5 |
| Bonaventura Isle | 48 | 29 | 64 | 10 |
| Chaleur Bay, Carlisle | 48 | 1 | 65 | 16 |
| „ Dalhousie Isle | 48 | 4·4 | 66 | 22·25 |
| Miscou Isle, N.E. Point, Pt. Birch | 48 | 1 | 64 | 31 |
| Port Escumenac * | 47 | 5 | 64 | 46 |
| **Prince Edward Isle**,, N. Cape | 47 | 4 | 64 | 1 |
| Richmond Bay, Royalty Point | 46 | 34·0 | 63 | 43·0 |
| „ East Point | 46 | 27 | 61 | 58 |
| Charlotte, Fort George, Flag-staff | 46 | 14·0 | 63 | 7·0 |
| **Cape Breton**, Cape North | 47 | 3 | 60 | 25 |
| Sydney Harbour, East side,* Entr. | 46 | 16 | 60 | 8 |
| Scatary Isle, N.E. Point * | 46 | 2 | 59 | 41 |
| Pictou Harbour ** | 45 | 41·5 | 62 | 40·25 |
| Gut of Canso, N.W. Entr. * | 45 | 41·8 | 61 | 29·5 |
| Cranberry Isle * (Bass Rk., 2 m. E.) | 45 | 20·0 | 60 | 56·0 |
| **Halifax**, Dockyard, Tablet, S.M. | 44 | 39·7 | 63 | 35′ 30″ |
| Sambro Isle * | 43 | 26·3 | 63 | 33 |
| Malaguash Harbour, Cross Isle ** | 44 | 20 | 64 | 7 |
| Coffin Isle * | 44 | 3 | 64 | 36 |
| Shelburne, M'Nutt's I., S.E. Pt.** | 43 | 37·5 | 65 | 16 |
| C. Sable, S.E. Pt. of Islet (advanc.) | 43 | 24 | 65 | 36 |
| Cape Fourchu * | 43 | 47 | 66 | 10 |
| Bryer's Isle * | 44 | 16 | 66 | 22 |
| Annapolis, Pt. Prim, S. side Entr.* | 44 | 41 | 65 | 45 |
| Black Rock, Point * | 45 | 10·8 | 64 | 48 |
| Cape Enrage * | 45 | 36 | 64 | 29 |
| Quaco * | 45 | 23 | 65 | 20 |
| **St. John's**, Partridge Isle | 45 | 14·1 | 66 | 3·5 |
| Cape Lepreau ** | 45 | 3·7 | 66 | 27 |
| St. Andrew's, South Point * | 45 | 4·3 | 67 | 3 |
| Passamaquoddy B., Campo,* N.Pt. | 44 | 57 | 66 | 55 |
| Quoddy Head * | 44 | 48 | 66 | 57 |
| Grand Manan, N.E. Point | 44 | 46 | 66 | 43 |
| Gannet Rock * | 44 | 30 | 66 | 46 |
| Machias Seal Isle ** | 44 | 29 | 67 | 5 |
| Petit Manan, South Point * | 44 | 22 | 67 | 52 |
| Baker's Isle * | 44 | 13·5 | 68 | 8 |
| Castine * | 44 | 17 | 68 | 45 |
| Owl's Head Bay,* N.E. Point | 44 | 4 | 68 | 45 |
| Mount Desert Rock,* Bell | 43 | 58 | 68 | 8 |
| I. Haute (Saddleback to Eastward) | 43 | 59 | 68 | 36 |
| Matinicus Isle, South Rock ** | 43 | 46·5 | 68 | 49 |
| White Head * | 43 | 57 | 68 | 4 |
| Manhegan Isle * | 43 | 44 | 69 | 18 |
| Penmaquid Point * | 43 | 48 | 69 | 29 |
| Townshend Harbour * | 43 | 48 | 69 | 36 |
| Seguin Isle,* Bell | 43 | 41·6 | 69 | 44 |

| N. AMERICA. | Lat. N. | | Long. W. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Portland**, City Hall | 43 | 39·2 | 70 | 15·2 |
| „ West Entrance | 43 | 39 | 70 | 17 |
| Cape Elizabeth ** | 43 | 33·6 | 70 | 11·5 |
| Saco Harbour, Wood Isle * | 43 | 27 | 70 | 19 |
| C. Porpoise, Goat I.* S.W. Point | 43 | 21 | 70 | 25 |
| Bald Head | 43 | 13 | 70 | 34·5 |
| Boon Isle * | 43 | 8 | 70 | 29 |
| Whale's Back * | 43 | 3 | 70 | 41 |
| **Portsmouth**, Fort Constitution | 43 | 3·5 | 70 | 43 |
| Isle of Shoals, South Isle * | 42 | 58 | 70 | 37 |
| Newbury Port ** | 42 | 48·5 | 70 | 49·0 |
| Ipswich Bay ** | 42 | 41 | 70 | 47 |
| Annis Squam. Harbour * | 42 | 39·8 | 70 | 41 |
| Cape Ann, on Thatcher Isle ** | 42 | 37 | 70 | 40 |
| Cape Ann Harb., Ten-pound I.* | 42 | 37 | 70 | 40 |
| Salem, City Hall | 42 | 31·5 | 70 | 54·0 |
| Baker's Isle ** | 42 | 32·2 | 70 | 47·5 |
| Marble Head * | 49 | 30·0 | 70 | 51 |
| **Boston**, State House | 42 | 21·4 | 71 | 4·25 |
| „ Harb.,N.side,Main Outer Entr. | 42 | 19·7 | 70 | 53·75 |
| Scituate * | 42 | 12·3 | 70 | 43·25 |
| Plymouth, Gurnet ** | 42 | 0·2 | 70 | 36·25 |
| Barnstable * | 41 | 43·2 | 70 | 16·5 |
| Billingsgate Isle * | 41 | 51·6 | 70 | 4·5 |
| Race Point * | 42 | 3·7 | 70 | 15·0 |
| Cape Cod, Higher Truro * | 42 | 2·4 | 70 | 4·0 |
| Long Point, Cape Cod Harbour * | 42 | 2·1 | 70 | 10·5 |
| Nausset *** | 41 | 51·6 | 69 | 57·25 |
| **Chatham** Harbour ** | 41 | 40·3 | 69 | 57·25 |
| Monomy Point * | 41 | 33·6 | 70 | 0·0 |
| Point Gammon * | 41 | 36·6 | 70 | 16·25 |
| Nantucket Isle, Sandy Point * | 41 | 23 | 70 | 3 |
| „ Brant Point, Town * | 41 | 17·5 | 70 | 5·25 |
| Martha's Vineyard, N.E. Point * | 41 | 25·2 | 70 | 27·5 |
| „ Holmes Harbour, West Chop* | 41 | 28·8 | 70 | 36·25 |
| „ West Point, Gay Head * | 41 | 20·9 | 70 | 50·5 |
| „ Cuttchank,* S.W. Point | 41 | 25 | 70 | 57 |
| Seaconnet Point | 41 | 26·5 | 71 | 13·5 |
| Bristol Episcopal Chapel | 41 | 40 | 71 | 17·2 |
| Providence, College | 41 | 49·6 | 71 | 24·7 |
| **Newport**, Court House | 41 | 29·5 | 71 | 19·2 |
| Beaver-tail Point, or Rhode Isle * | 41 | 26 | 71 | 24·5 |
| Port Judith * | 41 | 23 | 71 | 30 |
| Stonington, Town, South Point * | 41 | 19 | 71 | 54·5 |
| New London,* West Entrance | 41 | 18·9 | 72 | 5·7 |
| Goose Island * | 41 | 13 | 72 | 42 |
| New Haven, Five-mile Point * | 41 | 14·5 | 72 | 54·5 |
| Norwalk Isle * | 41 | 2·8 | 73 | 25·5 |
| Block Isle, North Point *** | 41 | 13·4 | 71 | 35 |
| Long Isle, East or Montauk Point * | 41 | 4·2 | 71 | 52·0 |
| **New York**, City Hall | 40 | 42·7 | 74 | 0·75 |
| Fort Tomkins * | 40 | 36 | 74 | 3·5 |
| Prince's Bay | 40 | 30·4 | 74 | 13·25 |
| Sandy Hook *** | 40 | 27·6 | 74 | 0·7 |
| Nevisink ** | 40 | 23·7 | 73 | 59·5 |
| Barnegat Inlet * | 39 | 45·9 | 74 | 7·0 |
| Little Egg Harb., Tacker's I., N.Pt. | 39 | 30·8 | 74 | 17·5 |
| Cape May * | 38 | 55·8 | 74 | 58·5 |
| Brandy-wine Shoal ** | 38 | 59 | 75 | 8 |
| Egg Island * | 39 | 10·4 | 75 | 9 |
| Cohanzey Creek * | 39 | 25 | 75 | 17 |
| **Philadelphia**, State House | 39 | 57 | 75 | 9·5 |
| Reed Isle,* Bell | 39 | 30 | 75 | 35 |
| Bombay Hook * | 39 | 21·7 | 75 | 31 |
| Salem, City, Church | 39 | 34·5 | 75 | 36·0 |
| Mahon's Ditch * | 39 | 10 | 75 | 25 |
| Cape Henlopen * | 38 | 46·6 | 75 | 6·0 |
| „ Beacon,* Small | 38 | 47·4 | 75 | 5·5 |
| „ Beacon,* W. end Breakwater | 38 | 47·5 | 75 | 6·7 |
| Assenteague Isle, South end * | 37 | 59 | 75 | 25 |
| Smith's Isle, East Point * | 37 | 13 | 75 | 52 |
| Sand Spit * | 37 | 45 | 76 | 4 |
| Cape Charles | 37 | 3 | 76 | 2 |
| **Baltimore**, Battle Monument | 39 | 17·4 | 76 | 37·5 |

| XVIII. N. AMERICA—*cont.* | Lat. N. | | Long. W. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Washington**, Capitol | 30 | 53·4 | 77 | 2·0 |
| Point Look-out * | 38 | 1 | 76 | 27 |
| New Point Comfort * | 37 | 18 | 76 | 21 |
| Back-river Point * | 37 | 5 | 76 | 21 |
| Cape Henry * | 36 | 56 | 76 | 4 |
| Pimlico Sound, New Inlet | 35 | 37 | 75 | 27 |
| Cape Hatteras * | 35 | 15 | 75 | 30 |
| Ocracock Inlet, North side * | 35 | 6·5 | 75 | 58 |
| Cape Look-out * | 34 | 36 | 76 | 36 |
| New Inlet, Federal Point * | 33 | 56 | 77 | 55 |
| Cape Fear | 33 | 48 | 77 | 57 |
| Bald-head Isle * | 33 | 51 | 78 | 0 |
| North Isle, South Point * | 33 | 13 | 79 | 10 |
| George Town | 33 | 22 | 79 | 18 |
| Cape Roman * | 31 | 1 | 79 | 24 |
| **Charleston**, Fort Pinckney | 32 | 46·4 | 79 | 55 |
| Charleston Light * | 32 | 42·2 | 79 | 52·7 |
| Beaufort Arsenal | 32 | 26 | 80 | 41 |
| Port Royal, Entrance * | 32 | 7 | 80 | 34 |
| **Savannah**, South Entrance * | 32 | 0 | 80 | 52 |
| ,, Town, Exchange | 32 | 4·9 | 81 | 7 |
| Doboy Sound * | 31 | 27 | 81 | 24 |
| Danen, Town | 31 | 25 | 81 | 33 |
| St. Simon's Isle, on South Point * | 31 | 8 | 81 | 36 |
| Cumberland Isle, North Point * | 30 | 56 | 81 | 34 |
| Amelia Isle, North Point * | 30 | 42 | 81 | 36 |
| St. John's River, South Entrance * | 30 | 20 | 81 | 33 |
| St. Augustine Harbour, Fort * | 29 | 54 | 81 | 26 |
| Anastasia Isle, North Point * | 29 | 52 | 81 | 25 |
| Cape Canaveral * | 28 | 28 | 80 | 33 |
| C. Florida,* S. Pt. of Biscayno B. | 25 | 41 | 80 | 10 |
| Carysfort Reef * | 25 | 13 | 80 | 11 |
| Sand Cay * | 24 | 27 | 81 | 52 |
| **Cay West**, West Point * | 24 | 32 | 84 | 48·5 |
| ,, Floating Light * | 24 | 38 | 81 | 53 |
| Tortugas, West Point, Bush Cay. | 24 | 37·4 | 82 | 52·5 |
| Cape Sable, Fort | 25 | 6 | 81 | 9 |
| Cape Romano | 25 | 51 | 81 | 56 |
| Tampa Bay, Egmont Cay,* at Entrance North Point | 27 | 36·1 | 82 | 45·25 |
| Dog Island * | 29 | 46·3 | 84 | 38·2 |
| St. George Isle * | 29 | 37·4 | 85 | 5·25 |
| Pensacola Bay, Entrance * | 30 | 20·8 | 87 | 17 |
| ,, Naval Yard, Store | 30 | 20·5 | 87 | 15·25 |
| **Mobile**, East Entrance * | 30 | 13·6 | 88 | 0·75 |
| ,, Sand Isle * | 30 | 11 | 88 | 2 |
| ,, Chocktaw Pt.,* S. of City | 30 | 40 | 88 | 2 |
| Ship Isle, West Point * | 30 | 12·6 | 88 | 57·2 |
| Cat Isle, West Point * | 30 | 13·7 | 89 | 5 |
| Pass Christian,* on Main | 30 | 18 | 89 | 10 |
| Chandeleur Isle,* North Point | 30 | 3 | 88 | 50 |
| Mississippi R., N.E. Pass, Frank's I. | 29 | 8·5 | 89 | 1·5 |
| ,, South Passage | 29 | 0 | 89 | 8 |
| ,, S.W. Passage | 28 | 58·5 | 89 | 20 |
| **New Orleans**, City Hall | 29 | 57·7 | 90 | 6·75 |
| Timbalier Isle * | 29 | 4 | 90 | 17 |
| Point au Fer * | 29 | 19·5 | 91 | 20 |
| Belle Isle (Vermilion B.),* W. end | 29 | 32 | 92 | 0 |
| Bolivar Point * | 29 | 22 | 94 | 49 |
| Aransas Pass * | 27 | 50 | 97 | 2 |
| Rio Grande del Norte | 25 | 56 | 97 | 12 |
| Tampico, North Point | 22 | 15·5 | 97 | 46 |
| **Vera Cruz**, San Juan de Ulloa * | 19 | 11·9 | 96 | 8·0 |
| Sacrificios Isle * | 19 | 10·2 | 96 | 5·5 |
| Isle Carmen, West end, Port Laguna, Entrance of Terminos Lagoon, Brit. Cons. | 18 | 38·4 | 91 | 50·7 |
| Lerma, Church in Square | 19 | 48·4 | 90 | 36·75 |
| Campeachy | 19 | 50 | 90 | 33 |
| Sisal, Fort | 21 | 10·1 | 90 | 2·75 |
| Silam, Town | 21 | 23·7 | 88 | 54·5 |
| Cape Catoche | 21 | 36 | 87 | 6 |
| Arenas Isle, Sandy Isle, N. Point | 22 | 8 | 91 | 23 |
| Alacranes, North Point | 22 | 35 | 89 | 49 |

| N. AMERICA. | Lat. N. | | Long. W. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Alacranes, Port, Perez Isle, Huts. | 22 | 23·6 | 89 | 42 |
| Mageras Isle, Stone Turret | 21 | 12·7 | 86 | 40·5 |
| Ambergris Isle, East Point | 18 | 6 | 87 | 50 |
| Light-house Reef,* S.E. Pt. Half-moon Cay | 17 | 12 | 87 | 33 |
| Turneffe Rfs.,*** N. Pt. Maugor Cay | 17 | 36 | 87 | 46 |
| **Belize**, Fort St. George | 17 | 29·3 | 88 | 12 |
| Truxillo, Fort | 15 | 55·7 | 85 | 59·5 |
| Utila Isle, N.E. Peak | 16 | 7·5 | 86 | 52·7 |
| Port Royal, George Cay, N.W. Pt. | 16 | 24·3 | 86 | 19·2 |
| Caratasa Lagoon, East Point | 15 | 23·7 | 83 | 43 |
| St. Andrew's Isle, S.W. Cove | 12 | 31·7 | 81 | 44 |
| Blewfields | 11 | 59·3 | 83 | 41·5 |
| Great Corn Isle, S.W. Point | 12 | 9·2 | 82 | 59·7 |
| San Juan de Macaragua | 10 | 55 | 83 | 43 |
| **Jamaica**, E. Point or Pt. Morant | 17 | 55·7 | 76 | 11 |
| Port Antonio, Fort | 18 | 11·3 | 76 | 27 |
| St. Ann's Bay, Long Wharf | 18 | 26·4 | 77 | 13 |
| Falmouth Harbour, Fort | 18 | 30·6 | 77 | 40 |
| Montego Bay, Fort | 18 | 29·4 | 77 | 56 |
| North Negril, North Point | 18 | 23 | 78 | 22 |
| Old Harbour, Careening Isle | 17 | 53·5 | 77 | 6 |
| Port Royal, Fort Charles | 17 | 56 | 76 | 51 |
| Pedro Bank, N.W. edge | 17 | 36 | 78 | 52 |
| Great Cayman Isle, Fort George | 19 | 17·7 | 81 | 23·5 |
| **St. Domingo**, City, Consulate | 18 | 28·2 | 69 | 52 |
| Port au Prince, Fort Isle | 18 | 33·7 | 72 | 21 |
| Gonaive Isle, West Point | 16 | 55·4 | 73 | 18·25 |
| Gonaives, Port Verreur | 19 | 25·7 | 72 | 42·5 |
| St. Nicholas' Mole, Ft. St. George | 19 | 49·5 | 73 | 22·2 |
| C. Haytien Harb., Turret d'Estaing | 19 | 46·7 | 72 | 11·75 |
| Samaná, Town, Fort | 19 | 12·5 | 69 | 19·25 |
| Banistre Cays, N.E. one | 19 | 10·4 | 69 | 15·75 |
| **Cuba**, Santiago,* Morro | 19 | 53·9 | 75 | 55·5 |
| Cape de Cruz | 19 | 50·4 | 77 | 45 |
| Jagua Bay * | 22 | 1 | 80 | 30 |
| Isle de Pinos, S.W. Point | 21 | 24 | 83 | 7 |
| West extremity Cape St. Antonio. | 21 | 51·5 | 84 | 57·2 |
| **Havannah**,* Morro, S.M. | 23 | 9·4 | 82° | 21′57″ |
| Piedras Cay (Light destroyed) | 23 | 14·7 | 81 | 8·0 |
| Port Icacos * (Light to S.Eastward) | 23 | 11 | 81 | 9 |
| Pan de Matanzas, 1,277 feet | 23 | 1·9 | 81 | 45 |
| Cay Sal, North Point | 23 | 41·7 | 80 | 25·0 |
| Cay Sal, Elbow Cay * | 23 | 56·5 | 80 | 26·5 |
| Port Maternillas * | 21 | 40 | 77 | 8 |
| Barracoa, Fort | 20 | 21·6 | 74 | 29 |
| East Point, Cape Maysi | 20 | 15 | 74 | 7 |
| Cayo Romano, N.W. Point | 22 | 27 | 78 | 19 |
| **Bahamas**, Turk's Isle, N. extr. | 21 | 23 | 71 | 6 |
| ,, Hawk's Nest | 21 | 26·3 | 71 | 10·5 |
| Great Inagua, N.E. Point | 21 | 21 | 73 | 1 |
| Caicos Bank, East Harbour | 21 | 31 | 71 | 32 |
| Hogsty Reef, N.W. Cay | 21 | 40·5 | 73 | 50·7 |
| Mariguana Isle, Centre Hill | 22 | 23 | 72 | 55 |
| Samana, or Attwood's Cay, W. Pt. | 23 | 5·5 | 73 | 49 |
| Crooked Isle, Moss Flag-staff | 22 | 7·5 | 74 | 20·5 |
| Rum Cay, South Point | 23 | 37 | 74 | 50 |
| Watlings Isle, South end | 23 | 56·7 | 74 | 26 |
| Concepcion, West Point | 23 | 50 | 75 | 8 |
| St. Salvador, East Point | 24 | 8 | 75 | 17 |
| Stirrup Cays, Ellis Flag-staff | 25 | 49·7 | 77 | 55 |
| Andros Isle, Mastic Point | 25 | 4 | 77 | 57 |
| **New Providence**, Nassau * | 25 | 5·6 | 77 | 21·25 |
| Eleuthera I., N.E. or Palmetto Pt. | 25 | 9 | 76 | 9 |
| Long Isle, South Point | 22 | 51 | 74 | 51 |
| Lobos Cay, Beacon | 22 | 22·6 | 77 | 35·5 |
| Gun Cay * | 25 | 34·5 | 79 | 19 |
| Great Bahama Bank, Gt. Isaac Rk. | 26 | 2 | 79 | 5 |
| Great Abacou Isle,* near S. Point | 25 | 51·5 | 77 | 10·7 |
| Bahama Isle, West Point | 26 | 41 | 79 | 9 |
| Memory Rock | 26 | 57·5 | 79 | 5·25 |
| **Bermuda**, Dockyard, Clock | 32 | 19·0 | 64 | 52·0 |
| ,, Light,* 365 feet | 32 | 14·7 | 64 | 52·0 |

| XIX. S. AMERICA. | Lat. N. | | Long. W. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| **Chagres**, San Lorenzo Fort | 9 | 19·7 | 79 | 59·25 |
| Porto Bello, Fort, San Ieronymo | 9 | 32·5 | 79 | 38·5 |
| Cartagena de las Indias, Dome | 10 | 25·6 | 75 | 34·0 |
| Santa Maria, Morro | 11 | 15 | 74 | 16·0 |
| Bahia Honda, East Point (Shoal) | 12 | 19 | 71 | 48 |
| Maracaybo | 11 | 2 | 71 | 41 |
| Oruba Isle, North Point | 12 | 36 | 70 | 8 |
| Curaçao I., Ft. Amsterdam. St. Ann | 12 | 6·3 | 68 | 54 |
| Little Curaçao * | 12 | 2 | 68 | 38 |
| Buen Ayre Isle, South Point | 12 | 2 | 68 | 17 |
| Orchila, West Point, Rock | 11 | 50·2 | 66 | 14 |
| Tucacas * | 10 | 47 | 68 | 22 |
| Porto Cabello | 10 | 29·4 | 68 | 0·0 |
| La Guara | 10 | 36·7 | 66 | 56·5 |
| Cumana, Fort Bocca | 10 | 27·6 | 64 | 11·0 |
| Tortuga Isle, West End | 10 | 58 | 65 | 26·5 |
| Margerita Isle, N. Point Cape Isla | 11 | 10 | 63 | 58 |
| **Trinidad**, East Point, Port Galera | 10 | 50 | 60 | 54 |
| Port Spain, Fort | 10 | 38·7 | 61 | 32 |
| Tobago, North Point | 11 | 25 | 60 | 32 |
| Grenada, St. George, Fort | 12 | 2·9 | 61 | 43 |
| St. Vincent, Kingston | 13 | 13 | 61 | 13 |
| Barbados, Bridge Tn., Engin. Whf. | 13 | 4·2 | 59 | 37 |
| St. Lucia, Port Castres * | 14 | 0 | 61 | 1 |
| Martinique, Fort Royal * | 14 | 36 | 61 | 4·25 |
| Caravel Rock | 14 | 48·5 | 60 | 53 |
| Dominica, Roseau Town, Flag-st.* | 15 | 18·4 | 61 | 24·75 |
| Guadeloupe, Basse Terre, Ft. Trois | 16 | 0·5 | 61 | 45·25 |
| Montserrat, Redondo | 16 | 55·5 | 62 | 18·75 |
| **Antigua**, English Harb., Dockyard | 17 | 0·0 | 61 | 45·7 |
| „ St. John's, Fort James | 17 | 6·7 | 61 | 51·25 |
| Barbuda, River Fort, S.W. side | 17 | 35·8 | 61 | 49·5 |
| Nevis, Charleston,* S.W. Point | 17 | 8·8 | 62 | 42 |
| St. Christopher, St. George's Ch.* | 17 | 18 | 62 | 43·0 |
| Anguilla, Custom House | 18 | 13·2 | 63 | 4 |
| St. Bartholomew, Fort Oscar | 17 | 53 | 62 | 51·25 |
| St. Martin, Fort Marigot | 18 | 4·1 | 63 | 5·5 |
| Santa Cruz, Christianstad | 17 | 44·5 | 64 | 41 |
| Sombrero | 18 | 35·8 | 63 | 27·75 |
| Tortola, Fort Burt | 18 | 24·1 | 64 | 32 |
| St. Thomas, E. Entr. Ft. Christian | 18 | 20·4 | 64 | 55·7 |
| Porto Rico, City * | 18 | 29 | 66 | 7·25 |
| Mona Isle, East Point | 18 | 5 | 67 | 50 |
| Point Barima,* River Orinoco | 8 | 36 | 60 | 23 |
| Cape Nassau | 7 | 36 | 58 | 56 |
| George Town * | 6 | 49·4 | 58 | 11·5 |
| **Berbice**, Floating Light * | 6 | 19 | 57 | 22 |
| Corentyn, Nickerie Fort | 5 | 57·5 | 56 | 52 |
| River Surinam, Paramaribo, Ch. | 5 | 44·3 | 55 | 13 |
| Cayenne, Fort, Flag-staff | 4 | 56·5 | 52 | 18·6 |
| Cape Orange | 4 | 22·4 | 51 | 24·9 |
| Cape do Norte | 1 | 42·0 | 49 | 48·0 |
| Macapà, N.E. Bastion | 0 | 0·8 | 50 | 59·5 |
| | Lat. S. | | Long. W. | |
| **Para**, Custom-House Quay | 1 | 26·9 | 48 | 27·7 |
| Atalaia Point * | 0 | 35·0 | 47 | 17·0 |
| Itacolomi Point,* Morro | 2 | 19·2 | 44 | 23·6 |
| Maranhao, San Luis, Sea Battery | 2 | 31·7 | 44 | 15·6 |
| Isle St. Anna,* | 2 | 19·4 | 43 | 30·3 |
| Ceara, Church Tower | 3 | 43·0 | 38 | 30·0 |
| Port Macoripe * | 3 | 41 | 38 | 47·5 |
| Cape St. Roque | 5 | 28 | 35 | 14·5 |
| Cape Branco, Extreme | 7 | 8·5 | 34 | 45·9 |
| Pernambuco, Fort Picao * | 8 | 3·6 | 34 | 49·7 |
| **Bahia**, Cape St. Antonio * | 12 | 58·3 | 38 | 28·2 |
| Morro St. Paolo * | 13 | 22·6 | 38 | 51·2 |
| Porto Seguro, Entr. to River | 16 | 26·8 | 39 | 0·8 |
| Espiritu Sto. B., Convent da Penha | 20 | 19·2 | 40 | 13·7 |
| Cape St. Thomè (banks 15 m. off) | 22 | 2·0 | 40 | 56·0 |
| Cape Frio, South Point * | 23 | 0·7 | 41 | 57·1 |
| **Rio Janeiro**, Ft. Villagagnan, S.M. | 22 | 54·7 | 43 | 6′ 20″ |
| Santos Harbour, Arsenal | 23 | 55·8 | 46 | 17·8 |
| Moela * | 24 | 3·1 | 46 | 13·8 |
| Cape Joao Diaz | 26 | 10·3 | 48 | 30·0 |

| S. AMERICA. | Lat. S. | | Long. W. | |
|---|---|---|---|---|
| | ° | ′ | ° | ′ |
| Anhatomerim, Isle, Flag-staff | 27 | 25·5 | 48 | 31·5 |
| Rio Grande de Sul * | 32 | 7·5 | 52 | 5·2 |
| Maldonado, Tower | 34 | 54·6 | 54 | 55·0 |
| Flores Isle * | 34 | 56·9 | 55 | 52·3 |
| **Monte Video**, Custom House | 34 | 54·3 | 56 | 9·7 |
| Colonia * | 34 | 28·0 | 57 | 49·0 |
| Buenos Ayres, Mole, Landing Pl. | 34 | 35·5 | 58 | 19·4 |
| Cape St. Antonio, North Point | 36 | 18·5 | 56 | 43·4 |
| Cape Corrientes, E. Summit | 38 | 5·5 | 57 | 26·8 |
| Bahia Blanco, Fort Argentine | 38 | 43·8 | 62 | 12·3 |
| Union Bay, Indian Head | 39 | 57·5 | 62 | 4·6 |
| Port Desirè, Ruins | 47 | 45·0 | 65 | 51·8 |
| Port St. Julian, Sholl Point | 46 | 15·3 | 67 | 39·6 |
| Port Santa Cruz | 50 | 6·7 | 68 | 21·1 |
| **Falklands**, Eddystone | 51 | 11·30 | 59 | 0·9 |
| West Cay, Jason Isle | 50 | 59·8 | 61 | 25·1 |
| Port Egmont, Saunders Isle | 51 | 21·0 | 60 | 1·6 |
| Port Stephens, E. Entrance, Pt. | 52 | 12·0 | 60 | 38·4 |
| Port Louis, Carenage | 51 | 32·3 | 58 | 4·5 |
| East extremity, Cape Pembroke *. | 51 | 40·7 | 57 | 40·6 |
| Port William, Stanley Harbour, Government Store | 51 | 41·1 | 57 | 49·1 |
| C. Fairweather, Patagonia, S. Pt. | 51 | 32·1 | 68 | 53·9 |
| Port Gallegos, Obs. Mound | 51 | 33·3 | 68 | 56·7 |
| Cape Virgins, S.E. Point | 52 | 20·2 | 68 | 19·1 |
| Cape Froward, S. extr. America | 53 | 53·7 | 71 | 15·8 |
| Staten Isle, Cape St. John, E. Cliff | 54 | 42·8 | 63 | 41·3 |
| „ Cape St. Anthony | 54 | 43·5 | 64 | 43·2 |
| **Cape Horn** | 55 | 58·7 | 67 | 13·6 |
| Orange Bay, W. part Burnt Isle. | 55 | 30·8 | 68 | 2·7 |
| Townshend Harbour, Obs. Islet | 54 | 42·3 | 71 | 53·1 |
| Cape Inman, Cliff Summit | 53 | 18·5 | 74 | 16·9 |
| Famine Port, Tent | 53 | 38·3 | 70 | 55·4 |
| Cape Pillar, North Cliff | 52 | 42·8 | 74 | 40·9 |
| Harbour of Mercy, Bottle I., Sum. | 52 | 45·0 | 74 | 36·8 |
| Port Otway, S. Entrance, Summit | 46 | 49·5 | 75 | 16·9 |
| Ypun, or Narborough I., S. Point | 44 | 40·7 | 74 | 45·5 |
| Port Low, Huscane Isle, S. Point. | 43 | 48·5 | 74 | 0·1 |
| Huapilacuy, Point * | 41 | 46·7 | 73 | 52·7 |
| Port San Carlos, Point Arena | 41 | 51·3 | 73 | 53·0 |
| Reloncavi Sound, Port Montt | 41 | 30·5 | 72 | 55·0 |
| Valdivia, Fort Corral | 39 | 52·9 | 73 | 26·0 |
| Santa Maria Isle, Aguada Point | 37 | 2·8 | 73 | 31·0 |
| Talcahuano, Fort Galvez | 36 | 42·0 | 73 | 7·0 |
| River Maule, Church Rock | 35 | 19·7 | 72 | 26·3 |
| **Valparaiso**,* Ft. San Antonio, S.M. | 33 | 1·9 | 71° | 38′ 0″ |
| Port Huasco, Outer Rk., Inner Pt. | 28 | 27·3 | 71 | 16·0 |
| Coquimbo, B., Pajarosninos, N. Rk. | 29 | 55·2 | 71 | 22·2 |
| Port Calderà, Summit of Isle | 27 | 3·0 | 70 | 53·1 |
| Mount Moreno, 4,160 feet | 23 | 28·5 | 70 | 35·3 |
| „ Cobija Bay, Landing Place | 22 | 34·0 | 70 | 18·1 |
| Iquique, Centre of Island | 20 | 12·5 | 70 | 11·5 |
| Arica, Mole | 18 | 28·1 | 70 | 20·7 |
| Islay, Arequipa, Custom House | 17 | 0·0 | 72 | 7·3 |
| Point Lomas, Flag-staff | 15 | 33·2 | 74 | 51·7 |
| Pisco Town, Centre | 13 | 43·0 | 76 | 13·5 |
| Chincha Isles, North I., Boat-slip | 13 | 38·3 | 76 | 24·5 |
| Chilca Port, S.W. Pitch | 12 | 31 | 76 | 49·7 |
| Cape San Lorenzo * | 12 | 4·0 | 77 | 16·5 |
| **Callao**, Arsenal, Flag-staff | 12 | 4·0 | 77 | 10·5 |
| Supè Bay, Head of Bay | 10 | 49·7 | 77 | 44·0 |
| Casma Bay, Inner South Point | 9 | 28·0 | 78 | 22·6 |
| Samanco Bay, Cross Point | 9 | 15·5 | 78 | 29·7 |
| Truxillo Town, Church | 8 | 7·5 | 79 | 1·0 |
| Lambayeque Rd., Centre of Beach | 6 | 46·0 | 79 | 56·5 |
| Payta Point, North extremity | 5 | 5·0 | 81 | 10·0 |
| Santa Clara Isle * | 3 | 10·7 | 80 | 24·6 |
| Puna Isle, Church Cross | 2 | 44·1 | 79 | 53·2 |
| Guyaquil, Arsenal | 2 | 12·4 | 79 | 51·4 |
| C. San Lorenzo, Marlingspike Rk. | 1 | 3·5 | 80 | 55·0 |
| Port Manta, N.W. Point of Town | 0 | 56·8 | 80 | 42·8 |
| Juan Fernandez I., Cumberland Ft. | 33 | 37·6 | 78 | 50·0 |
| Galapagos, Charles Isle, P. O. Bay | 1 | 15·5 | 90 | 28·5 |
| Cocos Isle, Chatham Bay | 5 | 32·9 | 86 | 58·4 |

| XX. ARCTIC OCEAN. | Lat. N. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| Kola Town, Lapland | 68 52·5 | 33 1·0 |
| **Sviatoi Noss,** North Tower | 68 10·0 | 39 47·0 |
| Sosonova | 67·41·0 | 41 2·5 |
| Orlovsk* | 67 11·5 | 41 22·2 |
| Sosnovetz, Tower | 66 29·5 | 40 44 |
| Tetrina, Village Chapel | 66 3·9 | 38 17·5 |
| Cape Touri | 66 33 | 34 28 |
| Kundsalaksha Monastery | 67 7·7 | 32 26 |
| „ River Mouth | 65 45·1 | 34 42·7 |
| Kemmi, Church | 64 56·5 | 34 38·7 |
| Onega, St. Michael Church | 63 53·6 | 38 8·5 |
| Jaghinsk Isle, North Point* | 65 12·3 | 36 51·5 |
| Pertominsk, Monastery | 64 47·2 | 38 29·2 |
| **Archangel,** Trinity Church | 64 32·1 | 40 33·5 |
| Moudiuga Isle,* Dvina River | 64 55·8 | 40 16·2 |
| Cape Kerets | 65 19·9 | 39 45 |
| Cape Voronoy | 66 31·1 | 42 19·7 |
| Morlovetz, N.W. Point* | 66 45·7 | 42 29 |
| Mezen, Epiphany Church | 65 50·3 | 44 17 |
| Cape Knouchin, near Brook | 67 11·5 | 43 48·7 |
| Cape Kanin, Noss | 68 39·2 | 43 48·7 |
| Kolguyev Isle, North Point | 69 30 | 49 20 |
| Cape Mikoulkin | 67 47 | 46 32 |
| Vaigatch Isle, North Point | 70 28 | 59 10 |
| „ South extremity | 76 20 | 73 10 |
| „ West extremity | 72 5 | 51 25 |
| **Nova Zembla,** Mount Pervoous Motrennaia | 72 54 | 53 22 |
| „ Admiralty Penins., W. Pt. | 75 0 | 55 22 |
| „ Cape Nassau | 76 35 | 62 40 |
| „ N.E. Point Cape Jelanie | 76 58 | 76 40 |
| **Spitsbergen,** Cloven Cliff | 79 50·0 | 11 40·5 |
| „ Magdalena Hook | 79 31 | 10 41 |
| „ Treurenberg B. Hecla Cove | 79 55·3 | 16 52 |
| „ Verlegen Hook | 80 2 | 16 37 |
| „ Black Point | 80 28 | 19 28 |
| „ South Cape, or C. Look-out | 76 35 | 17 23 |
| „ Ryk Isle | 77 50 | 26 10 |
| „ Fair Foreland | 78 53 | 10 35 |
| Maksimon Isle | 74 20 | 76 30 |
| Bielor Isle, Cape Schubert | 73 20 | 72 20 |
| N.E. Cape of Obi Gulf | 73 12 | 77 0 |
| Cape Timour | 77 0 | 97 30 |
| **Cape Sievero,** Vortochni | 78 20 | 100 0 |
| Olensk River, Mouth | 73 0 | 118 50 |
| Lena River, Mouth, N. Point* | 73 30 | 126 30 |
| C. Mourachi, Mouth of the Jana | 71 35 | 135 50 |
| Liakhov Islands, East Point | 75 10 | 150 30 |
| Linkhovski Isle, South Point | 73 20 | 140 15 |
| **Cape Sviatoi** | 73 2 | 141 30 |
| Mouths of Indagurka R., E. Point | 71 0 | 151 40 |
| Bear Islands, East or Column Isle | 70 38 | 162 20 |
| „ West Isle | 70 50 | 160 35 |
| Cape Chelagskoi | 70 2 | 170 47 |
| Cape Severni, or North Cape | 68 55 | 179 57 |
| Kolioukhin Isle, South Point | 67 27 | 184 24 |
| Cape Serdze Kamen | 67 12 | 188 20 |
| Cape Vostoichin, or East Cape | 66 3 | 190 16 |
| St. Lawrence B., E. Pt., Entrance | 65 37 | 189 11 |
| Cape Tchoukotski | 64 17 | 187 46 |
| Cape Navarin | 62 16 | 178 56 |
| Cape Olyutorski | 59 57 | 170 19 |
| Karaghin Isle, North Point | 59 13 | 164 38 |
| „ South Point | 58 28 | 163 27 |
| Mednoi Isle, South Point | 54 33 | 168 11 |
| Behring Isle, West Point | 55 17 | 165 46 |
| „ South Point | 54 43 | 166 44 |
| Cape Kamchatka | 56 0 | 163 10 |
| Kluchevski, 16,131 feet | 56 8 | 160 41 |
| Cape Kronotski | 54 54 | 162 35 |
| Kronotski Peak, 10,610 feet | 54 45 | 160 35 |
| Cape Shipounski | 53 6 | 160 4 |
| Mount Vilutchin, 7,060 feet | 52 47 | 158 22 |

| ARCTIC OCEAN. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| **Sitka,** Arsenal* | 57 2·9 | 135 17·2 |
| Mount Fairweather | 58 13 | 136 35 |
| Port Mulgrave, Port Turner | 59 33·0 | 139 43·0 |
| Mount St. Elias, 16,800 feet | 60 17 | 140 52 |
| Hitchinbroke Isle, South Point | 60 16 | 146 27 |
| Port Etches, Russian Settlement | 60 21·2 | 146 32 |
| Montague Isle, West side / Port Chalmers, East Cove | 60 16 | 146 50 |
| Cape Elisabeth, East Point | 59 9 | 151 18 |
| Kodiac Isle, East Point | 57 34 | 151 46 |
| Trinity Is., East Point, Rocks | 56 34 | 153 22 |
| **Aleutian Isles.** | | |
| Ounalaska, Illuluik Port | 53 52·4 | 166 32·0 |
| „ South Point | 53 14 | 167 47 |
| Bogoslov Isle, South Peak | 53 56·3 | 167 58 |
| Goreloy, or Burning Isle, Snow | 51 56 | 178 40 |
| St. Paul Isle, East Point | 57 20 | 169 14 |
| Bristol Bay, Cape Tschichagoff | 58 17 | 157 54 |
| „ Cape Constantine | 58 29 | 158 45 |
| Cape Newenham | 58 42 | 162 24 |
| Nuniwak Isle, N.E. Point | 60 32 | 165 30 |
| Isle St. Matthew, S.E. Point | 60 18 | 172 4 |
| „ North Point | 60 44 | 172 52 |
| Isle St. Lawrence, West Point | 63 34 | 171 45 |
| Cape Roumianstov | 61 49 | 166 18 |
| Port Clarence, Port Spencer | 65 16·7 | 166 48·0 |
| **Cape Prince of Wales** | 65 33 | 167 59 |
| Kotzebue Sd., C. Espenberg, E. Pt. | 66 33 | 163 28 |
| „ Chamisso Isle | 66 13·2 | 161 46·0 |
| Cape Lisburn | 68 52 | 166 6 |
| **Icy Cape** | 70 20 | 161 46 |
| Point Barrow | 71 24 | 156 20 |
| Point Beechey | 70 24 | 149 37 |
| Herschel Isle, South Point | 69 34 | 139 3 |
| Mount Cupola | 68 45 | 137 53 |
| Mackenzie River, West Mouth | 68 49 | 136 37 |
| **Cape Bathurst** | 70 36 | 127 35 |
| Cape Parry, N.E. Point | 70 6 | 123 35 |
| Coppermine River, Mouth, E. side | 67 48·5 | 115 31·25 |
| Cape Franklin | 68 38 | 109 4 |
| Melbourne Isle, East Point | 68 32 | 104 30 |
| White Bear Point | 68 7·1 | 103 36.7 |
| Point Ogle | 68 14·0 | 96 4 |
| Castor and Pollux River | 68 28·5 | 94 14 |
| Aberdeen Isle, West end | 68 36 | 93 10 |
| **Baring Isle,** Nelson's Head | 71 5 | 123 0 |
| „ Ballast Beach | 74 27 | 122 32.3 |
| „ Cape Crozier | 74 30 | 121 30·8 |
| „ Bay of Mercy | 74 6 | 117 55 |
| „ Cape Hamilton | 74 15 | 117 30 |
| **Melville Isle,** Winter Harbour | 74 47·2 | 110 48·25 |
| Cape Providence | 74 20 | 112 30 |
| Byam Martin Isle, South Point | 75 0 | 104 8 |
| Bathurst Isle, Cape Cockburn | 75 3 | 100 23 |
| Lowther Isle, South Point | 74 26 | 97 40 |
| Griffith Isle, South Point | 74 28 | 95 20 |
| Cornwallis Isle, East Point | 74 38 | 93 34 |
| Beechey Island | 74 43·5 | 91 39·3 |
| Port Leopold | 73 50 | 90 15 |
| Cape Bullen | 74 22 | 85 0 |
| Possession B., S. Entr. Lancaster Sound | 73 30 | 77 20 |
| Bellot's Straits, Depôt Bay | 72 0 | 94 0 |
| Fury Point | 72 50 | 92 0 |
| Cape Felix | 69 55 | 98 5 |
| **Victory** Point, K. William's Land, the Franklin Record | 74 43·4 | 91 39·3 |
| Cape Herschel | 68 42 | 98 2 |
| Magnetic Pole (1831) | 70 5 | 96 47 |
| C. Parry, Whale Sound, S. Head | 77 6 | 71 23 |
| **Kane's Furthest,** Mount Parry | 82 30 | 66 0 |
| Cape Bellot | 82 1·9 | 68 10 |
| Cape Jefferson | 81 0 | 67 40 |
| Cape Andrew Jackson | 80 17·6 | 66 40 |

| ARCTIC OCEAN—*continued.* | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| Cape John Barrow | 80 17·3 | 69 58 |
| Cape Winfield Scott | 79 6·8 | 66 49 |
| **Rensselaer Bay** | 78 38·0 | 71 14 |
| Cape Inglefield | 78 34·5 | 72 51 |
| Cape Dudley Digges | 76 5 | 68 46 |
| Cape York | 75 55 | 65 30 |
| Sanderson's Hope (Upernavik) | 72 42 | 56 10 |
| **Disco Isle**, South Point | 69 11 | 53 20 |
| „ West Point | 68 53 | 54 53 |
| Whalefish Islands, Kronprindsen's Isle, Flag-staff | 68 58·9 | 53 14·0 |
| Lichtenfeld | 63 2 | 51 40 |
| Cape Comfort | 61 44 | 50 0 |
| **Cape Farewell** | 59 49 | 43 54 |
| Igloolik Isle | 69 21 | 81 31 |
| Winter Isle, Melville Pen., S. Pt. | 66 11·4 | 83 10·0 |
| Salisbury Isle, East Point | 63 27 | 76 40 |
| Bulton Isle, N.E. Point | 60 45 | 64 53 |
| Resolution Isle, East Point | 61 30 | 64 30 |
| „ S. Pt., N. Entr. Hudson's Straits | 61 21 | 64 54 |
| **Cape Chidleigh** | 60 25 | 65 0 |
| York Factory, Hudson's Bay | 57 0 | 92 19 |
| Cape Henrietta Maria | 55 10 | 82 30 |

| ARCTIC OCEAN. | Lat. N. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| **Labrador**, Black Head | 60 0 | 64 28 |
| Mount Thoresby, Port Manvers | 56 58 | 62 27 |
| Cape Harrison | 54 54 | 58 5 |
| Gannet Islands, Sandwich Bay | 54 0 | 56 34 |
| Cape St. Lewis | 52 21 | 55 39 |
| Table Head | 52 6 | 55 43 |
| Belle Isle, N.E. Point | 52 1 | 55 17 |
| **Newfoundland**, Quirpon Isle, North Point | 51 38 | 55 24 |
| Croc Harbour, S. Point, Entrance | 51 2·4 | 55 46 |
| Rouge Harbour, Entr., S. Point | 50 54 | 55 50 |
| St. Barbe Islands, East Point | 50 11 | 55 42 |
| Cape St. John, North Bill | 50 0 | 55 20 |
| Cape Freels | 49 16 | 53 31 |
| Cape Bonavista* | 48 42 | 53 8 |
| Trinity Harbour, Hog Nose | 48 21 | 53 24 |
| Cape St. Francis | 47 48 | 51 51 |
| **Iceland**, E. Extr., Pt. Gepirhuk | 65 5 | 13 33 |
| „ North Cape | 66 28 | 22 29 |
| „ W. Pt., or Staalburghuk | 65 30 | 24 35 |
| Reikiavig | 64 8·4 | 21 58 |
| Mount Hecla, 5,364 feet | 63 58 | 19 44 |
| Cape Reikianess | 63 48 | 22 45 |

| ANTARCTIC OCEAN. | Lat. S. | Long. E. |
|---|---|---|
| | ° ′ | ° ′ |
| Ross's Furthest | 78 4 | 161 0 |
| Mount Erebus, 12,400 feet | 77 33 | 166 58 |
| Mount Sabino | 71 42 | 169 55 |
| Balleny Islands | 66 44 | 163 11 |
| Adelie Land, Geology Point | 66 35 | 140 10 |
| Enderby's Land | 67 30 | 44 0 |
| Marion and Crozet's Isle, Hog I. | 46 9 | 50 28 |
| Kerguelin's Land, Christmas Harbour | 48 41 | 69 6 |

| ANTARCTIC OCEAN. | Lat. S. | Long. W. |
|---|---|---|
| | ° ′ | ° ′ |
| **South Shetlands**, C. Possession | 63 45 | 61 50 |
| „ Deception Isle, Port Foster | 62 55·6 | 60 35·0 |
| **New Orkneys**, E. Extremity | 60 49 | 44 20 |
| „ Coronation Isle, E. Summit | 60 46 | 45 53 |
| Sandwich Islands, Candlemas Isle | 57 10 | 26 45 |
| South Thule Islands, E. Point | 59 26 | 27 13 |
| South Georgia, North Point | 53 57 | 38 13 |
| Bouvet's or Circumcision Isle | 54 20 | 6 0 |

| MID-ATLANTIC. | Lat. S. | Long. W. |
|---|---|---|
| | ° ° | ° ° |
| Region of Submarine Volcanoes | 7N. to 1S. | 16 to 24W. |
| Penedo de San Pedro, or St. Paul's Rocks, Summit | 0 55·5N. | 29 22·0 |
| Fernando de Noronho, Conceptcao Fort | 3 50·0 | 32 25·0 |
| Roccas, N.W. Cay | 3 51·5 | 33 49·0 |
| Trinidad Isle | 20 31 | 29 19 |
| Martin Vas, Large Isle | 20 28 | 28 51 |
| Tristan d'Acunha, Waterfall, North side | 37 1·9 | 12 17 |
| Inaccessible Isles, West one | 37 17 | 12 36 |
| Nightingale Isle | 37 27 | 12 29 |
| Gough's Isle | 40 19 | 9 44 |
| Saxemburg | 31 35 | 16 0 |
| **Mid-Pacific.** | | |
| Easter Isle | 27 6 | 109 17 |
| Pitcairn Isle | 25 3·6 | 130 8 |
| Masafuera Isle | 33 49 | 80 54 |

| MID-INDIAN OCEAN. | Lat. S. | Long. E. |
|---|---|---|
| | ° ° | ° ° |
| Great Chagos Bank, East extr. | 6 5 | 72 43 |
| „ North extremity | 5 39 | 72 1 |
| „ N.W. extr., Eagle Isle, N. Point | 6 10·5 | 71 18 |
| Diego Garcia S. Point | 7 26·0 | 72 23·25 |
| **Cargados** | | |
| Baleine Shoal | 16 40·7 | 59 33·5 |
| Frigate Isle | 16 36·0 | 59 33·25 |
| Pearl Isle | 16 32·7 | 59 32·75 |
| Siren Isle | 16 28·2 | 59 37·25 |
| Establishment | 16 26·5 | 59 39·0 |
| North Isle | 16 23·3 | 59 41·0 |
| Albatross Isle | 16 15·0 | 59 37·7 |
| St. Paul's Isle, Ninepin Rock on East side | 38 43 | 77 34 |
| Amsterdam, Summit | 37 52 | 77 35 |
| Direction Isle, S.W. Point | 12 5·4 | 96 53·0 |